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Department of Innovation
Industry, Science and Research

Submission to the House of Representatives Committee on Infrastructure and Communications

Inquiry into the Role and Potential of the National Broadband Network

25 March 2011

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Terms of Reference

The House of Representatives Standing Committee on Infrastructure and Communications will examine the capacity of the National Broadband Network to contribute to:

(a) the delivery of government services and programs;

(b) achieving health outcomes;

(c) improving the educational resources and training available for teachers and students;

(d) the management of Australia's built and natural resources and environmental sustainability;

(e) impacting regional economic growth and employment opportunities;

(f) impacting business efficiencies and revenues, particularly for small and medium business, and Australia's export market;

(g) interaction with research and development and related innovation investments;

(h) facilitating community and social benefits; and

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

Scope of Submission

The Department of Innovation, Industry, Science and Research (the Department of Innovation) was established as a department of state in the Innovation, Industry, Science and Research Portfolio following the 2007 federal election.

The Innovation, Industry, Science and Research Portfolio comprises:

- the Department of Innovation, Industry, Science and Research;
- the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS);
- the Australian Institute of Marine Science (AIMS);
- the Australian Nuclear Science and Technology Organisation (ANSTO);
- the Australian Research Council (ARC);
- the Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Intellectual Property (IP) Australia; and
- the Office of the Chief Scientist.

Each portfolio agency reports to the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr. He is assisted by Senator the Hon Nick Sherry, Minister for Small Business, Minister Assisting on Deregulation and Minister Assisting on Tourism.

The Department of Innovation has policy and program responsibilities across a broad spectrum of industry, science, research and innovation areas, ranging from basic research through to applied research and development (R&D), commercialisation, small business issues and deregulation initiatives.

The Department of Innovation is structured into a number of divisions: AusIndustry; Australian Astronomical Observatory; Corporate; eBusiness; Enterprise Connect; Industry and Small Business Policy; Innovation; Manufacturing; the National Measurement Institute; Questacon; Research; and Science and Infrastructure.

This submission will focus on the relevance of the National Broadband Network (NBN) to activities of the Department of Innovation. In addition to this submission, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Institute of Marine Science (AIMS) have made individual submissions to the Inquiry.

Introduction

The Department of Innovation, Industry, Science and Research is the Innovation, Industry, Science and Research Portfolio's central policy and coordination agency.

The Department of Innovation develops and implements policies and programs to assist industry and to build a competitive and world-class science, research and innovation system. The Department strives to create an environment where new ideas are nurtured and innovation drives productivity, economic growth and social wellbeing by strengthening the links between science, research and industry.

The work of the Department of Innovation falls into four key areas:

- innovation;
- industry;
- science and research; and
- small business and deregulation.

The Department of Innovation provides policy advice to its Ministers and Parliamentary Secretary. It also administers legislation; manages programs; undertakes analysis; provides services to the business, research and scientific communities; and provides advice to the government. The Department of Innovation works in close partnership with industry, science and research communities, and other stakeholders to achieve these goals.

Work of the Department of Innovation is structured to support two key outcomes:

1. enhanced opportunities for business innovation and growth through national leadership in converting knowledge and ideas into new processes, services, products and marketable devices; fostering business cooperation; delivering advice; assistance; and business, measurement and online services; and
2. the generation, utilisation and awareness of science and research knowledge through investment in research, research training and infrastructure, science communication, skill development and collaboration with industry, universities and research institutes domestically and internationally.

The Australian Government's Innovation Agenda for the 21st Century, *Powering Ideas*, notes that direct investment in Australian innovation is supported by key investments in infrastructure such as the NBN.

The comments provided in this submission by the Department of Innovation build the case for sustained investment in a national scale, advanced, broadband capacity, given the potential and complementary benefits of such infrastructure to the other facets of innovation building in Australia.

The Department of Innovation has therefore considered the capacity of the NBN to enhance the work undertaken to support the outcomes listed above.

The comments provided span across the portfolio and outline a range of impacts including the nature and level of relevance of the NBN to the work of the Department of Innovation,

including its activities to promote and invest in innovation through its work to enhance industry and business and to foster science endeavours and research in Australia.

This submission responds against all the terms of reference for the Inquiry.

1. Delivery of Government Services and Programs

The NBN has the potential to play a positive role in significantly enhancing the delivery of the government services and programs that are delivered by the Department of Innovation.

The NBN will provide significant improvements to the current rate of data transfer around Australia and in particular to regional and remote areas of the country. This will result in a range of benefits for all socio-economic activities that are dependent upon communications services as well as government services and scientific endeavours that require large amounts of data to be transferred.

Two specific instances where the Department of Innovation anticipates that the NBN will influence activities related directly to government services and programs are outlined below.

In addition, comments against other terms of reference in this submission have varying relevance to the delivery of government services and programs. These include in the areas of industry assistance, including to promote industry, business and employment opportunities in regional areas, health, education, built environments, science and research.

Earth Observation System (EOS)

The NBN will develop the next generation of infrastructure that will increase Australia's Earth Observation System (EOS) capabilities. Observing the Earth from space provides crucial data to support national security, weather forecasting and safety activities. It helps protect and manage our natural resources for sustainable development and the future health and prosperity of Australia.

Currently, there are at least ninety-two government programs, totalling $1.3 billion in annual expenditure, dependent on EOS, including key activities such as the National Carbon Accounting System, National Weather Forecasting Services and reporting obligations under the UN Framework Convention on Climate Change.

The infrastructure and communication systems needed to collect and transfer EOS data require modernisation and rationalisation to cope with the increases in data volumes that are expected over the next decade. The NBN will play an important role in providing this needed boost to capability.

For example, the communications network at the Alice Springs ground station operated by Geoscience Australia, the main terrestrial station in Australia, is unable to cope effectively with current data transfer requirements. This was demonstrated in the delays experienced during the "Black Saturday" Victorian bushfires of 2009.

Coupled with investments in supercomputing under the Super Science Initiative and other Australian Government and research sector initiatives, the introduction of high bandwidth communications infrastructure enabled by the NBN, both in-situ and terrestrial, will assist to transfer, process, distribute and archive the massive increase in data volumes expected from the next generation of Earth observing satellites.

National Measurement Institute - Coordinated Universal Time

The NBN will enhance the capacity of the National Measurement Institute (NMI) to deliver services and programs.

The NMI is responsible for Australia's national measurement system and top-level infrastructure in physical, chemical, biological and legal measurements.

Under the *National Measurement Act 1960 (Cth)*, NMI establishes and maintains the measurement units and standards that allow Australian industry to operate competitively in a global environment.

NMI represents Australia on international measurement organisations that secure international mutual recognition of Australia's measurement standards, which in turn underpin acceptance of Australian commodities and products and facilitate international trade.

NMI maintains a broad range of scientific and technical capabilities and undertakes research to support Australian innovation, the application of new developments in science and technology, and the increasing demand from industry and government agencies for new services and greater accuracy in measurement. NMI's role and expertise enable it to form strategic partnerships with industry and government to solve measurement problems.

A key strategic priority for NMI is to deliver capability for measurement in Australia that increases national economic efficiency, empowers sound regulation and enables effective social and health policies.

Specific goals include maintaining and developing Australia's reference standards of measurement (Goal 1), working with other agencies to provide national leadership in measurement science (Goal 2), and improving and developing measurement services (Goal 3). NMI delivers essential services to the Australian economy by providing the legal and technical framework for disseminating measurement standards.

Timing and time standards are a significant example of the potential of the NBN to positively impact on the work of the NMI and support the strategic priorities outlined above.

The *National Measurement Act 1960 (Cth)* establishes Coordinated Universal Time, designated UTC, as the primary reference for time in Australia for legal purposes.

Internationally, UTC is derived from a global network of atomic clocks by the International Bureau of Weights and Measures in Paris. NMI maintains an Australian realization, denoted UTC(AUS), using an ensemble of atomic clocks, and ensures that UTC(AUS) is closely synchronised to UTC.

NMI has substantial experience in disseminating UTC(AUS) to provide precise and high-integrity timing for a wide variety of applications throughout Australia. NMI has developed custom time dissemination systems to support important applications at the highest levels of accuracy and reliability, including in the telecommunications, transport and academic sectors and particularly electronic time references in computer networks.

NMI provides access to the UTC(AUS) reference standard through a number of mechanisms. These include provision of reference timing for computer networks, either by access to a number of reference Network Time Protocol servers or by custom infrastructure that supports major clients.

For example, NMI developed, commissioned, and continues to maintain reference Network Time Protocol servers for Telstra, which underpin the integrity of charging and billing processes. The *National Measurement Act 1960 (Cth)* sets out requirements for measurements made for legal purposes, and NMI timing systems establish a formal link to UTC(AUS) which meets these requirements.

The NBN is expected to provide key national infrastructure that will enable a wide range of applications, many of which will benefit from access to Australian reference standards of measurement. The NBN will enable new ways for NMI to disseminate these standards, to support the integrity and efficiency of both existing and future applications, as well as extending this support to other sectors.

Delivery of Business-oriented Government Services and Programs

The section on impacting business services and revenues, at Chapter 6 in this submission, provides detail on the relevance of the NBN to the Department's activities in relation to the business sector, including relevance to the services and programs it delivers to this sector.

2. Achieving Health Outcomes

The Department of Innovation recognises the significant potential for the NBN to facilitate health, business productivity, economic growth and improved healthcare resulting in greater social wellbeing through increased e-health activity. Realising this potential would lead to positive outcomes in these areas of interest to the Department of Innovation.

e-Health

"E-health" is defined by the World Health Organisation as 'the combined use of electronic communication and information technology in the health sector.' As outlined in the 2008 National e-Health Strategy, e-health should be viewed as both the essential infrastructure underpinning information exchange between all participants in the Australian health care system and as a key enabler and driver of improved health outcomes for all Australians[1]. The information and communications technologies (ICT) industry has embraced the idea of e-health with developers creating customised packages. A suite of software solutions now exists for specific health areas as well as hardware and software solutions that support the delivery of services across the national health systems of a number of countries.

The NBN is expected to assist in improving data transfer rates and connectivity within Australia by installing fibre optic cable, and wireless and satellite where cable is not possible. Without increased bandwidth and higher transfer speeds, e-health may not function adequately as it relies on secure, reliable and above all fast (high bandwidth) data transfer rates. For example, a colour ultrasound may consist of between 20 and 230 images totalling 180MB[2] and at current speeds, it may take 30 minutes to transfer the ultrasound. The transfer of this type of data becomes virtually impossible during peak times as transfer speeds are reduced, as more users are online. [3]

It is anticipated that the NBN will provide minimum speeds of 12 Mbps with maximum speeds of up to 100 megabits per second (Mbps), which is 100 times faster than current average transfer speeds.[4] CSIRO estimates that at least 30Mbps is required to make tele-health implementation effective and has developed the Virtual Critical Care Unit (ViCCU), a real-time tele-presence link enabling specialists in emergency medicine at one hospital to supervise a team treating a critically ill patient at a remote hospital in real-time. ViCCU currently links three hospitals in New South Wales and the underlying technology is being deployed in other states. Bandwidth requirements for this system alone are up to 70 Mbps per second.[5]

Innovation in the provision of e-health has the potential to dramatically improve health outcomes. According to a report by Booz & Co Inc., it is estimated that approximately 138,000 Australians are hospitalised and 18,000 die each year from adverse drug events, costing $5.1 billion annually.

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[1] http://www.health.gov.au/internet/main/publishing.nsf/content/national+Ehealth+strategy, p1
[2] Tan, J & Cheng, W 2005, 'E-Networking' in Tan J ed, *E-healthcare Information Systems: a introduction for students and professionals.* Jossey-Bass, San Francisco, p170
[3] http://www.ehealthinfo.gov.au/healthcare-providers/e-health-for/e-health-for-radiologists/
[4] http://www.nbn.gov.au/content/technically-speaking
[5] http://www.csiro.au/files/files/ps6z.pdf

Investment in comprehensive e-health programs could lead to substantial savings in annual national healthcare expenditures as innovation in the e-health space assists in diagnosing problems and supporting treatment plans before a patient requires hospitalisation, while adverse drug events are minimised through technological solutions.

In the case of Australia, this will equate to a conservatively estimated $7.6 billion in 2020, representing three per cent of the total healthcare expenditure.[6] The Business Council of Australia (BCA) has estimated that a national e-health strategy would reap benefits of close to $28 billion within eight years, compared to the estimated implementation costs of approximately $6.3 billion over five years.[7]

Access Economics also estimates that an investment of $6.3 billion in integrated electronic health records would increase the net value of Gross Domestic Product (GDP) by as much as $13 billion over ten years and create 30,000 jobs.[8] Additional support to these projections is also provided by research by the United Nations Broadband Commission which has estimated that a 10 per cent increase in broadband penetration has the potential to deliver an increase in national GDP of up to 1.4 per cent.[9]

A European Commission (EC) impact study on electronic health records in 2010 outlined that for those health areas in the European Union that had adopted interoperable electronic health records and e-pharmacy, the socio-economic gains to society from these strategies eventually exceeded the respective costs. This EC study found that successful e-health developments can reach a cumulative socio-economic return of close to 200 per cent, with an average of 80 per cent.[10]

The benefits of e-health can be expected to improve individual health outcomes and provide gains to the economy in the long term. However, these gains can only be realised when they are supported by investment in ICT infrastructure. Therefore, the potential impact of the NBN on health outcomes in Australia is significant when the improvements in technical capacity provided by the NBN are coupled with the innovation occurring in the e-Health sector.

The NBN has the capacity to contribute to the development of new, and use of existing, products, services and software for prevention, monitoring and treatment interventions.

Medical devices, services and software developed for use over fast broadband could result in more efficient delivery of the Pharmaceutical Benefits Scheme, increased independent living, reduced avoidable hospital and institutional aged care admissions, increased ageing in the family home and improved remote community health services.

Medical devices, services and software for remote prevention, monitoring and treatment interventions over the NBN could include blood pressure, glucose level, heart rate, weight, incontinence and falls monitors and chronic disease treatments (e.g. for dialysis and cardiac conditions).

The NBN could enable greater positive health outcomes through enhanced interventions via these services and treatments. The NBN also has the potential to enable more efficient use of the health workforce in remote areas, such as allowing the speedy communication of X-ray, Computed Tomography (CT) and Positron Emission Tomography (PET) scan

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[6] Booz & Co, 2010, *Optimising E-Health Value Using an Investment Model to Build a Foundation for Program Success*, p 8
[7] http://www.cebit.com.au/news/health/ehealth-could-save-28-billion-bca
[8] http://www.csiro.au/files/files/ps6z.pdf
[9] http://www.minister.dbcde.gov.au/media/speeches/2010/013
[10] http://www.ehealthnews.eu/images/stories/pdf/201002ehrimpact_study-final.pdf

images to specialists anywhere in Australia to report on the imaging. The NBN would also allow for imaging to be sent with the report to the treating physician enabling verification of the findings, thereby improving the quality of healthcare.

The NBN could also result in an increase in regional economic growth and employment opportunities by facilitating health business servicing of urban populations in non-traditional locations, for example by facilitating the growth of regional, rural and remote pathology facilities.

The NBN has the capacity to contribute to greater business revenues through new possibilities for medical devices, services and software. Many medical device and software companies are small and medium enterprises (SMEs) and would benefit from the increased use of their products and services over the NBN.

Australia's export market could be enhanced through the early development and use of products and software for patient health prevention, monitoring and treatment interventions over the NBN as it would provide international buyers with demonstrated use of the medical devices, services and software over high speed broadband.

These medical devices, services and software could also contribute to health business efficiencies, particularly for small and medium enterprises (SMEs) such as pharmacies and General Practitioners (GPs) by enabling a greater range of healthcare services. For example, a pharmacy may be able to offer different services or products due to monitoring and GPs could treat more patients with chronic diseases through remote monitoring using the NBN.

3. Improving educational resources and training

Questacon[11]

As Australia's National Science and Technology Centre, Questacon's mission is to promote a greater understanding and awareness of science and technology. The development of the NBN is expected to significantly extend Questacon's ability to deliver science communication programs and events to Australian students and families as well as further developing opportunities to share Australian expertise with the world community.

Questacon already has the infrastructure in place to capitalise on the NBN and the increased bandwidth will provide greater access to Questacon's on-line content, digital programs and events, especially in regional and remote communities.

Since 2009, Questacon has been expanding its capability in science communication via digital delivery particularly to enhance its national outreach programs. The NBN has potential to enable this expanded capability to be even more effective in improving public reach and accessibility.

Improving science-related educational opportunities and motivation are main aims of Questacon. The NBN will greatly increase Questacon's ability to:

1. provide more students, teachers and communities with access to scientists, organisations and research facilities that they would not otherwise be able to access;
2. provide teachers and students access via the Questacon website to educational games, simulations, videos and other educational materials to enhance science and mathematics education;
3. provide additional resources to all levels of the educational market including early childhood, primary, secondary, trade and further educational institutions, juvenile detention and tertiary institutions nationally and internationally;
4. deliver teacher professional development via high-definition video conferencing to support teachers and enhance the quality of science and mathematics education;
5. assist regional and remote teachers with the delivery of the National Curriculum;
6. deliver interactive science and mathematics workshops for students with particular focus on those in regional and remote locations;
7. encourage and facilitate schools to connect and engage with other schools around Australia and overseas via video conference to share the learning of science;
8. facilitate the connection between schools and scientific experts in Australia and overseas to enhance education and motivation;
9. facilitate access to research facilities and research data; and
10. source and share high quality materials from the world science centre community and contribute Australian content to the international community.

[11] Questacon is the division of the Department of Innovation that has improving educational resources and training as a primary objective. Questacon presents creative, interactive science exhibitions and programs to emphasise the importance of science, technology and innovation, and to encourage students to pursue careers in science, maths and engineering. Questacon operates numerous outreach programs, which target a range of audiences and have been developed to support national science and education priorities.

Provision of educational material

The development of the NBN will allow Questacon to enter into the provision of educational material through various formats including video conferencing, online retail sales and promotions and bookings, thus enabling the organisation to cover an increasingly geographically diverse area.

The NBN will allow the delivery of high definition real-time interactions with Questacon presenters, scientists and international experts through video conferencing. The Questacon video conferencing experience is already far more dynamic than conferencing configurations currently seen within industry, government or education.

Questacon's digital studio supports multiple inputs allowing presenters to appear to be anywhere in the solar system or within the human body to aid the learning experience. Presenters using the studio can vary the way they interact with students. This flexibility can result in a program with a live television look and feel that can also be actively participated in by students.

Educational materials are increasingly requiring a visual format. In response, Questacon has invested in the technology and the skilled staff needed to provide high quality video production to assist in the development of educational materials for the science communication community. For example, scientific experiments that are too dangerous or otherwise inaccessible to schools are now filmed or transferred to schools via live video-conference.

Online education

Questacon has had an award-winning web presence since 1996 when it was one of the first science centres in the world to have an interactive web page. The website currently houses significant educational content. The higher bandwidth of the NBN is expected to allow more extensive and greater range of web resources to be developed and downloaded for educational purposes. Utilising the skills and expertise of staff from a number of programs, Questacon plans to extend its web content to include filmed science demonstrations, simulations and games to support classroom teaching and learning in the home.

Increasing science and technology awareness

Questacon provides a range of programs focused on increasing science and technology awareness while promoting the opportunities of careers in science and technology. Examples include the Questacon Smart Moves program which focuses on innovation and careers in science. This is currently delivered in schools by young presenters with additional resources on the Questacon website.

The Smart Moves Invention Convention brings together young Australians from regional locations with young entrepreneurs for a one-week intensive workshop on entrepreneurship and invention. This has already led to demonstrable outcomes with several enterprises having been established by the Invention Convention delegates.

Student access to subject specialists

The NBN is expected to increase opportunities to link young Australians with inspirational young entrepreneurs through interactive video conferencing into schools.

Questacon has also used video conferencing to promote science as a career by linking scientists with school students in an event known as 'The Hot Innovations' convention

which brings together young Australian scientists from around the world to discuss the importance of science in the community.

Finally, Questacon's technology learning centre will be aimed at providing secondary and tertiary level students with access to subject specialists in educational and research areas that are difficult to obtain in their local communities.

An example of the way the NBN can be leveraged in the ways noted above is through Labshare,[12] a program run through the University of Technology Sydney (UTS) that provides students in upper secondary and at the tertiary level with access to a number of remote control experimental apparatus including structural visualisation and loaded beams.

It is expected that the increased connectivity provided by the NBN will contribute to allowing students from across Australia in both regional and remote locations to access educational resources and training such as Labshare.

[12] http://www.labshare.edu.au/

4. Managing Australia's Built and Natural Resources

Managing the built environment

The Built Environment Industry Innovation Council was established in 2008 as an advisory body to the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr and as an innovation advocate for the industry.

The Council considers industry innovation challenges including climate change, sustainability and industry competitiveness as well as issues such as regulatory reform, workforce capability, skills needs, access to new technologies and other priorities for the industry.

The Council anticipates that increasing the use of information technology, facilitated by the NBN, will have a profound effect on the way the built environment is planned, designed, procured, constructed and operated. Some of the potential impacts of the increased use of information technology supported by the NBN will include the following:

- Plans and designs can be conceived, tested and optimised in a virtual world before moving to the construction phase. Undertaking planning in this online environment will allow designs to benefit from access to data about usage, consumption and performance of the existing built environment.
- Efficiencies will be fostered as construction moves towards a manufacturing process using "just in time" procurement allied to "mass customisation" and on-site assembly with all information flowing directly from digital databases and/or information rich models (Built Environment Models).
- Assets will be able to be managed and efficiently operated directly from Built Environment Models, reducing energy consumption, optimising operating costs and determining replacement plans.
- Some systems (transport, electricity grids, water supply for example) can be optimised in real time using sensors, networks and computers.
- People will improve their usage of systems if provided with real time, pertinent information via communications networks (urban informatics, smart meters).
- All usage, consumption and performance of systems and assets, including relevant human behaviour, can be recorded; used for physical optimisation and reconfiguration; and fed back into the planning and design of the future built environment.

Building Information Modelling (BIM)

A key aim of the Built Environment Industry Innovation Council is the development and application of innovation tools and technologies. Principal amongst these is the technique of Building Information Modelling (BIM), which is the process of generating and managing building data during its life cycle by the use of three-dimensional, real-time, dynamic building modelling software to increase productivity in building design and construction.

According to the Australian Bureau of Statistics' economic indicators, the construction industry is the fourth largest contributor to Gross Domestic Product (GDP) in the Australian

economy and accounted for 6.8 per cent of GDP in 2008-09, as well as employing around 9.1 per cent of the Australian workforce.

The Council considers that the use of BIM could improve productivity in the sector by a very significant six – nine per cent with an extremely high benefit cost ratio of ten. This accelerated rate of BIM adoption would produce an economic benefit equivalent to $5 billion being added to Australia's GDP.

Accelerated uptake of BIM would provide significant productivity benefits to Australia, in particular a 0.05 percentage boost to GDP by 2025, according to a recent report *Productivity in the Buildings Network: Assessing the Impacts of Building Information Models*, commissioned on behalf of the Council by the Department of Innovation and industry partners. The Allen Consulting Group, in compiling the report, stated that there are very few options available for enhancing productivity that can be achieved on such favourable terms and without difficulty to achieve structural reform.

Supporting community awareness of environmental sustainability

National institutions such as Questacon will be supported by the NBN to engage in programs that productively link state and territory organisations and programs. For example, it will become increasingly possible to promote community awareness of scientific outcomes based on ecosystems larger than a single governmental administrative area, including the water management in the Murray-Darling basin system, the management of the Great Barrier Reef, or soil degradation due to salinity in Western Australia and Victoria.

This is done by encouraging and facilitating community and government organisations to connect and engage with other similar organisations around Australia via video conference to promote cross cultural and regional education and understanding.

Questacon in particular also has the ability to capitalise on its science communication expertise and high brand value to help deliver key environmental messages to young Australians. Utilising internal programs and partners such as CSIRO's CarbonKids program, Questacon can promote sustainability and natural resource management throughout Australia.

Through the ClimateXchange website Questacon is bringing together national and international organisations (Asia Pacific Network of Technology Centres (ASPAC), World Wildlife Fund, Great Barrier Reef Marine Park Authority) to discuss and promote environmental awareness and sustainability in Australia and the region.

5. Regional Economic Growth and Employment Opportunities

ICT Industry Development

The Department of Innovation has policy responsibility for supporting the improved economic viability and competitive advantage of the Australian information and communications technology (ICT) industry, including as an enabler across the economy, and promoting the take up of telework. Teleworking refers to ″utilising information and communications technologies (ICT) to free staff from traditional office locations and enable them to work elsewhere″ [13].

The NBN has the potential to increase regional economic growth and employment opportunities through the increased use of telework. The Department of Innovation is responsible for promoting the uptake of telework and supports the Telework Australia[14] website which provides a range of tools and resources to assist with the implementation of telework.

The 2009 Sensis Business Index Teleworking Report found that 24 per cent of small and medium sized businesses (SMEs), in metropolitan and regional areas, reported that they or their employees teleworked.

Across the SMEs surveyed by the Sensis report, 82 per cent who had teleworking employees reported that teleworking had had a positive impact on their business, 17 per cent had not noticed any real impact from teleworking and less than one per cent had a negative experience.

Research by Access Economics has indicated that the NBN will assist in the growth of teleworking in Australia. In 2006, only six per cent of workers in Australia reported having any teleworking arrangements with their employer[15]. Access Economics predicts that if 10 per cent of Australian employees were to telework 50 per cent of the time, the total annual gains from teleworking would be in the order of $1.4-$1.9 billion per year [16]. Additionally, employment opportunities could be increased by enabling employers to recruit the best employee regardless of where they are located.[16]

Analysing a Macquarie Telecom survey of 540 firms from 17 industry groups, Access Economics found that approximately 20 per cent of respondents believed that the NBN would change their employment model. The key impact identified was through increased flexibility in the location of staff (for example, through teleworking and regional centres) and expanding the supply of skilled labour available. However, more than a quarter of respondents stated that while they considered that the NBN might bring changes, they had not yet considered what the impact might be.[17]

Currently employees who are undertaking telework are largely based in lifestyle locations rather than remote and rural areas. However, the NBN will have a positive and direct impact on the ability of telework to expand into truly remote areas.

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[13] Sensis ‘Business Index Teleworking’ Report, July 2009
[14] www.teleworkaustralia.net.au
[15] ABS, Household use of Information Technology 8146.0, Australia, 2008-09, Canberra, December 2009
[16] Access Economics, ‘Impacts of Teleworking Under the NBN’ Report, July 2010
[17] Access Economics, ‘Australian Business Expectations for the National Broadband Network’, 19 November 2010

Additionally, where skills shortages exist, telework is a means of retaining existing employees. For example, IP Australia[18] offers flexible employment arrangements which rely on teleworking to retain highly skilled patent examiners located outside of Canberra.

Advantages to home-based work and out-posted work include improved retention, additional individual productivity and reduced commuting. The NBN provides an opportunity to support the growth of telework and enhance the benefits that telework can provide across the Australian economy.

Additionally, the NBN offers an opportunity to address challenges including broadband access and long initial set up timeframes, including unexpected delays in broadband provision often experienced in regional and remote Australia, that impact adversely on teleworkers.

The Enterprise Connect Program

The Department of Innovation is responsible for administering the Enterprise Connect program. Enterprise Connect is a $50 million a year initiative designed to boost productivity, improve innovation and increase the competitiveness of Australian SMEs.

Enterprise Connect provides a range of services to SMEs, including the provision of Business Reviews at no cost to firms and grant assistance to implement recommendations flowing from the Business Reviews. Enterprise Connect has a network of 12 manufacturing and innovation centres and approximately 100 Business Advisers across Australia who have to date completed over 3,000 Business Reviews.

Regional economic growth and employment

Regional economic growth and employment opportunities for SMEs in regional and remote areas will be positively impacted by the development of the NBN. In particular, the NBN presents a significant opportunity for SMEs to become better connected with their industry stakeholders and, in particular, their existing and potential market.

SMEs in regional and remote areas will be given an opportunity by the NBN to break down geographical barriers and have greater access to new consumer markets including online consumers. However, for these opportunities to be realised, the opportunity for change growth must be understood and acted upon by the managers of these SMEs.

Currently, many regional and remote SMEs have limited growth potential due to a slower uptake of online technology than in metropolitan areas. This is mainly due to the difficulty in obtaining connection to these services at a reasonable price. The NBN has the potential to break down this barrier and allow an increased uptake of online technology.

The Enterprise Connect Innovative Regions Centre (IRC) works with 10 regions (economic zones) around Australia. In every region, the need for improved broadband Internet services is a common theme raised by client SMEs.

Regional areas of Australia are experiencing the consequences of regional population decline and ageing combined with urban drift which affects the access of SMEs to skilled workers. With the average age of workers in many regional areas steadily increasing over recent decades, initiatives to stem youth migration and to encourage mature workers to

[18] Intellectual Property (IP) Australia is the Australian Government agency responsible for granting patent, trade mark, industrial design and plant breeders' rights. IP Australia also manages programs to educate and promote awareness of the benefit of effective protection and use of intellectual property; provides policy advice to government; develops legislation to support Australia's IP system; and contributes to bilateral and multilateral negotiations to improve IP protection internationally.

remain in the workforce are becoming increasingly important. The provision of in-situ training and re-training will be important factors in providing an adequate workforce to ensure optimisation of growth opportunities for non-metropolitan regions.

To ensure economic growth in these regions, which often support Australia's critical resources sector, issues of liveability, access to re-training and staff, and the management of input and output resources will revolve around provision of on-line education and training or intelligent logistics and supply management systems.

The NBN will allow SMEs to up-skill their workforce through the increased availability of high-definition video conferencing to access industry specific training. Employees will be able to participate in training without the need for lengthy travel and costs.

In both metropolitan and non-metropolitan regions of Australia, the challenge to compete globally in an environment of a strong Australian dollar, high relative labour input costs, and significant distance to market means Australian firms need to work more cleverly.

This means innovation in business models, distribution channels and how they develop and apply technology. If regions are to continue to grow, develop smart people and ways of doing business, businesses will require access to enabling mechanisms in order to be connected to each other, the national and international innovation system, and the global markets for their products and services.

Many regions around Australia see future business growth potential in specialised 'niche' ICT applications and businesses. The significance of the NBN has been recognised with many of Enterprise Connect's IRC's regions (including Geelong, Northern Adelaide and Central Queensland) developing taskforces to maximise the growth potential that can be tapped through regional alignment and adoption of the NBN.

Opportunities to virtually attend conferences and meetings without the cost and time of travel mean companies no longer need to be disadvantaged by these factors. The potential to deliver training across regional Australia will mean that both education and professional pursuits will be greatly enhanced. SMEs' efforts to market their businesses are greatly enhanced through social networking platforms and channels and by accessing software to improve their on-line capability.

Benefits to regional business in the creative industries

There will be considerable benefits to regional business within the creative industries. The benefits of being able to access research from across the world will ensure that new and existing business pursuits are well informed; increasing their chances of success. Improvements to communications through tools like video streaming will allow greater opportunities for networking and professional collaboration.

High speed broadband provided by the NBN will significantly enhance the artistic endeavours and business prospects of creative businesses. For example, theatres will be able to live stream performances of music, drama and dance across the country. Musicians are able to join the world-wide trend of on-line publishing, allowing them to share their music with the world through sites like YouTube and Myspace. People living in remote communities will have instant access to a wide range of cultural diversity.

The lack of cultural infrastructure in regional Australia is recognised as a significant impediment to attracting skilled workers into regional Australia. The NBN is expected to help bring culture and entertainment to regional areas, reducing factors of isolation and stimulating ideas and opportunities.

Biotechnology Industry Development

The NBN will be a central component in supporting the biotechnology sector and its potential to re-energise regional communities. This will come about due to renewable industries colocating with renewable production facilities, resulting in increased economic flows in those communities and improved access to other services within local communities such as healthcare specialists and online education. It is anticipated that these benefits would be felt in the medium term as high speed broadband is gradually rolled out across regional areas.

6. Impacting Business Efficiencies and Revenues

The Department of Innovation operates a number of programs designed to improve the efficiency and competitiveness of Australian industry and also provides a focal point for the development and consideration of small business policy issues within Government. The Department is responsible for providing, on a whole-of-government basis, online services to Australian businesses through initiatives such as the business.gov.au website. It is also responsible for policies and programs aimed at improving productivity, global competitiveness and market access.

The Department of Innovation provides policy advice and analysis to portfolio ministers on industry and small business policy issues to facilitate increased competitiveness and sustained growth for Australian businesses. It focuses on a range of issues affecting business, promotes small business interests within government, and fosters an understanding within government agencies of factors influencing small businesses.

The Department of Innovation also has responsibility for policy analysis and advice to the government on manufacturing, building, information and communcations technologies (ICT), space and aerospace industries, as well as on the automotive and textile, clothing and footwear industries.

Impact of NBN on business activity

The Department of Innovation recognises that telecommunications infrastructure is a vital input into business activity, including for small businesses which represent 96 per cent of all Australian businesses. Telecommunications infrastructure has traditionally been regarded as a vital business input in Australia. Its role in facilitating business activity has become increasingly important as Australian businesses respond to globalisation and international competition, as businesses shift away from low value labour intensive activities towards high value, knowledge intensive activities, and as consumers rapidly adopt Internet based digital technology.

High speed broadband reduces the importance of location for doing business and allows more regional and rural small businesses to participate in the digital economy. Data intensive businesses, such as architects, graphic designers and sound engineers that utilise large image and audio files, will be able to transfer information quickly and reliably around the world.

While the use of the broadband and the Internet to conduct business is already well established in Australia, some small businesses, particularly those in regional or rural areas, have limited broadband coverage and performance available to them. Experience from the Department's support and services to over 3,000 Australian small and medium enterprises (SMEs) indicates that, while the NBN offers some potentially rewarding business opportunities, the benefits do not automatically accrue to the SMEs.

While a robust communications network is critical to giving SMEs the ability to integrate into the global market, including linking into global supply networks, the challenge for the SMEs is to harness the opportunity. A challenge for the NBN is to demonstrate in a practical sense the clear benefits of the network in improving their bottom line.

Impact on home-based business sector

The home-based business sector is diverse and complex. It is challenging for the Australian Government to engage directly with the sector as there is no common home-based business identity which could be used as a tool for communication. Work by the Department of Innovation, including internal research, indicates that businesses operated by home-based businesses vary greatly, from building trades through to ICT consultancies. Findings also indicate that low barriers to entry and low running costs are important to operators of home-based businesses.

A large majority of home-based businesses use a computer in their business and most use the Internet as part of their business activities. The research indicates a correlation between growth in business outcomes and ICT use. ICT is seen as important in this context as it allows these businesses to increase the scale of virtual operations without the costs associated with growth in physical operations.

Potential benefits to business from the NBN

There are a range of potential benefits to business from the NBN.

Small businesses may enhance their online presence by upgrading their website with interactive media and more sophisticated, content rich applications or by implementing online ordering and payment facilities to attract new customers and reach greater markets. They will be able to more efficiently access online services, including finance and banking, the latest news and research for their business as well as government information and programs.

In addition to enhancing current online business activities, the availability of high speed broadband may also have a broader effect on the innovation potential of business by providing opportunities to transform business activities and models. High speed broadband provides opportunities for small business to capitalise on their creativity and innovation to enhance efficiency, productivity, competitiveness and profitability.

For example, access to high speed broadband may foster opportunities for small businesses to adopt more efficient operational or organisation processes such as outsourcing administrative tasks via the Internet to focus on core business activities; obtain greater access to markets both in Australia and overseas; participate in global value chains and industries; and establish extensive business networks.

In addition, the NBN is expected to provide the opportunity for SMEs to improve current capabilities in product design and innovation, technical analysis and engineering functions which may in turn assist to streamline their production and supply processes. The NBN has the potential to improve SMEs' access to and adoption of software platforms that will improve their efficiency and competitiveness, both domestically and internationally.

High speed broadband allows businesses to undertake greater collaboration with other businesses, their own customers and research institutions to develop improved services and products. There is an increasing level of integration across supply chains through web based systems and the NBN will make this task far easier for firms to collaborate on their production planning.

As outlined in section 5, regional businesses may also benefit from using teleworking to employ the best staff regardless of their location or use ICT tools that were previously unviable due to limited broadband services – such as web conferencing and voice over

Internet protocol – to reduce travel time and costs, and conduct online distance learning and staff training to further grow their business.

Historically, a home-based business has been defined as a business where most of the work of the business is carried out at the home(s) of the operator(s) or where the business has no other premise owned or rented other than the home(s) of the operators.

Australian Bureau of Statistics (ABS) publications on business characteristics no longer provide information that distinguishes businesses in the latter category. However, the 'locations of work survey' conducted in November 2008 as a supplement to the ABS monthly labour force survey, provides some information that may provide some inferences about both these categories, while also providing information about employees.

In particular, during the reference week, 49.3 per cent of persons who worked any hours at home in their main job, were employees (excluding owner-managers of incorporated entities), 30.4 per cent were owner-managers of unincorporated enterprises (OMUE) and 19.5 per cent were owner managers of incorporated enterprises (OMIE).

Some home-based businesses exist alongside outside employment for at least a period of time. During the reference week, 55.1 per cent of persons who worked any hours at home in their second job were OMUEs, 19.6 per cent were OMIEs and 24.3 per cent were employees (excluding owner-managers of incorporated entities). Of persons who worked any hours at home in their main or second job in the reference week, 77.2 per cent used both the computer and the Internet. [19]

The availability of a similar quality broadband experience in household locations to that available at business premises may be important to some people in these categories. It is worth noting that the www.business.gov.au web site is, on average, used outside of standard business hours (9am to 5pm) at a rate of 45 per cent.

Financial and corporate benefits may also accrue from teleworking. In an exercise involving 8,500 employees that worked from home using broadband, British Telecommunications (BT) reported a range of significant benefits including:

- reduction of (on average) £6,000 per employee on accommodation costs;
- an increase in the productivity rate of employees of between 15 per cent and 31 per cent (average 20 per cent);
- a 75% decrease in the number of sick days; and
- a total annual savings of more than GBP60 million for the company.[20]

Technology company Sun had nearly 19,000 employees (56 per cent of Sun's workforce) work from home or in a flexible office in mid 2008 and had been expanding teleworking for a decade. By comparing home and work energy use, the company found that:

- Office equipment in a Sun office consumed energy at a rate twice that of home office equipment.
- Employees who eliminated the commute to a Sun office also slashed their carbon footprints.

[19] Australian Bureau of Stastics, Locations of Work, 6275.0., November 2008, p23.
[20] Qiang 2009, Information and Communications for Development 2009: Extending Reach and Increasing Impact, World Bank.p.37.

- Commuting accounted for more than 98 per cent of each employee's work-related carbon footprint, while powering office equipment made up less than 1.7 per cent of a person's total work-related carbon emissions.
- By eliminating commuting 2.5 days per week, an employee reduces the energy used for work by the equivalent of 5,400 kilowatt hours each year[21].

There is also the potential that, as the NBN fuels opportunities for the information technology industry as developers and suppliers, Australian SMEs will be supported to increase revenues by allowing them to do more business online with customers, suppliers, government, employees and other stakeholders.

The following sections provide examples of specific industry or business areas where benefits may accrue.

Impact on IT Industry Development

The Information Technology (IT) industry will have a role to play in supporting the development of software applications to exploit the availability of high speed broadband access. The IT Industry Innovation Council (ITIIC)[22] specifically identified in their strategic plan the importance of maximising the opportunities offered by the NBN.

The Council believes the coverage and capacity offered by the NBN coupled with technology-based solutions can be transformational to the Australian economy, driving productivity and securing prosperity in the years to come.

As businesses, individuals and governments become aware of the benefits of an economy enabled by high speed broadband, investment in technology applications and infrastructure will fuel opportunities for the IT industry as developers and suppliers. In turn, businesses and government will have an increased opportunity to become more productive and hence competitive through widespread and innovative application of technology.

The recent Digital Economy and Broadband Applications Mission to Japan, Korea and Singapore in October 2010 highlighted the opportunity for Australia's IT Industry to benefit from the development of the NBN. The Mission, organised by Austrade and attended by both industry and government, was designed to showcase the Asian economies experience with broadband use.

The Mission report highlights some key lessons from each country, but on the whole demonstrates that these countries value the investment in their networks. Importantly, the report notes that there is an active search in these economies for *'killer applications for the business and domestic markets'* [23] which provides an opportunity for Australia's ICT industry to feed into the global software and applications market. Importantly also, is the role of these economies as competitors to Australia, and the notion that we should not be left behind as the digital world moves forward.

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[21] Network World Sun sheds light on telework savings 30 June 2008 http://www.networkworld.com/news/2008/063008-sun-telework-savings.html?page=1

[22] The Information Technology Industry Innovation Council (ITIIC) was established in 2009 as an advisory body to the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr and as an innovation advocate for the industry. The Council consists of representatives from across the IT spectrum, including from industry, suppliers, users, education, research, government and unions. The secretariat for the Council is provided by the Department of Innovation.

[23] Digital Economy and Broadband Applications – Mission to Japan, Korea and Singapore 18-26 October 2010.

The following is a case-study of an Australian company exporting to Asia, and is representative of the business activity that has the potential to emerge in response to the introduction of high speed broadband in Australia through the investment in the NBN.

Export Case Study: Clive International ***Australian exporter of e-education services to Asia***	
CLIVE	Continuous Learning in a Virtual Environment is an Australian company providing transnational e-learning, specialising in English language training in Asia
Problem:	Shortage of qualified and native English speaking teachers in Asia (NESTs)
Solution:	NESTs in Australia are linked to students in Asia (Korea, Japan, China) via high definition video conference and IPTV
Strategic advantages	Australia is the only native English speaking country in the same time zone as the target Asian countries. CLIVE has developed pedagogy and systems to effectively deliver transnational education through B2B and B2C models
Korean Market strategy	• CLIVE started teaching English via video in 2009 (the private English language training market is worth between USD $2.5-5bn. A Korean provincial government paid for a pilot project • CLIVE has developed English lessons based on the National Geographic Explorer magazine targeting the primary education market. Each Explorer magazine has 3-4 stories targeting various levels of English •
Korean market environment	Government policies to encourage e-learning, online training, lifetime learning and computers and Internet access in schools. Online education is growing at a faster rate than offline (traditional) education

Case Study - Impact on Textile Clothing and Footwear Industry Development

The NBN has the potential to provide significant support to the Textile Clothing and Footwear (TFC) industry with the Textile Clothing and Footwear Industry Innovation Council (TCFIIC)[24] expecting that a range of new business models will emerge in response to the connectivity provided by the NBN that may help the TCF industries to become more competitive and sustainable. For example, online shopping will offer both opportunities and challenges for local manufacturers and retailers.

In particular, growing demand for customised products through Internet selection and ordering may open up greater opportunities for local manufacturers, particularly if they are able to provide the product quicker than overseas options.

For example, a Footwear Manufacturers' Association of Australia consortium that includes RM Williams and J. Robins and Sons has recently received Commonwealth funding to develop a mass customisation model for footwear manufacturing that will more effectively meet the needs of individual customers. Computerised foot scanners will be introduced into RM Williams' network of over 40 retail stores, with the information then relayed via the Internet to Australian production facilities to quickly and efficiently produce footwear to meet individual customer needs.

[24] The Textile Clothing and Footwear Industry Innovation Council (TCFIIC) was established in 2009 as an advisory body to the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr and as an innovation advocate for the industry.

The introduction of the NBN will make the transfer of this information, particularly from regional areas of Australia, more efficient. This will potentially make the adoption of a mass customisation model in other industries more viable especially in areas where Internet access and bandwidth capacity is currently less reliable.

Another example of the significant potential of the NBN to support Australian companies to reach new customers and provide a customised product and service is Sydney company Shoes of Prey which allows its customers to design their own shoes online. Since it began in October 2009, the company has become a net exporter, shipping 40 pre cent of sales to customers outside of Australia within the first year of operation.

The company released a promotional YouTube video that became the fifth most viewed on YouTube worldwide and at one time the most commented on video worldwide. The video drove over 500,000 hits to the company's website, which converted to a 300 per cent permanent uplift in sales.[25]

An example of early success in online retail is Sean Ashby who owns aussiebum.com.au, an online swimwear company with a global market. Current projections indicate that the aussiebum website will allow customers to purchase $22 million worth of underwear and swimwear online this year with the majority of the product being shipped offshore.[26]

In addition, with the majority of TCF industry training courses in Sydney and Melbourne, and only limited elements available online, the NBN may bring new levels of interactivity that will allow students from other parts of Australia greater access to TCF industry training and potentially greater opportunity for employment in the TCF industries particularly in regional areas.

Case Study - Impact on biotechnology-driven business

Across biotechnology-driven businesses, the NBN will support and enhance industry efficiencies and linkages, will strengthen revenues and competitiveness and will ensure that Australia's productive capacity is maximised in terms of its export markets.

This will be facilitated by broadband enabling real-time purchasing and selling to local, national and international customers as well as providing logistics support that will enable demand to linked to production cycles. These opportunities are currently limited and may continue to be so, only accruing in the regional context with more advanced stages of the NBN roll-out. This may mean benefits are constrained in the short term.

The sensor and technological measures made possible by high speed broadband are also expected to assist industries in the management of biotechnology resources vital for bio-refineries. Such technologies could maximise production cycles of biomass and provide feedback on important environmental variables from crop growth, to soil conditions, as well as environmental monitoring and efficient utility of finite resources such as water.

Biotechnology companies in Australia tend to be SMEs and technology-focused organisations. As a group, they are geographically dispersed across metropolitan and regional areas. For this reason, the NBN offers considerable benefits to the full range of biotechnology-driven organisations across Australia and has the potential to enhance linkages across firms and with regional Australian universities.

[25] Case study drawn from http://www.digitalbusiness.gov.au
[26] Online selling a two-way trade, The Australian Financial Review, Tuesday 1 February 2011, pg 53.

The NBN is particularly important when considering new and emerging biotechnology industries. For example, biorefineries (manufacturing products such as ethanol and bioplastics from renewable biomass) are likely to be located in regional areas with related logistics, manufacturing and distribution firms operating near such sources.

Potential benefits flowing from the NBN to biotechnology-driven business include options for clustering, collaboration opportunities that will enhance scale and focus, and the marshalling of expertise and teaching. While the Australian Research and Education Network[27] has already provided significant benefits to regional universities, the flow on effects of high speed broadband to regional businesses is currently limited until such time as the NBN becomes widely available.

Case Study - Impact on creative industries

The NBN has the capacity to provide extensive benefits to SMEs in the creative industry. SMEs that utilise digital distribution and large data files such as advertising, music, film, digital media, publishing and architecture will be able to more effectively and efficiently conduct business because of enhanced network speed and data transmission capacity.

Emerging technologies will stimulate and facilitate a whole new wave of creative pursuits. Digital simulation, 3D animation, situated media, cloud technology and social networking offer platforms for innovation and will stimulate many benefits both in mainstream business and across the creative industries. Early prototypes of highly connected immersive media for work and home environments already exist.

Creative industry SMEs will have increased capacity to develop and implement new business models because the NBN is expected to suddenly and significantly reduce costs for business and expand market opportunities for multiple business applications.

The rate of technological advancement and utilisation and integration of emerging technologies means that some future opportunities are hard to predict. Just as software engineering positions did not exist twenty years ago, there will be many new developments (jobs and businesses) emerging through increasing utilisation of infrastructure like the NBN.

Government support to business for online initiatives

It is critical that businesses, including SMEs adopt, embrace and understand how to use the NBN to full advantage. The Australian Government has a role to assist and support businesses to do this, particularly for SMEs which often have limited time, resources and expertise. The Department of Innovation has a range of complementary activities targeted towards achieving this goal.

Many SME owners and managers are focussed on the day to day running of their businesses. This creates considerable room for improvement in the way they use existing information technologies. As a result, they will not automatically understand or know how to use the potential benefits of new technologies such as the NBN.

The promotion of the NBN to SME owners needs to focus on the practical benefits that can be achieved. In order to achieve this, SMEs may need to be trained, mentored and

[27] Details of the AREN provided in Section 7.

coached to allow them to appreciate the potential of the NBN and what it can do for their firms.

The Department of Innovation Enterprise Connect Division works to foster the capacity of SMEs to take up the opportunities of the NBN.

- Enterprise Connect is assisting SMEs to improve their management and leadership skills through the Australian Government's Clean 21 Making Better Managers program. The program will be offered to firms that have completed a Business Review and have demonstrated that they are focussed on embedding change and deepening the range of capabilities that internationally competitive SMEs need.
- The Enterprise Connect Creative Industries Innovation Centre (CIIC) currently works with SMEs to raise awareness of what an NBN enabled environment will mean for them. For example, the CIIC has brought together a range of industry leaders across Tasmania to discuss and explain the strategic and practical impacts of the NBN. Through this collaboration with industry, the CIIC intends rolling out workshops which will inform business, enabling them to fully exploit the opportunities that the NBN offers.
- Just as SMEs require training, mentoring and coaching to assist them to appreciate the potential of the NBN and what it can do for their firms, there is currently a market failure amongst SMEs that lack the knowledge and/or expertise with the selection of software that best meets the firm's needs. A large proportion of SMEs run their business on the back of home grown desktop systems and/or non-integrated legacy systems that lack computerisation (integration). Enterprise Connect through the Technology and Knowledge Connect (TKC) service offers an independent broker service to diagnose IT related issues and provide advice on appropriate software solutions.

In addition to investment in NBN infrastructure and the support programs provided by Enterprise Connect, the Australian Government has launched initiatives to help businesses take advantage of online opportunities.

AusIndustry is the business program delivery division of the Department of Innovation and delivers a range of more than 30 business programs, including innovation grants, tax and duty concessions, small business skills development, industry support and venture capital – worth about $2 billion each year to more than 12,000 businesses and 70,000 individuals. Among the programs AusIndustry administers is the Small Business Online program.

- As part of the 2009-10 Budget, the Australian Government announced funding of $10 million, over two years from 1 July 2009 until 30 June 2011, to establish the Small Business Online program. On 19 January 2010 the Government announced an extra $4.291 million would be provided to extend the program to more tourism small business operators.
- The program aims to prepare small businesses, including home-based businesses, to go online, significantly enhance their web presence and engage in e-business capabilities. This service to small businesses is being delivered through third party service providers selected through a competitive, merit-based process to provide 'free or low cost' IT skills development, training and mentoring services to small business owners and/or managers.

- Subject to an evaluation of the program, anecdotal comments from service providers delivering the assistance indicates that it can be difficult for small businesses to realise the benefits of being online. Once they have participated in a small business support program such as the Small Business Online program, the feedback is very positive.
- As at 7 January 2011, small business, through the service providers, reported a satisfaction level greater than 85 per cent. Anecdotal comments following the January 2011 floods in Australia in Queensland, Victoria and New South Wales indicate that increasing small business capability and capacity to conduct business online increases the options for faster recovery and or new opportunities.

Within the Department of Innovation, the eBusiness Division delivers a range of whole-of-government online services to support business activities and business interactions with government. This includes online services between governments that collectively deliver services to business.

Australian businesses want to be well-placed to compete in a world where technology improves rapidly and where customers have increasing expectations about convenience, speed and cost. Innovation assists businesses to meet those customer expectations while also meeting their regulatory obligations.

Many business cases for government programs to support businesses transitioning to the online service delivery channel cite the need to reach a critical mass of business users before a return on investment is realised.

The programs and services delivered by the Department's eBusiness Division to assist businesses in moving to an online delivery channel are described below. The Department of Innovation considers that the introduction of a faster Internet service is likely to enable businesses to make better use of these initiatives.

- business.gov.au

  The Australian Government's principal business resource remains the award winning www.business.gov.au website. The site, which has been in operation for 13 years, includes information on all aspects of starting or growing business, including user-friendly checklists and business templates.

  Business.gov.au is a whole-of-government service providing essential information on all stages of the business cycle, including planning, starting, improving and closing a business. By using business.gov.au, businesses can comply with government requirements more simply and conveniently, saving time and money.

There is a range of www.business.gov.au services and resources:

- *ABN Lookup* is a service providing access to the publicly available information provided by businesses when they register for an Australian Business Number (ABN). Through the ABN service, businesses can also look up the publicly available information about superannuation funds through Super Fund Lookup.
- *Content Syndication* is an easy and cost-free service enabling businesses and intermediaries to publish business compliance information from all three levels of government on a third-party website. Once installed, the syndication service automatically creates and updates business information on a partner's website using business.gov.au content. The real benefit of the syndication service is that businesses can access up-to-date government information on sites they are more familiar or comfortable with.
- *Business Consultation* – Established as a result of the Taskforce on Reducing the Regulatory Burden on Business Report, the website gives businesses and individuals more opportunities to be consulted about government policies and regulations that may affect them. The website also allows visitors to register to receive notifications of new public consultations that are posted to the site by government agencies.
- *Starting and Growing Your Business Checklists* - These comprehensive checklists are designed to guide businesses through the various stages of starting or growing a business.
- The *Grants and Assistance Finder* helps businesses find grants and assistance is available from the Australian and all State and Territory governments. Businesses can quickly and easily find the grants most relevant to their business.
- *Advisor Finder* allows a tailored search by industry, type of advice and by state or territory – which in turn generates an interactive Google map and contact details for each advisory service, including phone numbers, email addresses, opening hours, service fees and walk-in locations.
- *Business planning templates* help businesses start or grow. The templates were developed in conjunction with business and financial advisers. The suite includes a business plan, marketing plan and succession plan.

In December 2010, a new Australian Government website, digitalbusiness.gov.au was launched to help businesses and community groups take advantage of online opportunities. The website covers topics including building a website, e-commerce, online marketing and social media. This website is administered by the Department of Broadband, Communications and the Digital Economy and provides a service that complements information provided on business.gov.au.

- GovForms/Smart Forms

The Department's online forms service, GovForms, helps businesses find, manage and complete government forms online without having to understand the structure of government or individual agencies. Businesses access GovForms via the business.gov.au website.

Businesses regularly deal with government; whether they are registering for an Australian Business Number, applying for permits or licences, or paying their rates. Although many government forms are available online, they can often be difficult to find. GovForms offers businesses a fast and convenient way to find forms and deal with government.

The Department of Innovation provides a Whole of Government SmartForms service using Adobe LiveCycle technology. There are no licence, service or hosting fees are required from participating government agencies. SmartForms are interactive, dynamic electronic PDF forms used to replace or complement non-interactive documents. Some versions of SmartForms can be filled, signed and submitted online. This means that the data does not need to be re-entered by the government agency.

The Department of Innovation currently provides the advanced forms component of the Government Service Environment (previously AGOSP) initiative by way of a Memorandum of Understanding with the Department of Finance. This service is also based on the Adobe LiveCycle technology.

- VANguard Authentication Service

The VANguard program provides a suite of online authentication services to secure business-to-government and government-to-government transactions. VANguard's authentication services help reduce the compliance burden on business by facilitating simpler, more secure electronic transactions between business and government.

As a whole-of-government program, VANguard is fundamental in progressing the Government's online service delivery agenda by providing effective authentication mechanisms to enable secure business-to-government online transactions. VANguard also provides agencies access to a dedicated infrastructure for conducting secure business, eliminating the requirement for costly duplication of authentication solutions across government agencies.

VANguard services are being used to deliver the authentication requirements of multiple government programs, including the Standard Business Reporting Program (SBR) run by the Treasury and the Australian Business Number-Business Names (ABN-BN) Program. Since May 2010, VANguard also brokers the Australian Taxation Office (ATO) and Auskey credentials across the ATO external business and tax agent portals, providing authentication for millions of transactions per month.

The Authentication Governance Committee has appointed the Department of Innovation, through VANguard, and the ATO, as a 'lead agency' partnership in the provision of business-to-government (B2G) and government-to-government (G2G) authentication.

VANguard provides the following authentication services:

- *User authentication service* verifies a business user's identity to access secure portals and websites (i.e. agency secure portals). The Single Sign On feature allows users to work across multiple agencies without the need to login multiple times.
- *Signature verification service* eliminates the requirement for signed paper forms by providing verification of a business user's digital signature on signed electronic business forms. This service leverages Innovation's whole of government SmartForms capability.
- *Timestamping service* provides independent, verifiable evidence of the date and time of an electronic transaction. This service utilises certificated time provided by Innovation's National Measurement Institute.
- *Security token service* facilitates secure transactions between business and government systems as well as between government systems. This service has been developed to meet the authentication requirements of the SBR program.
- *Claims replications service* provides near real-time data replication between a registration authority and VANguard. This service has also been developed to meet the authentication requirements of the SBR program, and it enables credential information to be updated as required without the need to issue a new credential.

- Australian Business Account

  The Australian Business Account (ABA) is a new whole-of-government online service that will be launched later in 2011. The ABA is an online account for managing ongoing business interactions with all tiers of government.

  The account will allow businesses to take control of their regulatory activities online 24/7 and to save time through the pre-filling and submitting of forms online, where available.

  Businesses will be able to access registrations, monitor their compliance requirements, and receive updates on regulatory changes, news of business development opportunities and other information.

  The ABA will integrate with the existing VANguard Authentication Service, the existing GovForms Service, the new Australian Business Licensing and Information Service to Government agencies with one, central place for business users to manage their interactions with government. The ABA will provide the ability to pre-fill SmartForms from information held in the account, further improving the accuracy and consistency of data entry and reducing the load on business users. The ABA will mean increased consistency and integration of systems across all tiers of government to deliver better services to businesses.

- Australian Business Licensing and Information Service

  The Australian Business Licensing and Information Service (ABLIS) is a new whole-of-government online service that will be launched in 2011. ABLIS will deliver information about licences, registrations, permits and assistance to business and will be brought together in one place from all tiers of government.

ABLIS will give businesses customised information about their regulatory requirements, simplifying business start-up and saving existing businesses valuable time.

Australian Government agencies will have a central place for business users to search and find business-related information. The ABLIS will mean increased consistency and integration of systems across all tiers of government to deliver better services to businesses.

- Business interaction with Government

  The Department of Innovation provides a broad range of value-add e-business services for the business community. These services:

  - assist individuals considering new business opportunities;
  - assist existing business comply with regulation;
  - are delivered via a number of channels with the online channel becoming increasingly prevalent; and
  - provide citizens and businesses the convenience to undertake a range of business related activities via a dedicated single service delivery point.

  The increase in capacity and speed that the NBN will deliver should improve the range and richness of government services delivered to businesses. For example, the design of online forms is currently constrained by size of the forms which limits exploitation of this technology. Another example would be the ability for geographically remote businesses to effectively communicate and collaborate with government using interactive online tools that require high bandwidth.

  With the introduction of multi-agency programs delivering services via a single online service point comes an increased need for high speed and reliable Internet connections. These services often require data to be aggregated to the service point and then dispersed to the various agency systems. To allow the businesses using these services to experience a seamless service, two main factors come into play – latency and throughput. Latency is the time taken for a message to be transmitted from start to end. Throughput is the network's ability to process many transactions in a short period of time. Latency and throughput together affect a user's perceived speed of a connection. Both should be enhanced by the NBN.

- Government interaction with Government

  The Department of Innovation currently provides a range of e-business services for use by agencies across the three tiers of government. These services:

  - assist agencies to deliver their services via the online channel by providing reusable and scalable infrastructure and services; and
  - enable multi-agency programs to deliver their services via a single online service point. Considerable effort is being made by governments to reorganise service delivery channels so that a business can undertake a range of transactions relating to a particular subject in one place regardless of the underlying agency arrangements.

For example, a business that uses the Australian Business Licensing and Information Service (ABLIS) will be able to find all of their obligations with government within a single Internet service regardless of whether those obligations are with Federal, State or Local government and regardless of the locality of the business. To realise single service points requires considerable underlying communications between systems. Often data needs to be aggregated to the service point and then dispersed to the various agencies.

The increase in capacity and speed that the NBN will deliver should improve the range and richness of online services between government agencies. For example, the successful expansion of single service delivery points is dependent on reliable and efficient network connections across governments.

- Intra-Agency interactions

  The Department of Innovation is geographically dispersed with over 100 offices located across metropolitan and regional Australia. Within major cities, access to dedicated high-speed networks (Icon links or other private fibre networks) is utilised where available. The NBN would not necessarily provide additional capability. However, outside major cities and between major cities, offices do not generally have access to high-speed communications infrastructure. The NBN could provide opportunities for these offices including:

  - ability to process large transactions; and
  - ability to process transactions more quickly.

  These offices could deliver services and receive systems support that is currently limited to metropolitan locations because of communications constraints. This flexibility should also enable the Department of Innovation to tap into local skills and employment markets. Another example would be the ability for geographically dispersed offices to effectively communicate and collaborate using high bandwidth interactive online tools.

Mobile communications

The use of the Internet by government to deliver services is being driven by increasingly community demand for services using online channels that are fast, convenient and affordable; and technological improvements that make using the online channel a richer and more convenient experience.

The use of mobile computing devices is becoming increasingly popular as the online channel improves their capability. The use of online and mobile computing transactions should be enhanced as the supporting network's speed and capacity is increased.

7. Research and Development and Related Innovation Investments

The Australian Government's investments in research and innovation infrastructure are designed to support jobs and growth in the short-term, while increasing the long-term capacity of the system to ensure the production and commercialisation of new ideas.

This involves setting priorities and strengthening coordination; improving skills and expanding research capacity; increasing innovation in business, government and the community sector; and boosting collaboration - domestic and international - across the system.

The Australian Government's Innovation Agenda for the 21st Century, *Powering Ideas*, identified that as the problems studied become more complex, the infrastructure needed to develop collaborative and multi-disciplinary solutions will need to reach higher levels of sophistication. The research supported by research and innovation infrastructure will more often than not involve researchers from a variety of disciplines and increasingly depend on large-scale information and communications technology (ICT) capabilities in data computation, integration, storage, and distribution.

The Department of Innovation has a role in advising the Australian Government on policy and implementation of programs relating to research and science, including higher education and research training and research infrastructure.

The Australian Research and Education Network (AREN)

The Australian Government's commitment to provide national high-quality research infrastructure to support Australian researchers across a range of disciplines and research institutions, in particular through the National Collaborative Research Infrastructure Strategy (NCRIS) and the Super Science Initiative, is supported by the development of the NBN.

In particular, the Regional Backbone Blackspots Program (RBBP), under the NBN, serves to complement and support the enhancement of the Australian Research and Education Network (AREN), which has been developed to enable high-end connectivity between researchers. To date, the Australian Government has invested just over $127 million in the AREN, through grants provided through the Systemic Infrastructure Initiative, NCRIS and the Super Science Initiative.

An effective national innovation system requires investment in research infrastructure and facilities to support priority research and science in Australia. The Super Science Initiative, announced in the 2009 Budget, and funded through the Education Investment Fund, included an investment of $901 million in research infrastructure to give Australia's researchers the tools they need in three areas of world-leading scientific capability: Space Science and Astronomy; Marine and Climate Science; and Future Industries.

This investment builds on earlier funding of $542 million through the NCRIS to invest in major research infrastructure in support of priority Australian research.

A feature of both the NCRIS and Super Science programs has been to optimise the ability of leading researchers to access and make full use of the available infrastructure, regardless of the physical location of the facilities. Hence, both programs support the development and provision of high capacity networks for multi-disciplinary research, conducted from multiple locations, through enhancements to the AREN.

In doing so, both programs build on previous Commonwealth investment in the AREN, a high-speed core network which connects Australian universities, some research institutions, and regional and international research networks.

The Commonwealth's investments since 2002 have contributed to the AREN's development including acquiring access to a high bandwidth trans-Pacific backbone for research and education.

The AREN forms the backbone of Australian research collaboration infrastructure and is essential for the transfer of large data sets between universities and research institutions in all capital cities and many regional centres, as well as isolated research facilities and for collaboration between Australian and overseas researchers.[28] As a result, it ensures that national, collaborative research infrastructure is accessible by researchers from universities, government agencies and research institutions across Australia.

The NBN offers sustainable solutions for those areas that the AREN is still striving to reach. In particular, this applies to the connection to Darwin, which has so far been at a lower rate of capacity than the rest of the AREN, and which has only been supported through successive and short-term solutions. The RBBP under the NBN is expected to enable researchers access to the fibre being rolled out to Darwin in a way that presents a sustainable solution for researchers in Darwin, and those researchers who wish to access research resources in the Northern Territory.

The NBN connection to every street address represents an opportunity to put in place a new generation of data gathering capabilities of benefit to research. This would provide greater opportunities for networking that could be used to connect higher bandwidth research instrumentation 'in the field'. For example, the NBN could provide the capability for wireless research sensors near any town and therefore anywhere in the country where research needs to be undertaken. This would allow researchers to install a greater number of low-cost imaging and sensing devices.

Unlike the universities and research institutions, many museums are not connected to the AREN. The NBN would provide opportunities for effective digitisation strategies for Australia's highly distributed museum based artefact collections.

By providing access to data collections and instruments that are relevant to researchers, though not created primarily for research purposes, the NBN would offer new

[28] For instance, the AREN, through international links, connects to National Research and Education Networks (NRENs) in other countries. Examples include:

- GÉANT the pan-European data network dedicated to the research and education community. Together with Europe's national research networks (NRENs), GÉANT connects 40 million users in over 8,000 institutions across 40 countries. The GÉANT network enables data transfer speeds of up to 10 Gbps across 50,000 km of network infrastructure and over 12,000 km of lit fibre. The network allows users to collaborate seamlessly regardless of distance or location; and
- KREONET (Korea Research Environment Open NETwork) is the national broadband network dedicated to the research and education community in Korea. Run by KISTI (Korea Institute of Science and Technology Information) KROENET has been supported by the Korean government since 1988. KREONET provides high-performance network services for Korean research and development community to support science and technology information exchange and supercomputing related collaboration. KROENET provides a 10Gbps backbone network and 1Gbps high-bandwidth lines to approximately 190 member organisations throughout academia, industry and research sectors.

opportunities in research, including by connecting interested researchers with substantially enhanced coastal data gathering capabilities and highly disbursed real time urban environment monitoring sensor systems. In these cases, the speed of the connection is a key factor in effectively transferring the data from individuals and businesses to researchers or their institutions.

Areas of research that rely increasingly on the gathering and synthesis of very large data sets, including those collected through sophisticated research instruments, have the potential to benefit from the NBN. A clear example is radio astronomy research, through the impact on the Square Kilometre Array (SKA) bid described further in this chapter. Another such area is the life sciences field of research, which stands poised to change the shape of our future based on an enormous growth in research instrument capabilities. Thousand fold increases in data gathering are expected to occur in this domain over the next few years. A step change in connectivity and data sharing in the life sciences field is an essential requirement to undertake relevant research possibilities.

Relevance of the RBBP to the AREN

The Australian Government's commitment under the NBN to invest $250 million through the RBBP to immediately address backbone blackspots throughout regional Australia has particular relevance to the development and enhancement of the high capacity networks to support researchers.

Nextgen Networks[29] is responsible for the rollout of the approximately 6000km backbone infrastructure, as well as operating and maintaining the backbone transmission links for an initial five-year period.

Concurrently, under the Super Science Initiative, the Australian Government is investing $37 million via the National Research Network Project to enhance and extend the AREN.

Both initiatives have identified connectivity between regional centres as a priority. Of the eight priority sub-projects being developed under the AREN enhancement and extension project, five of these will contribute to improve the connectivity of regional areas to the AREN backbone.

A key example of how the NBN and the Super Science investments complement each other in delivering key research and science outcomes is in how they will serve the commitment to host the Square Kilometre Array (SKA) as well as ongoing benefits of Australian Square Kilometre Array Pathfinder (ASKAP) project.

Benefits to the SKA bid and related activities

Both the NBN and Super Science AREN enhancement and extension project have singled out the connectivity between Geraldton and Perth as a key priority, recognising this would support science and research outcomes and complement substantial existing Australian Government commitments in the area of high performance computing and radio-astronomy, in addition to connecting a significant regional community currently under-served.

The Perth to Geraldton route, which is provided through fibre built under the NBN RBBP, is of particular importance as it will boost the joint Australia-New Zealand bid to host the

[29] Nextgen Networks owns and operates Australia's third largest fibre network with a diverse customer base including carriers, corporations and government. Nextgen Networks is a specialist provider of high performance data services and is a wholly owned subsidiary of Leighton Holdings.

$2.5 billion SKA radio-telescope, which will be based in Western Australia's mid-West if the bid is successful. This build is complemented by the investment under the Super Science National Research Network Project to light the fibre on this Perth to Geraldton route for research purposes. The Department of Innovation is coordinating Australia's involvement in the SKA bid.

The contest to host the SKA is between Australia-New Zealand and Southern Africa. A decision is expected in early 2012. To date, the Australian Government has committed approximately $350 million to the infrastructure that supports the SKA bid.

The ASKAP is a key part of the SKA bid and will form Australia's premier radio-astronomy instrument in future regardless of decisions regarding the site of the SKA.

The ASKAP (and potentially the SKA) will generate extremely large amounts of data from 2012 onwards and will require significant communications capacity to link the Boolardy site in Murchison Shire (315km north east of Geraldton) with high performance computing resources at the Pawsey High Performance Computing Centre for SKA Science in Perth.

Combined with the fibre-optic link between the Murchison Radio-astronomy Observatory and Geraldton being built by the CSIRO, the RBBP Perth to Geraldton link and the Super Science AREN enhancement and extension project will work together to ensure that 'end-to-end' connectivity exists from the site of the ASKAP, through Geraldton to Perth. From this link, the AREN will enable connectivity and transfer of the research data on to other Australian researchers, and to global researchers via AREN's international links. The link will also capture and support education and research sites along the link including the Geraldton University Campus and Edith Cowan and Curtin Universities.

The Super Science AREN enhancement and extension project will also support backbone capacity extensions from Perth to Adelaide and will fund connectivity extensions on the Perth Metropolitan Ring, linking all education and research sites in Perth and the Pawsey High Performance Computing Centre for SKA Science to the east coast of Australia via Adelaide.

The capability provided by investments into the NBN and AREN will allow Australia to offer a cost-effective solution to the massive data transport requirements of the SKA. This is a significant advance in proving the feasibility of the project and highlighting the already significant scientific and logistical advantages of the Western Australian site.

Questacon interaction with research and development

Questacon has been working with a number of significant organisations to promote science and technology within Australia and to increase the interaction between research and development organisations and the general community.

For example, Questacon can provide avenues for the government to engage the science community in nation building projects such as the SKA project. Questacon currently has responsibility for the maintenance of www.ska.edu.au, an interactive website identifying the opportunities, goals and challenges of the SKA project.

Through its use of video conferencing technologies, Questacon has also been providing teachers, students and regional communities access to scientists in world leading research facilities. These scientists are located across multiple disciplines and locations, including

those working with the Large Hadron Collider[30] at the European Organisation for Nuclear Research (CERN)[31]; Arctic and Antarctic scientists participating in the global Polarpalooza event in Canberra and in the field in Antarctica; and Cooperative Research Centres in the field of robotics.

Through partnerships with other Divisions of the Department of Innovation, Questacon is providing avenues to engage communities with "big science" such as raising awareness of the SKA project.

The direct connection between schools and scientific experts in Australia and overseas is enticing students to engage in science and potentially take up careers in science, technology, engineering and mathematics.

National Measurement Institute and SKA

In addition to applying its expertise to meet the measurement needs of Australian industry, NMI undertakes leading-edge research into new techniques to disseminate reference standards with higher accuracy and precision.

The NMI is a partner in a large collaboration funded by the Australian Research Council entitled 'Creating a national time and frequency network for Australia'.

Although atomic clocks have reached extraordinary levels of accuracy and stability over the last decade, the ability to *distribute* time information has not developed at the same rate.

However, recent advances in precision laser frequency measurement offer the potential to distribute time and frequency information using laser light transmitted through optical fibres over long distances with a precision around 1000 times better than currently possible.

In collaboration, the NMI and other participating partners expect to develop these techniques for use in Australia, to disseminate accurate time and frequency information and enable access by end-users anywhere across a long-range fibre network.

There are strong synergies between this project and the national reach of the NBN, which could apply these techniques to disseminate timing at new levels of accuracy across the entire nation.

A long-range fibre network disseminating time at very high precision will provide a significant resource in support of major national research projects. The most significant is Australia's bid to host the SKA radio-observatory, one of the largest and most ambitious science projects ever devised.

The NBN will already provide support for the SKA bid, which would be significantly enhanced by the additional provision of high-accuracy timing across the network.

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[30] The Large Hadron Collider (LHC) is a particle accelerator used by physicists to study the smallest known particles. It is a gigantic scientific instrument near Geneva at the European Organisation for Nuclear Research CERN, where it spans the border between Switzerland and France about 100 m underground.

[31] CERN is one of the world's largest and most respected centres for scientific research focused on fundamental physics. CERN hosts the world's largest and most complex scientific instruments and promotes international co-operation focused on achieving four goals: Research: seeking and finding answers to questions about the Universe; Technology: advancing the frontiers of technology; Collaborating: bringing nations together through science and Education: training the scientists of tomorrow.

A second example is AuScope[32], a major collaboration for earth-science research, where improved timing enables improved resolution in tracking the continental drift of the Australian landmass.

Research Workforce Strategy

The Australian Government is currently finalising a Research Workforce Strategy (RWS) to ensure Australia is well placed to meet the future demand for research skills in an innovation economy. The RWS development process was anchored by the Department of Innovation over 2009 and 2010.

Consultations with the ICT sector during the RWS consultation process noted that ICT and associated ICT skills are important enablers of a wide range of cutting edge research. Greater ICT capability also enhances interconnectedness between researchers within Australia and promotes greater 'virtual' collaboration beyond Australian shores.

As such, the Department of Innovation is supportive of efforts to improve access of Australian researchers to high-end ICT infrastructure, such as proposed under the National Broadband Network.

Cooperative Research Centres

The Cooperative Research Centres (CRC) Program supports end-user driven research collaborations to address clearly articulated, major challenges facing Australia, many of which are global challenges.

Since the inception of the CRC Program in 1991, 190 CRCs have been funded or approved for funding. The Australian Government has committed more than $3.4 billion in CRC Program funding. Participants in CRCs have committed a further $11 billion in cash and in-kind contributions.

There are 42 active CRCs that operate across four broad ANZSIC industry categories: agriculture, forestry and fishing (11 CRCs, 26 per cent), manufacturing (five CRCs, 12 per cent), mining (four CRCs, 10 per cent) and services (22 CRCs, 52 per cent).

The nature of the research that many CRCs undertake, such as the CRC for Spatial Information, eWater CRC and the Antarctic Climate and Ecosystems CRCs, require the capacity to deal with high volumes of information input and complex computer modelling systems. The AREN has enabled such research to be undertaken, however, as our use of, and reliance on, large amounts of data grows rapidly, the NBN is anticipated to become essential to support such activities.

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[32] AuScope Limited is a non-profit company formed to facilitate the implementation of a world-class infrastructure system for earth science through the delivery of a range of technologies and capabilities in data acquisition, management, modelling and simulation across the geospatial and geoscience spectrum. AuScope was awarded $42.8 million in 2007 under the National Collaborative Research Infrastructure Strategy (NCRIS) and brings together 23 participants including CSIRO, Geoscience Australia, 11 universities, and state government agencies. In addition to its NCRIS funding, over $70 million in co-investment has been committed by the participants in AuScope.

In addition to the current computing requirements, a number of CRCs are specifically working to develop outcomes for all Australians that are designed to be delivered on broadband platforms. Examples include:

- In 2009-10 technologies developed by Smart Services CRC, Immersive Services iSee technology and their aged care Keep in Touch technology – were selected to be showcased as part of the NBN launch in Tasmania and as part of an extended NBN Testbed trial by the NSW Government.
- In December 2010, the Minister for Innovation, Industry, Science and Research, Senator the Hon Carr announced funding of $27.5 million to the CRC for Young People, Technology and Wellbeing which aims to improve the mental health and well being of young people aged 12 to 25 years through the use of technology and will also provide the first consolidated Australian data on young people's technology use, through an online knowledge hub for researchers, policy-makers and the community.

The research organisations and end-users of the majority of CRCs are geographically dispersed across Australia and rely heavily on an effective ICT infrastructure to undertake research and utilise research outcomes. CRCs operating in remote locations, such as the CRC for Remote Economic Participation headquartered in Alice Springs, are particularly dependent on robust systems to effectively deliver their program outcomes.

The proposed NBN will significantly benefit the CRC Program and the CRCs and enable them to address major challenges and develop innovative solutions in health, education and the environment.

Investments in ICT Industry Development

In 2010, the Australian and Victorian Governments provided a financial incentive to IBM Australia to establish a Global Research and Development Laboratory in Melbourne. IBM has stated that a significant factor in its decision to site the Laboratory in Australia was the Government's commitment to the establishment of the NBN. The Australian Government's contribution to the laboratory is administered by the Department of Innovation.

At the launch of the initiative, former IBM Managing Director Mr Glen Boreham stated that the Laboratory was the most significant investment IBM has made in Australia since it commenced operations in 1932 while stressing that "delivering these types of real solutions is without question enhanced by Australia rolling out a ubiquitous high speed broadband network …" and "this will underpin our ability to deliver solutions that will be available in regional and rural Australia in the remote parts of our country."

IBM is one of the world's leading ICT corporations with a pre-eminence in computing capability. IBM is a leader in promoting a 'smarter world' – the application of ICTs to link sensors and analytics to deliver efficiencies and solutions to problems in such areas as water, energy and traffic management. These smart systems rely on fast and ubiquitous communication systems such as the NBN.

The IBM Laboratory will contribute to IBM's smarter world efforts and undertake research aligned with the Australian Government's National Research Priorities.[33]

[33] The National Research Priorities include: an environmentally sustainable Australia; promoting and maintaining good health; frontier technologies for building and transforming Australian industries; and

High performance computing is required for virtually all research. IBM has acknowledged that the NBN will provide an important test bed for IBM's real time instrumentation, monitoring and optimisation technologies that can be used in a range of areas including e-health, water and energy management and natural disaster responses.

Dr Robert Morris, Vice President - IBM Research, has highlighted that there is a *"need to understand data in flight as opposed to at rest"*. The delivery of this type of real time data for smart systems – stream computing capability handling large amounts of data – relies on fast, ubiquitous and high capacity broadband.

The IBM Global Research and Development Laboratory has the potential to develop new applications and services and demonstrate the contribution the NBN it will make to innovation, the growth of new industries and solutions to local and global challenges.

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safeguarding Australia). More detail is available at http://www.innovation.gov.au/AboutUs/KeyPublications/PortfolioFactSheets/Documents/NATIONAL-RESEARCH-PRIORITIES.pdf

8. Facilitating Community and Social Benefits

Supporting Telework

The Department of Innovation supports telework enabled by broadband networks as part of its business continuity arrangements.

The Department's Business Continuity Management Plan 2009-10 includes the requirement to:

- acquire, configure and test any information and communications technology (ICT) equipment required for home based or alternate site accommodation outside head office;
- maintain the operations of switchboards (management of calls and setting up teleconferencing) in workplace buildings; and
- be prepared to support additional and/or alternate information technology requirements during a continuity situation.

The NBN has the potential to facilitate community and social benefits through supporting telework. Home-based teleworkers save time and costs by not travelling to work which, among other benefits, reduces road congestion and carbon emissions.

Access Economics also cites greater job satisfaction among employees as beneficial given that teleworking demonstrates flexible working arrangements. With a growing ageing population, teleworking also enables carers to undertake employment.[16]

For employees, telework provides them with the flexibility to work anywhere anytime. In 2006, an internal IBM study assessing their own workforce mobility policy reported that over 70 per cent of employees felt that working remotely positively enhanced their work/life balance, improving productivity, morale and motivation. In terms of retention, the flexibility of working from home resulted in a 96 per cent return rate from parental leave.[34]

An internal survey found that about 14 per cent of Westpac's 40,000 work force occasionally work from home while 78 per cent of IBM employees said they worked in a team where it was considered acceptable to work from home.[35]

Continuing operations during emergencies (for example, snowstorms and terrorist attacks) is an area of focus in the United States where telework is considered well advanced[36]. In Australia, telework is seen as a means of enabling employees to work throughout adverse events including epidemic threats (for example, the H1N1 virus in 2009) or transport failures.[16]

Chapter 5 and 6 in this submission provide further context on the relevance of the NBN to teleworking from the perspective of benefits to regional economic growth and home-based businesses.

34 IBM, 2006. Work Force Mobility. Presentation.

35 Australian Financial Review Corporate culture switches on to flexibility 4 March 2011.

36 federaltimes.com, Stephen Losey, 'Obama signs bill to increase telework', 9 December 2010.

9. Optimal Capacity and Technological Network Requirements

Networking requirements

The Australian Government, via its wholly owned company NBN Co Ltd (NBN Co), will design, build and operate a national broadband network, the NBN. The NBN will be a wholesale-only open access high speed broadband platform intended to provide all premises with access to a high speed broadband Internet connection via retail Internet service providers.

NBN Co proposes to service 93 per cent of premises with a fibre-based network, with the remaining seven per cent to be serviced by wireless (four per cent) and satellite (three per cent) connections, subject to final design. The decision to employ satellite and wireless systems is driven by the prohibitive costs of establishing fibre-based networks in regional or remote areas of Australia.

It is vital that in making an investment of the scale of the NBN, the Australian Government strives to future-proof the technology. There are a range of existing technologies already delivering broadband access to many Australians, including shared access technologies such as that provided by wireless.

In discussing these technologies, Professor Rod Tucker[37] from the University of Melbourne notes that "*the electromagnetic spectrum used by wireless is limited, and as more users share the available wireless spectrum, the experience of all users is degraded.*"[38] He goes on to refer to some wireless carriers touting rates of up to 50 Mbps, but points out this is achievable only if no-one else is using the spectrum. In this instance, the only option to increase the capacity of the technology is to build many more towers, which may not be acceptable for many people.

Another shared access technology that Professor Tucker highlights is hybrid fibre coax (HFC), which is the technology used by Telstra and Optus for approximately 2 million homes in Melbourne and Sydney. However, he goes on to point out that again, *"in HFC networks, the available bandwidth on the coaxial cable is shared by a number of users in the street. The more people using the network, the lower is the bandwidth per user."*[39]

The alternative is a direct access technology such as Asymmetric Digital Subscriber Line (ADSL) which is a technology for transmitting digital information at a high bandwidth on existing phone lines to homes and businesses. However, ADSL is by its nature asymmetric, using most of the channel to transmit downstream to the user and only a small part to receive information from the user.

ADSL is therefore not suited to many emerging technologies, and changes in business activities which will see individuals needing the ability to upload as well as download large volumes of data. Indeed, symmetry is required for many of the 'real time' applications.

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[37] Rod Tucker is a Laureate Professor at the University of Melbourne. He is Director of the Institute for a Broadband-Enabled Society (IBES) and Director of the Centre for Ultra-Broadband Information Networks (CUBIN), in the University of Melbourne's Department of Electrical and Electronic Engineering.

[38] http://www.computerworld.com.au/article/357039/professor_rod_tucker_access_technologies_broadband_policies/

[39] As above.

The other direct access technology is fibre to the premises (FTTP), which is the technology at the basis of the Australian Government's proposed NBN. As Professor Tucker explains, *"the FTTP network is based on a gigabit passive optical network (GPON) technology delivering a dedicated 100 Mbps[40] to the home. A fibre from the telephone exchange is connected to a user modem in each home, and the modem is connected to the home network."*

The important point with this technology is that "*the capacity of FTTP is virtually unlimited. In fact, the capacity of a single optical fibre is more than 10,000 times the capacity of the entire wireless electromagnetic spectrum*."[41] This implies that FTTP, which will operate alongside wireless technologies, is the logical, future-proof technology for a national network.

Australian industry participation

The proposed satellite system will consist of two to three geostationary satellites, eight ground stations, and a transceiver (small satellite dish) installed at each end user premises. The system, known as NBN Co Satellite Access Service (NSAS), will provide data transfer speeds of 12 Mbps as opposed to the 100 Mbps of the fibre network.

Current telecommunications satellites servicing remote and rural Australia which are owned and operated by Optus are not capable of providing the required 12 Mbps data transfer rate. Thus NBN Co plans, via a third-party satellite operator, to build and operate two to three dedicated satellites as part of the NBN. In January 2010, NBN Co issued a Request for Capability Statement for Satellite Services.

On 17 August 2010, NBN Co stated that it had started industry consultations on its plans for wireless and satellite products, and called for formal submissions in response to its satellite product overview. It is understood that more than 10 international and domestic satellite operators have made submissions to NBN Co, but only a handful are considered to be serious contenders.

It is understood that Optus, Intelsat and Hughes Network Systems are among the few being considered and a request for proposal (RFP) was due to be issued by NBN Co in November 2010. However, to date no RFP or tender has been issued regarding NSAS; and it is unclear if an Australian Industry Participation Plan is required with these submissions.

The satellites that will be built as part of the NBN will make Australia one of the first areas in the world with third generation satellite technology. It is noted that the proposed satellites will be dedicated to broadband service; other capabilities such as earth observation, navigation or other communications services will not be directly included in the satellites' functions.

This Australian Government investment can provide opportunities to develop and enhance Australian capabilities and stimulate various sectors of the Australian industry, such as those companies who can develop ground based equipment, communication devices, and direct-to-home equipment and installation. Efforts should be made to ensure Australian industry participation in these projects.

The NBN through the Regional Backbone Blackspots Program (RBBP) is currently supporting regional communities during its construction phase. For example, civil

[40] Mpbs – megabits of data per second
[41] http://www.computerworld.com.au/article/357039/professor_rod_tucker_access_technologies_broadband_policies/

engineering on the Perth to Geraldton route will be undertaken by Visionstream and Ngarda Alliance, a West Australian based Indigenous engineering services firm specialising in civil and mining projects. The involvement of Ngarda Alliance in this project will deliver important employment and training opportunities for a number of Indigenous staff.

National Measurement Institute

The implementation of reference timing and dissemination services (outlined in Section 1) would naturally impact on the core technological requirements of the NBN. The capabilities and experience of the NMI are available, on a cost-recovery basis, to support extensions to NBN timing infrastructure and services. NMI can also prepare specific advice relating to timing and associated implementation issues to assist with educating the wider marketplace as required.

Continued delivery and enhancement of services delivered by Questacon

Questacon's requirements of a national broadband network is for an affordable, high availability, high speed, low latency environment in which multiple transmission pathways can be undertaken to reach the specific target audiences.

A guaranteed five to ten percent of network bandwidth for educational material or a greater Quality of Service on network traffic related to video conferencing or educational material would provide the necessary safeguards for Questacon to continue to provide high quality science based educational material.

Access for the educational facilities is vitally important with appropriate concessions for high volume usage and business hour availability.

10. Conclusion

This submission, which provides comment on behalf of the Department of Innovation, Industry, Science and Research, indicates that there is a high level of portfolio interest in the development of the NBN.

Over the broad range of activities that the Department of Innovation administers, the NBN is seen to be relevant to, and supportive to varying degrees of, the role that the Department plays in fostering innovation.

There are numerous specific areas of activity to which the improvement and enhancement of broadband provision would bring benefits, challenges or change in practice, including in: space policy; earth observation; electronic health; support for Australian business and particularly small business; among others.

In addition, some of the work of the portfolio is complementary to the development of the NBN. For example, developments in high-bandwidth research networks, through the Australian Research and Education Network (AREN), complement and rely on proposed developments in the NBN. The work of the National Measurement Institute, a division of the Department of Innovation, in maintaining Australia's primary standard for time, also has relevance for the development of the NBN.

In short, the Department of Innovation considers that the development of the NBN presents critical, enabling, infrastructure to support many of its programs and activities.