Institute for a Broadband-Enabled Society
response to the
House of Representatives Standing Committee on Infrastructure and Communications Inquiry into the National Broadband Network

IBES
Institute for a
Broadband-Enabled Society

THE UNIVERSITY OF
MELBOURNE

www.broadband.unimelb.edu.au

Victoria Alcatel·Lucent CISCO HUAWEI ERICSSON 'yes' OPTUS NICTA aarnet OptiComm anue Haliplex NETGEAR Allied Telesis Microsoft PBN ttu Clarity NEC WB

Introduction

This paper is IBES' response to the House of Representatives Standing Committee on Infrastructure and Communications inquiry into the National Broadband Network. This paper will address the following criteria as outlined in the Inquiry's terms of reference:

- Interaction with research and development and related innovation investments
- Improving the educational resources and training available for teachers and students
- Achieving Health Outcomes
- The management of Australia's built and natural resources and environmental sustainability
- Facilitating community and social benefits
- The optimal capacity and technological requirements of a network to deliver these outcomes

About the Institute for a Broadband-Enabled Society (IBES)

IBES is a cross-disciplinary research institute dedicated to innovations in products, services and end-user experiences that maximise the benefits of new broadband technologies to Australian society. Research at the Institute focuses on a wide range of fields including education and learning, health and wellbeing, network deployment and economics, service and business transformation and social infrastructure and communities.

The Institute was founded in July 2009 and is jointly funded by the University of Melbourne and the Victorian State Government, through the Department of Business and Innovation (formerly Department of Innovation, Industry and Regional Development).

Interaction with research and development and related innovation investments

The National Broadband Network provides an enormous opportunity for innovation, providing a platform for applications that can assist in tackling many of Australia's most pressing issues. These include: the ageing population, the rise in youth mental health conditions, skill shortages in regional areas, monitoring and managing the environment, and ensuring equity of access to services including health and education. Addressing issues of this scale requires a collaborative effort between all tiers of Government, industry and the research sector. IBES is proactively developing these partnerships to respond to these challenges.

An important part of the Institute's activities is the Industry Partner Program. The program has 19 members comprising a range of multinational telecommunications equipment vendors, ICT companies, telecommunications service providers, Australian small and medium enterprises and research organisations. In the first year of operation IBES received $764,000 in cash and in-kind support from its Industry Partners. This figure is expected to double in its second year.

Additionally, through IBES the University of Melbourne has partnered with Alcatel-Lucent's research arm Bell Labs and the Victorian State Government to establish the $10 million Centre for Energy-Efficient Telecommunications. The Centre's research focuses on a broad range of telecommunications network infrastructure and its elements exploring how those elements can be made more energy-efficient.

Research at the Institute focuses on new applications that make use of high-speed broadband in different sectors, as well as quantitative, qualitative and ethnographic research that increases the understanding of end user behaviour. To date IBES has received $3.7 million cash and in-kind to support a range of research activities across its five research themes. One hundred and forty-four researchers from 28 departments at the University of Melbourne are actively engaged in 56 research projects. Researchers are collaborating with external organisations including: NICTA, VeRSI, University of Tasmania, Monash University, Swinburne University, Defence Science and Technology Organisation, and University of California San Diego. The Institute is actively supporting the next generation of researchers through the provision of ten PhD top-up scholarships.

IBES Test Bed

IBES has established a state-of-the-art broadband network test-bed laboratory. The test-bed enables researchers to trial new ideas and innovations in a real-life networking environment. Researchers can perform experiments, ranging from configuring broadband applications vertically through the technology stack through to assessing end user reactions to new services and applications. The equipment has largely been donated by Industry Partners and IBES is particularly grateful for this support.

Details of IBES research projects that are relevant to the terms of reference of the inquiry are detailed below exemplifying some of the research underway at the University of Melbourne that relates to broadband applications and usage.

Improving the educational resources and training available for teachers and students

Ubiquitous high-speed broadband provides a way to build the capacity of teachers, students, and the wider community through increased access to learning opportunities and choices. High-speed broadband has the potential to provide learners with a range of educational opportunities beyond their local environment, which is particularly beneficial to regional communities. Connectivity will enable students in different settings from primary and secondary schools, TAFE, tertiary institutions and in workplaces to access a range of classes and develop skills. These experiences can enhance compulsory learning activities throughout school years, and professional learning throughout adulthood. Additionally, high-speed broadband can help peers connect, collaborate and learn in new ways. IBES is actively involved in researching and developing applications that realise the benefits of high-speed broadband in learning and education.

Education and Learning

The IBES project *Connecting learners* is developing a prototype system that will bring together several broadband technologies to facilitate collaboration between diverse groups of students and their teachers. Three sub-projects are investigating how collaborative student groups can be established and maintained in broadband-enabled learning environments, by connecting:

- Primary schools in remote and rural locations with urban school children
- Aboriginal students in Fitzroy Crossing (WA) with non-Aboriginal Australians in metropolitan Melbourne
- Teachers and students from primary schools in Victoria with sister schools in Japan, Indonesia, Korea and China.

The prototype is expected to facilitate shared resources to enable collaboration between teachers, as well as provide mechanisms for cultural exchanges between students from different demographics.

Connectivity can also assist students from the same school. The *In school but not at school* project team at IBES is developing a prototype orb based on ambient technology that provides a connection between children admitted to the Royal Children's Hospital in Melbourne and their peers in their school community. The technology is aimed at younger students and it is anticipated that it will provide continuity of education for some of the approximately 10,700 children who are admitted to the Hospital every year.

Prototype Orbs

The use of 3D technology has the potential to impact on education opportunities. While the use of flight simulators to train pilots has set the benchmark for virtual reality training, developments in 3D visualisation and accessibility to high-speed, ubiquitous broadband services will enable students from a wide variety of disciplines to develop their skills. This could be achieved individually or through guided instruction. The *3D virtual reality* training research team is investigating the use of fully immersive 3D virtual reality environments in education and training. Potential uses for this sort of system are enormous and could include any activity whereby people are required to use tools or machinery. However research in this project is specifically focused on assisting new surgeons learn their technique.

The potential of broadband to transform tertiary education is also very real, and readers should refer to the separate submission provided by the University of Melbourne to the review. IBES researchers in collaboration with Ericsson have developed and demonstrated a prototype platform called *Uni TV*. Uni TV brings together a huge variety of both existing and newly created customised content from across the University of Melbourne and combines them with interactive applications such as shared learning environments, and virtual workspaces. New content development can harness the potential of 3D technology in learning, through the visualisation of molecular structures, artefacts and designs. End users could be educators, learners, researchers or the general public.

Demonstrating 3D Virtual Reality Training and Uni TV

Making data more accessible

Ubiquitous high-speed broadband facilitates access to large amounts of data, including valuable databases, through the public internet or private intranets. While it must be recognised that some data sets for research purposes are simply too large to regularly move around on the internet, there are many others that can be made available that will seed new opportunities, in research or otherwise. There are many databases of valuable information that are not currently easily accessible, either because they are not online, or searching is too cumbersome. Researchers at IBES are investigating ways to make particular datasets more easily accessible to a variety of end users.

The Digital Panopticon: Convict Founders & Survivors of Tasmania research project is using broadband technology to showcase one of Australia's great archival treasures. The Tasmanian convict records are considered to be of such international importance that in 2007 they were inscribed onto the UNESCO memory of the World Register. They contain information of interest to academics working in the field of history, demography and epidemiology; family historians; schools and other educational users, heritage sites and the wider tourism industry. Traditionally, hard copies of the records could only be accessed at the Tasmanian Archives. IBES researchers are collaborating with the University of Tasmania to develop a state of the art indexing and retrieval system that will enable easy access to the convict record datasets.

Another IBES project, the *Distributed international language museum* is building an online network of language collections. The project will form the basis of a networked virtual museum of human languages enabling previously unavailable language collections to be made public for the benefit of the research community and beyond.

Achieving Health Outcomes

Ubiquitous and high-speed broadband has the potential to dramatically transform the health care sector. The application of video-conferencing, sensor networks and enhanced information management systems can drive productivity growth in hospitals, general practice and support patients in their home. The potential for innovation in this sector is enormous and much research is taking place across the world in the broad area of e-health. Research at IBES is focused on four areas: ageing well, youth mental health and wellbeing, tele-health and electronic health records. Additionally, IBES is supporting research leadership in the emerging field of personalised or precision medicine, where advanced diagnosis and therapy in complex diseases such as cancer can benefit from specialists' and researchers' ability to rapidly process large volumes of human genomic data.

Ageing Well

Like many countries around the world, Australia is facing an ageing population that has the potential to place significant stress on the health care system. However, the use of broadband technologies can play an important role in ageing, promoting health and wellbeing that could help reduce the stress. The IBES research project *Smart homes for the elderly* is examining how South Korea is implementing ICT enabled technologies in 'silver towers' – high-rise apartments targeted specifically at the ageing population – to assist with the promotion of health and wellbeing of residents. IBES researchers are investigating the changes in design and patterns of use of smart technologies by residents of silver towers.

Broadband can also be used to overcome social isolation, a common concern for many elderly citizens. A Victorian Department of Planning and Community Development Report found that there were over 50,000 socially isolated Victorians over 65 years old and predicted this number will increase to 75,000 by 2020, a growth of 46 percent. Ubiquitous high-speed broadband has the potential to connect socially isolated people throughout the community. The IBES project *Mobile and broadband technologies for ameliorating social isolation in older people* is developing a prototype system that will address key aspects of social isolation.

Youth Mental Health and Wellbeing

In Australia, mental disorders (led by depression) account for more than 50% of the total disease burden for young people aged 12-25. Only a minority of young people who experience depression receive an intervention, and of those who do, few receive the best available, evidence-based treatment. While there are a lot of online resources available for youth, including those who are isolated there is little understanding of what such young people want or need in terms of treating mental illness.

The research underway at IBES aims to develop a new understanding of how broadband-enabled technologies can be used by different groups to meet the mental health and wellbeing needs of isolated youth. Researchers are collaborating in a *Youth Mental Health and Wellbeing Online* cluster to develop a prototype interactive system that addresses specific end-user needs. Four sub-projects are investigating the use of the prototype system for youths with mental health issues resulting from isolation (due to a physical disability or geographical location), through to illnesses such as psychosis or depression.

Electronic Health Records

The health sector is an information rich environment, in which the medical profession has traditionally controlled both access to and the form of information. Health data is currently stored in multiple places, often 'siloed', and has the challenge of privacy, data accessibility, comparability and initial collection. The advent of ubiquitous and high-speed broadband will allow sharing of patient information rapidly between sites, and allowing clinicians to access real time data during a patient consultation. It will also enable patients to interact with their health information through the implementation of Electronic Health Records (EHR). An individual, personally controlled EHR was proposed in the National E-Health Strategy and in the National Health and Hospital Reform Commission recommendations. Patients will have the ability and will be expected to be custodians of this information and will access it anytime they need from anywhere in Australia.

A research cluster at IBES is investigating different aspects of the implementation of *Individual Electronic Health Records*, including ethics and governance issues relevant to the rollout of IEHRs, the development of personalised interface for patients, and a prototype multi-site IEHR decision-support tool. The multi-site immigrant health database and decision support tool, clinical viewer and personal patient record prototype is being developed to improve clinical outcomes for immigrants and refugees in Victoria, and relies on broadband infrastructure in order to function. It will provide point of care decision support to clinicians, improve follow-up of patients, and permit practice evaluation and clinical research with the ultimate goal of better health and health services for this patient group. It will also enable improved sharing of information with patients, with the expected outcomes of increased understanding of and adherence to treatment and greater health system efficiency.

Tele-Health

Tele-health is often cited as a use of high-speed broadband and there is strong evidence to suggest that the use of video conferencing can assist and enhance medical outcomes, particularly for patients who have difficulty accessing specialist medical care, for example those in regional areas. IBES' tele-health program exemplifies some of the specific applications of tele-health across a range of medical disciplines.

One area where IBES research has demonstrated the power of tele-health is in the treatment of stroke victims. Stroke is a major cause of morbidity in Australia with the National Stroke Foundation estimating there are 48,000 strokes annually in Australia with a risk of death being 25 to 30 percent. Of those who survive stroke contributes to 25 percent of chronic disability in Australia. Treatment of stroke is time critical.

In 1997 a landmark 'clot busting' drug was introduced to Australia. Due to the risk of serious side effects, only a stroke neurologist can prescribe this medication. The National Stroke Foundation estimates that seventy-two percent of Australian hospitals are unable to provide acute stroke treatment. The *Telestroke* pilot study is demonstrating the feasibility and effectiveness of a remote consultation system between a comprehensive stroke centre at the Royal Melbourne Hospital and a rural hospital in Wangaratta. To date, 93 patients have been enrolled in the study. Of these patients, 20 were assessed with the telestroke system and nine of these were administered the 'clot busting' medications with an average treatment time of 82 minutes.
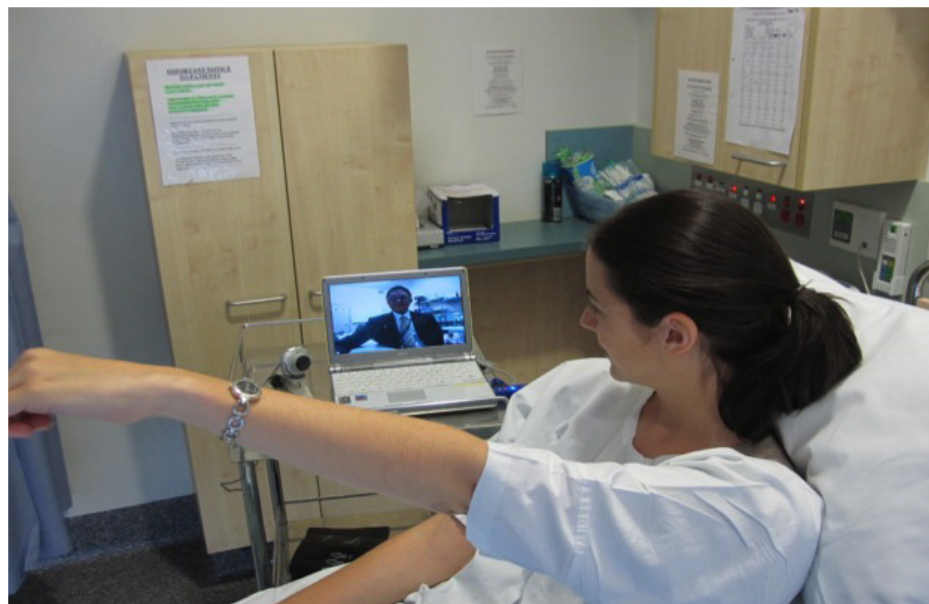

Telestroke study

IBES researchers are also investigating the use of *Haptic tele-rehabilitation* for stroke recovery. Haptic devices provide sensory feedback between two people in different locations, enabling them to share the sense of touch. Through the application of broadband technologies, haptic devices can provide alternative rehabilitation methods for stroke survivors. This project is developing a low-cost in-home tele-rehabilitation system to assist stroke patients in the rehabilitation process. The prototype system consists of a robotic platform on which the patient places his or her arm, and a simple rehabilitation software program that provides exercises with various degrees of difficulty. Clinicians can interact with a patient via the Internet, which allows them to monitor and change computer-based movement tasks according to the patient's performance and needs.

Haptic Tele-rehabilitation device

There are many applications for tele-health beyond stroke recovery. A research team at IBES is *Investigating the acceptability of webcam consultations for young adults' sexual health*. Many barriers exist to young people accessing sexual health care, particularly for people living in rural and remote areas. Barriers include limited options around medical providers, lack of confidentiality, limited bulk billing, and lack of transportation. A possible solution to decreasing these barriers is the use of webcam consultations, allowing people to access sexual health specialists from their own computer. The National Broadband Network will make such webcam consultations in rural areas a viable option by offering high-speed connectivity across the nation.

Tele-health also has applications in dentistry. The IBES project *Concordance between real-time teledentistry assessments and face-to-face examination* is investigating whether improvements in accessibility and appropriateness of oral health services can be achieved by using broadband technologies to screen for oral disease in older people living in residential aged care facilities. Face-to-face patient examinations are regarded as the most accurate method for correct oral health diagnosis. However, only 11 percent of aged care residents have seen a dentist in the past 12 months. Few dentists provide dental care for residents of aged care facilities. It is hoped that this research will impact on health outcomes for older people with dental issues.

Another example of tele-health is in the use of sensor networks to monitor and manage chronic conditions. The monitoring data provided by sensors can be transmitted using mobile technology, or WiFi networks depending on the size of the data being transmitted. IBES researchers are investigating the use of *Wireless broadband monitoring of knee osteoarthritis*. The project is developing a prototype device that will be integrated with a mobile phone to enable remote monitoring of patients as they undertake typical daily activities. It is expected that real time monitoring over extended periods will enable more accurate assessment of knee joint usage patterns, natural disease progression, and development of more effective interventions.
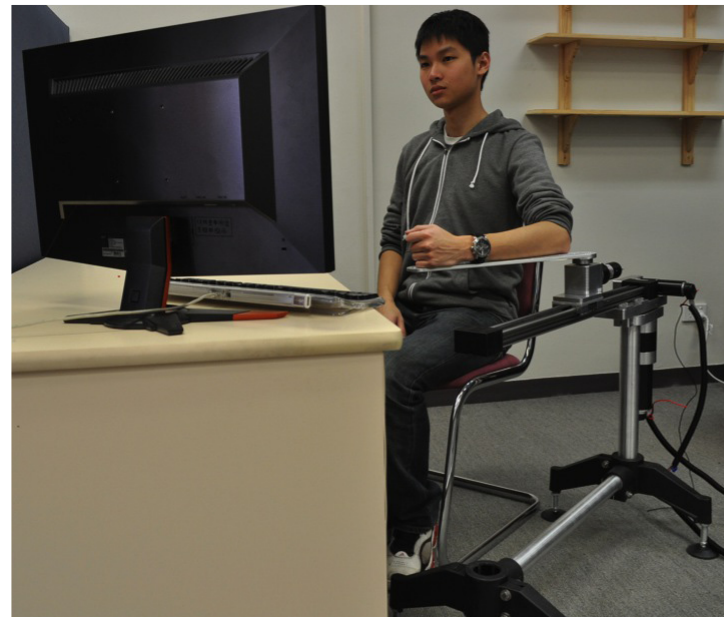
The management of Australia's built and natural resources and environmental sustainability

Broadband technologies have an increasingly important role to play in the protection of built and natural resources. The use of sensor networks to monitor the environment can provide useful feedback to ensure scarce resources are managed in the most efficient way possible. Additionally, high-speed broadband has the capacity to empower consumers to manage their impact in their local environment. The use of sensor networks and broadband technologies are increasingly important in the protection of both built and natural resources, including during disastrous events.

Mitigating disastrous events

Although researchers at the University of Melbourne have already developed a comprehensive risk assessment tool for bushfire disasters in Australia, there is a generally recognised need to upgrade the bushfire detection and early warning services in Australia. Ubiquitous high-speed broadband services can facilitate the transmission of high-resolution on-demand video and images between remotely located places during bushfires both to provide additional information to assist coordination or to disseminate predictions and warnings to the first responders and the public. The *Data Assimilation and Bushfire Modelling for Early and Rapid Bushfire Detection* project underway at IBES is designing an information collection and processing system to accurately detect and identify and alert communities to bushfires before they become a major threat.

Social networking technologies provide the capability to assist in the detection of disastrous events. The IBES project *Early Detection and Mitigation of Disastrous Events with Broadband-Enabled Social Interaction Technologies* is investigating how micro-messaging technologies such as Twitter messages can be harnessed to help identify and provide rapid response in emergency situations, including natural disasters such as floods or bushfires, and accidental or deliberate chemical, biological, and radiological releases.

Protecting water resources

Broadband technologies are increasingly playing a role in the monitoring of utility infrastructure and resources, including water. IBES researchers are investigating the *Gardens of tomorrow in broadband-enabled neighbourhoods*, which is demonstrating the potential benefits of integrating social networks with environmental sensors to monitor conditions in a domestic garden, and provide feedback to the householder on how to adjust the watering schedule in accordance with the garden conditions.

Researchers are also investigating the use of *Online Decision Support for Crop Irrigation*. This IBES project is a part of a larger initiative underway at the University of Melbourne and the Victorian Research Laboratory of National ICT Australia (NICTA) that is focusing on the development of a new online irrigation decision support tool to aid growers make decisions about water usage in horticulture, specifically orchard crops and viticulture. The development of online tools collating information and data sensed in the field will assist growers to undertake important economic decisions and manage their crops effectively.

Facilitating community and social benefits

High-speed broadband is a vital component of contemporary social infrastructure comparable to roads, water and electricity. Broadband availability drives changes in patterns of social interaction across a wide spectrum of activities, ranging from established media platforms such as television to emergent forms of social networking and user-generated content creation. Additionally, high-speed broadband services can assist to address contemporary issues such as; social inclusion and social diversity, improve service delivery to urban, regional and remote communities, and to develop innovative applications which not only find new uses for our cultural heritage, but facilitate new possibilities for user-led innovation.

Understanding the ways people use existing broadband technologies in domestic and community settings is important to Australia's future from a social, technological and economic perspective. Effective, evidence-based policy and policy implementation depends on developing a detailed and improved understanding of Australia's current broadband use. IBES researchers are conducting a longitudinal study of *Broadband Use in the Home*. This study qualitatively monitors the broadband use of eight Tasmanian families, first recipients of National Broadband Network services, over one year.

Broadband can support strategies for social connection and digital inclusion of young people and their families. The *Screen Stories and Community Connections* project examines the way a cohort of young people and their families, drawn from different socio-economic and geographic settings are engaging with new media technologies and broadband services. Understanding these different patterns of engagement will assist policy makers in designing effective support for the technological and socially connected communities of the future.

Broadband networks are recognized for facilitating community connections between end users with the same interests or experiences . The IBES project *Death, Grieving and Memorialisation* in a broadband-enabled society explores how broadband technologies are shaping 'communities of interest' in relation to contemporary social practices around dying. These include the ways that physical memorials to those who have made the ultimate sacrifice in war can engage distant publics through broadband technologies, as well as the creation of digital memorials for communities effected by specific events such as Victoria's Black Saturday Bushfires. Broadband technologies also allow people to shape their own practices of grieving and memorialisation through the preservation of personal pages on social networking sites such as Facebook. Research is needed to strike an appropriate balance between civic and commercial interests in this domain.

Broadband in public spaces

Video screens are an increasingly common part of contemporary architecture and urban space. To date, publicly located video screens have primarily been used for advertising; however the recent development of a new generation of large screens, built in traditional public spaces such as Melbourne's Federation Square, have challenged the assumption that public video screens can only support advertising.

The implementation of high-speed broadband will make a critical difference to public screen infrastructure in two respects. Firstly, they will shift from being stand-alone installations to being conceived and operated as nodes in interlinked network. An example of this is the 19 large screens in the BBC led 'Public Space Broadcasting' project in the UK. Secondly, screens will become active surfaces capable of responding to a new array of inputs, including the movements of those in their vicinity. IBES project *Broadband-Enabled Public Screens: From Display to Interaction* is partnering with Melbourne's Federation Square and Microsoft to explore the use of screens to support a range of proximity-based user interactions. The project is addressing the widely perceived decline of public space by enabling better utilisation of media infrastructure to facilitate public engagement and interaction.

IBES researchers are also examining how universal broadband access in urban public spaces can develop new forms of social interaction and community initiatives through a combination of mobile broadband, Internet-enabled devices, locative media and user-friendly social networking tools. The project *New Forms of Social Interaction through Universal Broadband Access in Public Spaces* is investigating ways in which broadband technologies can effectively promote social interaction in public places, empower community initiatives and bridge the gap between the online world and the urban environment.

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

The projects outlined in this submission demonstrate the breadth of opportunity, and the potential scale of application development. It is important to note that many of the applications outlined here do not require high bandwidth in singularity. However the National Broadband Network should enable multiple applications to work at the same time, in the same way as we expect the electricity grid to supply power to all appliances in the home. It is the combination of applications being used simultaneously that requires high bandwidth.

The increasing use of video, and in particular 3D video is already placing demands on telecommunications infrastructure. As the use of video becomes more prevalent, in sectors such as health and innovation, Australia's broadband infrastructure must be able to support speeds to deliver this functionality.

Work underway at the University of Melbourne has demonstrated that fibre-to-the-premises networks are the most future proof fixed technology available. The next generations of fixed telecommunications networks will continue to rely on fibre optic cable, however much faster speeds will be achieved by improving the equipment in telephone exchanges, and in the home. Wireless technologies are complimentary to fixed networks, however it should be recognised that spectrum is a limited resource and these networks cannot provide the bandwidth of fibre networks.

Additionally, University of Melbourne researchers have demonstrated that fibre-to-the-premises networks are more energy efficient than fibre to the node, HFC (cable) or wireless networks.
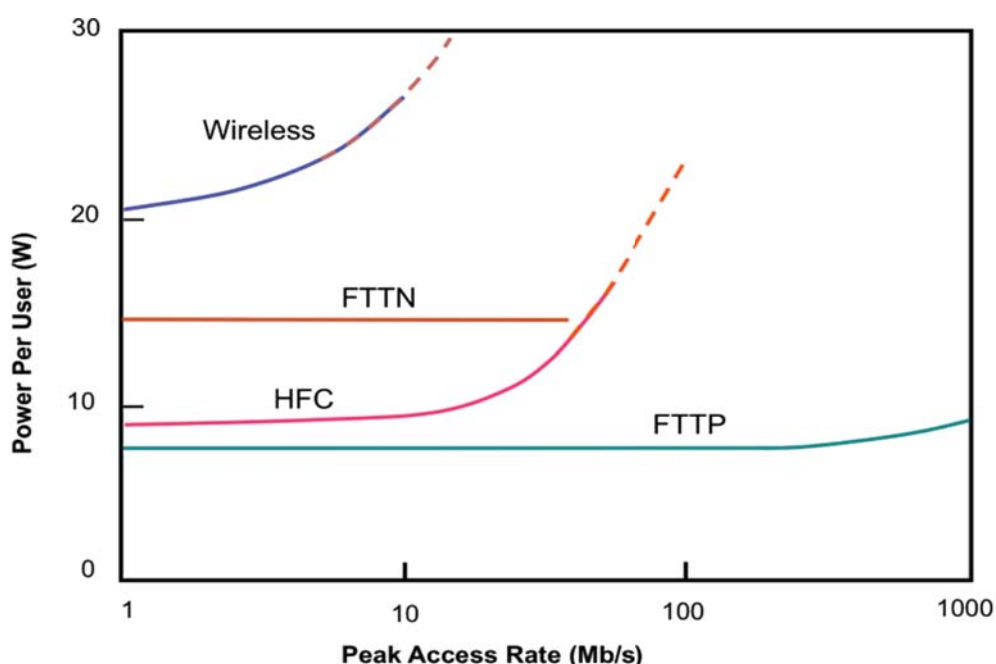
Broadband Power Consumption

Conclusion

This response has outlined how broadband applications can drive innovation and change across a range of industries. The National Broadband Network will provide the infrastructure basis that will shape the delivery of education, provision of health care, management of resources and connect with others. The projects in this response and the attached IBES annual report demonstrate that broadband applications and services have the potential to dramatically drive transformation across the economy.