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INTRODUCTION

Educational institutions have always had a central place in the online age. Before the advent of high-speed broadband, other communications technologies and services also played a big role in education.

University researchers were among the first Australian users of what became known as the Internet. When the domain name system was deployed in the mid-1980s, the .au domain was delegated to Robert Elz at the University of Melbourne. When the Australian Vice-Chancellor’s Committee decided to set up a national communications network to support research, Geoff Huston transferred to its payroll from ANU to work as technical manager for AARNet, whose current chief executive, Chris Hancock, is interviewed by Liz Fell in this issue. When a 56 kbps ARPANET link with Australia was made by NASA and the University of Hawaii via Intelsat in June 1989, the connection was established in Elz’s University of Melbourne laboratory. (Clarke 2004: 31)

In earlier times, the postal service made learning-at-a-distance possible by ‘correspondence’, particularly in remote areas of Australia. Advances in radio communications made it easier and the interactivity more immediate. Television sets and later video cassette and DVD players and recorders made it more visual. The telephone provided a tool of communication for teachers and learners; the best of them understood that most people were both at different times. Then simple low bandwidth tools like email and web browsing provided new ways for students, teachers and their institutions to communicate and distribute and share information. Learning management systems like Blackboard have been widely deployed through the education sector. Information that was once housed in libraries is now available online and social media platforms are providing new ways for students to collaborate. Ubiquitous, faster broadband and mobile access via smartphones and tablets promise further transformations.

At the Institute for the Broadband Society’s annual symposium in late October 2012, the University of Melbourne’s director of eLearning, Gregor Kennedy, identified three features of the contemporary university environment that make communications especially important: students spend less time on campus but more time online; the student population is bigger and more diverse; and educational researchers are encouraging teachers to move away from lectures as a primary teaching tool. Within this environment, the last year or so has seen what Kennedy calls the ‘small explosion’ of ‘MOOCs’, ‘massive open online courses’ run by organisations like Coursera and edX. Coursera was formed a few months ago with original partners including Princeton, Stanford and the University of Pennsylvania, and recently added others, including Brown and Columbia Universities, the Hebrew University of Jerusalem and
Hong Kong University of Science and Technology and the University of Melbourne. Broadband, Communications and the Digital Economy Minister Stephen Conroy recently warned: “universities know if they don't act now they will become irrelevant”.

So what should educational institutions do? Kennedy argues they should try to make smarter use of technology to promote faster, more convenient and widespread access to education, to promote genuine engagement and to do things they couldn't otherwise do.

There are many possibilities. To promote faster, more convenient and widespread access to education, experts can teach classes from a distance. An expert scientist can teach a high school class, or an eminent professor can take a guest lecture. Regional and remote communities can be helped to overcome specialist teacher shortages and be given access to specialist facilities such as ScienceWorks in Victoria that are typically located in or near major cities. ‘Anywhere, anytime learning’ can help people fit study around their jobs, family responsibilities and other interests, rather than being locked into scheduled classes and appointments with teachers and other students. School students can have access to information for homework exercises that is not available in the classroom or the school library.

To promote genuine engagement, ubiquitous high-speed broadband and virtual collaboration spaces can be used for exchanges between students and experts and among students themselves - perhaps between classes that are located in different places or among students working on the same homework, tutorial exercises or assignments. Tele-presence and video-conferencing enable classrooms and lectures to extend across geographic boundaries.

Many applications, supported by ubiquitous fast broadband, enable us to do things we couldn't otherwise do. Visualization tools, such as 3D video, can help students to grasp difficult concepts or view realistic environments. Fully immersive 3D virtual reality environments with haptic or force-feedback capabilities can allow students to practise skills such as surgery or the operation of complex machinery. Smart information systems that sense, collect and integrate data provide new ways to gather information for analysis. Augmented reality applications and interactive ‘serious’ gaming can supplement and complement face-to-face contact. MOOCs allow distant students to take a course offered by an institution they might not have contemplated attending, or in a subject area where they might not meet entry requirements set to maintain enrolment ceilings. Universities that have worked hard to attract fee-paying students to live and study a long way from home are now asking a related question that might seem more familiar to media companies: what needs to be done to attract an ‘audience’? A recent MOOC for artificial intelligence hosted by computer science professor Sebastian Thrun and his colleague Peter Morvig from Stanford University attracted over 160,000 students in a single semester. (Leckhart and Cheshire 2012)

This issue of the TJA focuses on what educational institutions, especially universities, are and might be doing with broadband. The first three articles report on research about particular educational applications. Vetere and others describe a trial of ‘ambient technology’ designed to help school-aged children deal with protracted periods of hospitalization or repeated admissions that can severely disrupt their education. Technologies such as email, blogs and teleconferencing are already widely used and larger hospitals employ teachers to ensure patients’ learning continues. Information and communication, however, is only part of what is needed. This trial used an ambient ‘orb’ to try to create a sense of belonging and a feeling of connection between the hospitalised child and the classroom. Ambient technologies are ‘peripheral, lightweight and aesthetically pleasing’: peripheral because they operate in the background; lightweight in that they are not used for data analysis or decision-making; aesthetically pleasing because they are designed for their setting. The researchers found the ambient orb did help to establish a ‘genuine sense of connection’ and propose further research into the ways ambient presence might support other relationships and longer periods of hospitalisation.

Doube and Salomon report on a science teaching trial conducted using the Adobe Connect web conferencing and collaboration software. ‘Zoo Connect’ was a science lesson developed by educators at Sydney’s Taronga Zoo, delivered to more than a hundred 12-14 year-old
students at two early secondary high schools. Three classroom teachers and three educational officers from the Zoo participated. The research found existing online collaborative tools and learning programs could ‘enhance and extend learning by harnessing communication techniques that are in contemporary use by school children in their everyday lives’, providing strong support for a widespread roll-out of online collaboration tools to classrooms. The main impediments were insufficient bandwidth and teacher resistance, suggesting that teaching and classroom management techniques needed to be revised to accommodate differences in learning paradigms driven by tech-savvy students.

Clarke describes IPTV and some of the possibilities for deploying it more widely in tertiary and school education, continuing professional development and public education, including the ‘Uni TV’ project based at the University of Melbourne. This platform will go live for staff and students in the Melbourne Dental School in 2013, making IPTV accessible at campuses in Melbourne and Shepparton and for home users in the first wave NBN build suburb of Brunswick. The School uses specialist cameras and simulation tools for teaching and patient treatment activities, including microscope cameras; podium cameras which look down on the clinical-tutors’ hands as they demonstrate complex procedures; wide angle cameras that capture dentist-patient interactions; 3D haptics simulation work-stations; and intra-oral dental cameras for tele-dentistry with confined elderly and remote patients. For school-age children, IPTV can help make available a wider range of subjects in outer metro, rural, and remote areas where there are serious teacher shortages. For professionals such as dental practitioners, IPTV can save lengthy and costly travel to city locations for continuing professional development.

Two other papers describe projects that are just beginning. The NBN Virtual School of Emerging Sciences (NVSES) is an initiative of Monash University, Pearson Australia and the John Monash Science School - a select entry school established by Victoria’s Education Department to raise the profile of science education and demonstrate new approaches to science in secondary schools. At a time when interest in high school science continues to decline, leading to a corresponding decline in university science enrolments, these organisations are launching a program for Year 10 students who are passionate about science. Aiming to ensure science is ‘an active exploration of modern insights to modern problems’ rather than ‘just a history lesson’, the program will run from January 2013 to December 2014, providing a variety of social, collaborative and self-directed learning tools to ensure students are challenged and supported by peers and teachers. With access to experts in fields such as nanotechnology and astrophysics, students will have the opportunity to be knowledge creators as well as problem solvers.

Building on more than twenty years’ experience licensing the use of audiovisual programming by Australian and New Zealand educational institutions and the EnhanceTV service it commenced in 2001, Screenrights – the Audiovisual Copyright Society – trialled an expanded service, EnhanceTV Direct, with 21 schools across Australia in 2011. Now being rolled out across the country, the new service provides streamed access to a searchable archive of more than 11,000 education programs that can be viewed at home or at school by teachers and students. The archive is growing by about 100 programs each week. Teachers can create video lessons using all of a program or short extracts and share them with other educators. EnhanceTV Direct is designed to provide content specifically curated for the education market without the need for expensive storage onsite, while ensuring Screenrights’ members - those who make the programs used in teaching - receive a royalty for the use of their work and are therefore encouraged to produce more.

The final two papers explain online teaching and publishing initiatives at universities. Grimley and O’Hare describe Swinburne Online, a partnership between Swinburne University and SEEK Limited that began offering Swinburne University accredited courses in 2012, via learning modules specifically designed for 100 per cent online delivery. These courses are intended to meet the needs of working Australian adults. In the last article, Jock Given discusses two online enterprises based at the University of Melbourne, The Conversation (started in 2011) and The Citizen (which will launch in 2013) with Misha Ketchell, managing
editor of *The Conversation*, and Margaret Simons, director of the Centre for Advanced Journalism, which will produce *The Citizen*.

These articles and interviews are just a small cross-section of the many topics that could be covered under the topic of broadband and education but they highlight the range of challenges and the diversity of responses for learners and teachers everywhere.

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**REFERENCES**


Chris Hancock was appointed in 2004 as chief executive officer of AARNet, Australia’s Academic Research Network that brought the first Internet connection to the nation in 1989. The not-for-profit AARNet Pty Ltd now manages the Australian Research and Education Network (AREN) providing high capacity infrastructure and services to research, education, training, cultural and scientific institutions.

Hancock's previous experience spans senior management positions in the telecommunications sector including as managing director, Optus Wholesale and Optus Data & Business Services (1998-2004); and executive positions at Vodafone Australia, Seven Network and Sarah Lee Corporation.

He holds a Bachelor of Arts (Social Science) degree from Charles Sturt University and a Master of Business Administration (Executive) from the Australian Graduate School of Management. His board positions include as a director of the Institute for a Broadband-Enabled Society (IBES), the Smart Services Cooperative Research Centre, and AARNet Pty Ltd.

Freelance communications journalist, Liz Fell, spoke with Hancock for the TJA in mid-October at AARNet headquarters in Binary House, North Ryde, Sydney.

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**TJA:** What attracted you to the CEO position at AARNet?

**Hancock:** Well, I had been working in the commercial sector. I came from Optus, where I for five years had been running Optus Wholesale and Optus Business and, before that, I was at Vodafone. The attraction was more inquisitiveness at first because AARNet had a lot to do with the development of the Internet in Australia. And I thought it would be interesting because the role didn't have the strong commercial flavour that I was used to at Optus.

**TJA:** Had Optus become SingTel Optus when you joined?

**Hancock:** No, I joined in ’98 when we were owned by Cable & Wireless and then we floated. So in five years we did what people don’t do in 20 years. It was just fantastic: we had an ownership structure, a majority owner, an IPO and then a sale!

**TJA:** And I see that your new employer, AARNet Pty Ltd., has a telecommunications
carrier licence. Do you describe the company as a carriage service provider or as a wholesaler or as an internet service provider?

**Hancock:** We’re a carriage service provider officially. We’re owned by 38 universities and the CSIRO, and we retail directly to our customers. Our customers are shareholders, which makes us an interesting beast!

**TJA:** So the company’s revenue comes from...

**Hancock:** ... our subscriptions that are charged to the universities. That’s how we get our revenue that allows us to re-invest etcetera. They pay for their membership and their traffic and their services generally. As well as that, we have a lot of customers underneath them.

**TJA:** Just leaving aside these customers ‘underneath’ for the moment, what about the Federal government funds or grants you have received?

**Hancock:** We don’t rely on regular government grants of any kind. The big grant we had was in 2003, which allowed us to purchase part of the Nextgen backbone or to build our backbone.

**TJA:** Was that when Brendan Nelson was Minister for Education, Science and Training?

**Hancock:** That’s correct, and this year we have another government program called the National Research Network Project that has led to seven or eight projects for which we will get funding to actually build for the sector. One of those projects is building fibre around Sydney, the Sydney Basin fibre rings, because we previously had the universities and the research and education institutions connected by a Uecomm lease. So we’re now in the process of building three fibre rings around Sydney. That’s an example of one of the grants that we got. There are several others as well.

**TJA:** Which Federal department offered these grants?

**Hancock:** That came from what is now the Department of Industry, Innovation, Science, Research and Tertiary Education.

**TJA:** Quite a mouthful isn’t it! Did AARNet request the funding?

**Hancock:** No, it was part of a review right across the sector talking to all major research players, and out of that review came the need for about eight projects. We gave a lot of input to that review. I call the areas that need work the research and education ‘black spots’.

**TJA:** Were the funds subject to a competitive tender process?

**Hancock:** No, the projects were nominated, and they didn’t all go to us. There were one or two that went to others. In fact, none of them went directly to us. It’s a bit convoluted, but they were contracted through the University of South Australia and awarded to the member communities. For example, the Sydney fibre rings project was awarded to the Sydney universities, and we became the supplier of that. In other words, we’re building that fibre pipe for them.

**TJA:** What were the other projects that received government funds?

**Hancock:** There were eight in all. The second was a Perth fibre ring; the third, which came directly to us, was upgrading our Adelaide to Perth backbone capacity. The fourth was building tails to join our backbone in far North Queensland-Rockhampton, Gladstone, Cairns; the fifth was a Brisbane metropolitan fibre extension on the fibre we already own there to complete a ring; the sixth was some funding that went to VERNet, the state fibre network in Victoria. The seventh was a Tasmanian project to give them some capacity on-island for the University of Tasmania and the CSIRO and to link with the Basslink fibre we...
have; and the eighth and final one was for a project at the University of Queensland called RDSI, Research Data Storage Infrastructure, which is basically about collecting nodes from around the country, and some of that money will also go towards the networking and joining up with high speed optical circuits around the country.

**TJA:** Did this funding package come from the government via Minister Kim Carr?

**Hancock:** Yes, it was when he was the Minister.

**TJA:** Were you personally involved in the actual lobbying for these funds?

**Hancock:** We lobbied into the review to convince that review that these were the right projects.

**TJA:** The capacity required by a research institution like CSIRO must be huge, and I think that NICTA is also a big customer?

**Hancock:** Yes, NICTA is a customer. They are probably the two big research bodies as such.

**TJA:** Then you have a number of other customers in addition to these two big research bodies and universities. Do you call them subscribers?

**Hancock:** We call them customers but they’re members of the network.

**TJA:** And these new customer groups include training institutions or TAFEs and also museums and schools...

**Hancock:** Basically we have four areas: schools, TAFEs, the health precincts, and what we call the ‘culture club’ which is really libraries or the Powerhouse museum or Questacon.

**TJA:** Do you keep track of the precise number of customers or end-users?

**Hancock:** There’s probably a rough figure of a million end-users such as staff and students, but in terms of customers, there’s probably only several hundred I suspect. I actually don’t know the number.

**TJA:** Still, that number must be much larger than when you arrived!

**Hancock:** Yes. The reason we do that, by the way, is because we want to maintain our not-for-profit status and those four areas I have mentioned revolve around and service and collaborate with the university higher education sector. The Bradley review was really one of the drivers for that. It actually drove the inter-connections like TAFEs working with schools and TAFEs working with universities and doing Pathways programs and things like that.

**TJA:** When you arrived at AARNet in 2004 I understand your major role was to lead the implementation of AARNet3...

**Hancock:** Initially, yes.

**TJA:** I have read that you have since built and leased capacity to create one of the largest network footprints in the world with 19 POPs ...

**Hancock:** ... Points of Presence, yes.

**TJA:** Plus some 100 kilometres of fibre. Indeed, I assume the footprint is even larger now since that information on footprints was written several years ago.

**Hancock:** Yes, it probably is more now. We haven’t bragged about it for a while!

**TJA:** Well, you don’t need to brag about it surely?

**Hancock:** No, we just get on and do it. We often sail under the radar a fair bit and that’s not a bad thing. At the end of the day, we’re Australia’s National Research and Education Network. We’re not a commercial organisation that needs to sell. So
when we go to see people who want to talk to us, we’re delighted if they want to join us but we don’t push them if they don’t.

**TJA:** So in implementing AARNet3 or the third generation, you have essentially ‘built’ your own network capacity using backbone fibre from companies such as Nextgen...

**Hancock:** That’s right, we leased Nextgen’s backbone, but we had to connect customers to that backbone and that’s why we built the tails. We started up a division internally that managed the build of fibre from the Parkes Telescope, for example, to our backbone and, because that didn’t pass by the front door, we built the tails. Our biggest tail, which we’ve just finished, is for the SKA [Square Kilometre Array] in Western Australia from Geraldton to Boolardy Station which is some 300 to 400 kilometres.

**TJA:** Did the division that you started actually construct these tails?

**Hancock:** No, when we say we ‘built’ it, we mean that we contracted it out. But we manage all of that, which is no mean feat.

**TJA:** And I think AARNet has leased Telstra’s backbone fibre in the Northern Territory and parts of Tasmania, for instance?

**Hancock:** Yes, bits of that.

**TJA:** I enjoyed reading the book you commissioned, *AARNet: 20 years of the Internet in Australia 1989-2009*, particularly the anecdote about your first board meeting where, asked about your priorities, you replied, ‘GOO ...Get Off Optus’. It reads like there was no love lost there!

**Hancock:** Did we print that? Oh god! Yes. That was a signal that we were really leasing capacity and now we were standing on our own two feet.

**TJA:** Was the reason for getting off the Optus network because of the service or the cost?

**Hancock:** No. That was a big turning point for AARNet because we then became an infrastructure owner. By having a long-term backbone and then building fibre, we didn’t need any longer to just take a service from Optus and pass it on.

**TJA:** But don’t you lease the backbone fibre?

**Hancock:** Yes. It’s a long-term lease though, so I argue it’s like ownership.

**TJA:** Wouldn’t that have been the case with Optus?

**Hancock:** No, I think at that point we were just buying capacity, as opposed to having dark fibre with Nextgen.

**TJA:** So you said farewell to Optus?

**Hancock:** Yes. My head said ‘yes’ but my heart said ‘no’ because I had a great five years with Optus.

**TJA:** By early 2006, I understand that you had 17 contracts to ‘build dedicated dark fibre links to almost all the legs’ in the AARNet network. It must have been a huge exercise?

**Hancock:** Well, we’ve always prided ourselves on being nimble and small. We have about 60 people now, and we had 12 back then.

**TJA:** And someone has to design the network?

**Hancock:** Yes. We have a number of people here, what we call ‘pits and pipe’ type people. They do all that.

**TJA:** In the case of your *alma mater*, Charles Sturt University, which is based in Bathurst and has expanded around regional NSW, it must have been a huge job
to join up all the campuses and coordinate companies like Soul and Transgrid as well as building the tails?

Hancock: Yes, we managed the build of that. Charles Sturt was a great example because of the bringing together of probably between five to eight rural campuses including Albury, Wagga, Goulburn Police Academy, Orange, and Bathurst.

TJA: Is the Goulburn Police Academy a university campus now?

Hancock: Yes, Charles Sturt University took it over and so they needed connectivity. I’m sure you remember the old CAE or College of Advanced Education in Bathurst. In bringing together the CAE as one university, technology is the way to do it.

TJA: Are you a director of Charles Sturt University?

Hancock: I was. I stepped down several years ago.

TJA: In the case of the CSIRO, which is a customer or, indeed, a shareholder. What is the right descriptor here?

Hancock: One of our shareholders, yes.

TJA: Does the CSIRO lead the demand for super-fast broadband links across the country and internationally?

Hancock: The astronomers, for example, really drive that space, but there are many other groups across the country who drive high speed demand too.

TJA: And does the CSIRO use its own funds to pay AARNet for its network?

Hancock: Yes, just like they pay for power and water, they have to pay for their data. If they didn’t have us, they would have to go with a commercial provider. The thing about these organisations is that you can’t really do this on commercial networks because of the nature of research and what we do.

TJA: At a recent ACMA Radcomms conference you argued that innovation flourishes under a research and education approach as opposed to a commercial approach. Were you suggesting it is the public service culture that enables innovation rather than commercial, profit-focused companies?

Hancock: Well, I wouldn’t be that definite, but that’s my view. My view is that particularly universities, and organisations like the CSIRO, drive the innovation agenda. I think that has been shown in technology with Facebook and Google and whatever is coming out of universities like Stanford and MIT. Even the wireless work that came out of the CSIRO was world-breaking when you look at it. So I think we do things with a number of the researchers that allow their community to develop technologically, and we would say that sometimes the commercial world is anywhere between five and seven years behind in terms of whether they commercially put together some of these products.

TJA: I think you said in your Radcomms address that the commercial world tends to offer small pilots to test new technologies which don’t provide enough scale or real world conditions.

Hancock: Yes.

TJA: Why don’t you refer to AARNet as a public service institution rather like the ABC?

Hancock: That is an interesting question. I think you can be a not-for-profit but be commercially focused, and that’s what we are. The expectations of big institutions like universities and the CSIRO these days are that we’ve got to deliver a service with service level agreements for them. I think that AARNet has moved from being a ‘club’ to being a commercial provider for a sector.

TJA: Does the structure of the AARNet board reflect this commercial style?
Hancock: Yes. We have a board structure, we have elections, and we have four independents, three vice chancellors, three CIOs, myself, and a dedicated CSIRO director. We rotate ever three years.

TJA: And one of those independents is John Rohan, who is well-known in the telecommunications world.

Hancock: Yes, John Rohan was my boss at Vodafone actually.

TJA: Moving to the services provided by AARNet, it appears that video – including ultra high definition video – has become the most important service you have been developing and delivering. Is that accurate?

Hancock: Yes, it’s one of them. I guess there are three service categories: collaboration services which are usually based around video; content delivery service where, for instance, we have designed a large file transfer service; and mobility services such as eduroam.

TJA: What is eduroam?

Hancock: Eduroam is a wireless authentication service that we deliver to the sector. The wireless end-points exist already in the universities: we simply put an authentication service over it that becomes something that operates for all higher education people. Eduroam is global and we operate it in Australia.

I was at a lunch recently with the Queensland Health minister and the vice chancellor of the University of Queensland where we’ve put eduroam into five or six hospitals. For University staff going into those hospitals all the time, and staff from the hospitals coming into universities, if they walk in with their device, they’re eduroam-enabled. They can walk into the campus of the University of New South Wales, or MIT, or Oxford and don’t need to put in a password! It simply authenticates your device.

TJA: What about the Unified Communications Exchange service that I understand was developed in-house using your IP-based network?

Hancock: That’s part of collaboration services.

TJA: Does this service include IP voice and IP video?

Hancock: That’s another cutting edge technology. In simple English, it allows me to pick up a phone, dial someone in Swinburne, and immediately have a video conference on that phone with the vice chancellor. We don’t need to go to a room, we don’t need to go through an MCU [Multipoint Control Unit] or to dial into a video system.

TJA: And what about the CloudStor service?

Hancock: Yes, that’s a large file transfer service. As a researcher, if you need to send large volumes of climate change data, you can do it over CloudStor.

TJA: Finally, can you talk about the use of high definition video?

Hancock: It varies from big room systems back to the desktop. I think the days of standard definition are just about gone. Everything is high def these days. You can’t run some of these walls of big video screens you see in that book unless you’ve got high bandwidth capacity!

TJA: The example given is often of a surgeon using high definition video to show every detail of an operation to students watching a screen that is thousands of kilometres away.

Hancock: Correct. It’s about getting it up as well, and having a big screen that you wouldn’t have normally.
TJA: Do you have much demand for the level of detail required for medical surgery or diagnosis?

Hancock: I would have to say that it’s patchy. Some people use it every day, others rely on normal video, some institutions even rely on Skype for communication, and there are some researchers who want to show their research on large screens!

TJA: I see that AARNet is signing up private schools such as Abbotsleigh in Sydney as customers. Do these schools use a video service?

Hancock: They wouldn’t use something like the huge wall screen, but they do use high definition video, and more of them are using it much more regularly. The schools join AARNet because the universities want them to do joint projects, but they also want to be part of the overall global community such as bringing NASA into the classroom for Abbotsleigh girls.

TJA: I thought I saw a grab of the Abbotsleigh girls exploring the Antarctic or somewhere like that!

Hancock: Well, there it is. You’ve seen it all!

TJA: I understand that the universities are using a lot of videoconferencing these days which suggests students have accepted the technology?

Hancock: For the generation at university now, I think a videoconference is second nature. Sometimes, it’s not as good as in-person teaching, but with Telepresence and some of the systems that exist it’s certainly very, very good. And if you’ve got a great network, you can almost do this in real time and it works!

TJA: You are a director of the Smart Services Cooperative Research Centre which, I think, is doing some creative work on video. Is that correct?

Hancock: Yes, they’re doing some great things in video technology: their TableTop surface technology is an extension of what iPads are about but on a bigger scale. My reason for being involved in them is because they are a source of innovation for us. We can’t replicate the CSIROs and the NICTAs and Smart Services CRC, nor should we, but we can certainly work with them to trial their services and push some of their services out to some of our customers.

TJA: Is the CSIRO’s SKA contract serving as a driver of high volume pipes?

Hancock: That’s one of the highlights, and the Large Hadron Collider in CERN as well as Geoffrey Taylor in Melbourne who has driven some of the work behind the discovery of the Higgs boson.

TJA: Do you charge the university customers based on volume?

Hancock: No. We used to be on a volume charging model back in the early days and we changed that very quickly as we could see growth. So you pay a subscription and then go for it.

TJA: Can individual students gain direct access?

Hancock: Our connection goes to the front gate of the university. From there, it’s up to the university to manage that network.

TJA: So if students late at night decide to dial up a copyrighted movie from a site like Pirate Bay ...

Hancock: ...the university needs to get on to that. But having said that, we’ve brought in off-peak, which means that we’ve extended it from 5 pm until 9 am the next morning because it was so popular. It’s all on-net so it’s unmetered traffic! And we have also decided to offer a new product to the universities using our own NOC – Network Operations Centre – which monitors traffic flows and how the network is performing in Sydney and Perth, basically on a minute-by-minute
Rather than paying commercial providers to do this for us, we will now provide that as a product with people 24 X 7 in either Perth or Sydney. Now the universities are seeing that they could reduce their costs and saying to us, ‘Gee, I wouldn’t mind you monitoring our network and some of the things we’re doing.’

TJA: It sounds like a good revenue source! I understand you are a partner of the Institute for a Broadband-Enabled Society (IBES) in a research project that also involves the NBN?

Hancock: Yes, some of the work that Kate Cornick from IBES is doing is great. We’ve been helping out in the Brunswick project, ‘Ageing Well at Home with Broadband’. We’re actually a retail service provider of the NBN just like Telstra or Optus and the 12 or 13 or so others.

TJA: What stimulated AARNet’s decision to become one of the early NBN retail service providers?

Hancock: We entered that arena because we knew that the NBN was going to go to places that probably we’re never going to go to. There are pockets of researchers all over the country – they could be at a solar farm in Moree or wherever – and the NBN will eventually go there, so we can be a service provider by purchasing an NBN circuit and providing that to them.

TJA: Do you envisage the reverse, namely, that NBNCo may purchase capacity or circuits from AARNet in some circumstances?

Hancock: No. It’s not intended. At the end of the day that would be a matter for our shareholders and, at present, they are keeping AARNet as it is.

TJA: Still, it would be an interesting move if NBNCo sought to save costs by making use of AARNet!

Hancock: They could, but I don’t think that’s the objective of NBN. I’ve never had that discussion with the Minister, Stephen Conroy.

TJA: You never know!

Hancock: That’s right. You never know what’s going to happen, I suppose!

TJA: Indeed, in some ways AARNet would appear to be competing with NBNCo since your shareholders and research customers are the really heavy users of capacity. Isn’t there a competitive edge to the relationship?

Hancock: Well, we don’t see it that way. We see it as being complementary, quite frankly.

TJA: Isn’t AARNet already providing retail services on NBN’s network!

Hancock: Yes. In Armidale, which is an NBN first release site, we are the retail service provider for PLC [Presbyterian Ladies’ College]. We’re also at the Cathedral School in Townsville which was opened by Wayne Swan [Deputy Prime Minister], Townsville being James Cook University and one of the first release sites for NBN as well. They’re only ‘one offs’, and we’ll try to do some really interesting things with them. We’re not there to sign up every school. It’s really just a question of using exemplars.

TJA: Does AARnet compete with NBNCs on products like multicasting?

Hancock: Well, we have multicast on our own network. I haven’t really gone into detail on that.

TJA: So would you suggest that a customer sign up to the multicasting product offered by an NBN retail service provider if AARNet itself has a product?

Hancock: Yes, we would if they had locations that we couldn’t help them with. We see it as very natural. It might be a CSIRO group of researchers somewhere like
Willuga, and NBN fibre is going to go in there, therefore they’re better off. Our job is really not competitive in that sense. It is to make this all come together so the end user gets the benefit.

TJA: Having led and completed AARNet3, are you now preparing for AARNet 4?

Hancock: It’s begun. We haven’t had a launch so don’t be disappointed that the invitation is not in the mail! But AARNet4 starts now, and it is really about having a more flexible and diverse network that allows us to go to 100 Gbps as a backbone for a start and to really up the ante. I guess everything needs modernising over a period of time.

TJA: I read somewhere that you were planning some 4000 satellite dishes at the Square Kilometre Array site!

Hancock: I think it was 3000 originally, but anyway those numbers have all changed because of the way the SKA has been divided between South Africa and Australia. In Australia, the ASKAP [Australian Square Kilometre Array Pathfinder] project is going from about 30 to about 90, so that’s another 60 dishes, and the other part for Australia will be the low frequency work out of Curtin University.

TJA: AARNet offers a global reach for its customers with undersea fibre capacity on cables and international POPs. Do the customers ask for advice from you, especially the universities who are facing a whole range of new risks and opportunities in this global market with all the new technologies?

Hancock: Yes, there’s no doubt about that. We just had a meeting for the first time ever. It was meant to be the G20 – or modelled on the G20 – but it ended up being 13 CEOs of the major National Research and Education Networks around the world, so China and Korea among others. AARNet was there representing Australia. We actually talked about this and about a global topology because we are all interlinked. When the physicist, Geoffrey Taylor in Melbourne, has to send data or work with his colleagues at CERN in Geneva, it should be seamless at very high speed, high capacity. That’s what research networks are really good at, and that’s what we have been doing on a global basis.

TJA: What steps is AARNet taking to support and inform its shareholders and customers in this changing global market?

Hancock: Well, we’ve just restructured in the last three months and we’ve started up a new unit called Enterprise Services. In English, it’s Consulting Services. The universities are wanting assistance, not from a commercial vendor, but someone who is going to give them an independent assessment of where they’re going, and review their video systems or their exchange systems and things like that.

TJA: Does AARNet charge for this service?

Hancock: Yes, we’ve only just started up this service because we were doing a lot for free previously, and workload-wise we can’t just keep doing that. We’ve even done that for the Federal government who are wanting to understand because we try to keep in tune to work with all of the vendors.

TJA: Meanwhile, competition from mainly US universities is arriving with these MOOCs – Massive Open Online Courses – and some Australian universities are setting up similar open courses...

Hancock: ...it’s the old conundrum of collaboration versus competition.

TJA: But the competition is taking place in a global context?

Hancock: Yes, there are no boundaries. If you look at where people can access courses from and what they can do, it doesn’t have to be in their own state or suburb.

TJA: Or even country!
Hancock: Yes, that’s why research networks are going to be more important in the future to enable this. I went to a conference in Melbourne several weeks ago and the technology people who presented at it were the ‘Big Four’ plus us: Google, Microsoft, Cisco, Amazon and AARNet. I think that all the messages were similar: the NBN is going to get into the student’s home.

TJA: Is AARNet considering getting into student homes?

Hancock: We could provide to the home as an NBN service provider, but that’s really going to be at the discretion of the universities. Quite frankly, the NBN and the commercial service providers will provide the large majority of all those services, but if you had academics at home who, because of time zones, want to chuck large amounts of data at night over AARNet, then we could do that through the NBN.

TJA: So could AARNet at some stage decide to go after student customers at home?

Hancock: No, because at the end of the day we’re concerned about what goes on at the campus. My view is that’s for the commercial market. ENDS

ENDNOTES


INCLUSION DURING SCHOOL ABSENCE
USING AMBIENT TECHNOLOGY TO CREATE A CLASSROOM PRESENCE FOR HOSPITALISED CHILDREN

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In this paper, we investigate the use of ambient technology to create a classroom presence for hospitalised children. We present results from four case studies, each of which included data from hospitalised children, their parents, classmates and teachers (at both school and hospital). Primary school-aged children from both metropolitan and rural areas were included. Data collected at both the hospital and the classroom were analysed to investigate children's experience of the ambient technology and their desire to be aware of the presence of their peers, from both ends of the hospital-school setting. The results indicate that ambient technology is positive at fostering a mutual sense of presence, from the perspective of the hospitalised children, their family, teachers and classmates.

INTRODUCTION

Children in hospitals are separated from their school community. Despite this, while at hospital their health and educational lives continue to be intertwined. A method to aid this connection is the use of ambient technology. In recent years, there have been developments in meeting the challenges of keeping absent children connected with their peers, learning and school community, and enhancing quality of life in an ambient-assisted world (Steg et al. 2006; Antón et al. 2010). Yet hospital and schools are complex and sensitive settings, and so demand deeper thinking about the design of technologies that mediate a non-disruptive connection and presence. This paper presents the use of ambient technology to help hospitalised children create a classroom presence. We present results of the use of this technology by four hospitalised children, their families, classmates and teachers. Our goal
was to minimise the sense of disconnection with school experienced by the hospitalised child, and to address the 'out-of-sight, out-of-mind' attitude toward the absent child.

We discuss the specific issues faced by children in hospital as part of a process to maintain a connection with their education, school community and peers. We illustrate the role of ambient and phatic technologies in mediating the hospital-classroom connection and describe the trial of an ambient orb through the case studies. We highlight the significance of this research as an exemplar of cross-sectoral collaboration between the health, education and information technology sectors.

HOSPITALISED CHILDREN AWAY FROM SCHOOL

Children's health and academic achievement are closely intertwined (Forrest et al. 2011). The quality of a child's school experience relies upon a motivation to learn, security at school and a strong sense of belonging (National Research Council 2003). This sense of belonging is challenged when children are hospitalised. For some children, protracted periods of hospitalisation and repeated admissions span multiple stages of learning and critical transition points of development. Hospitalisation creates significant barriers for many of these children in terms of their continuing education, resulting in a disrupted school experience and discontinuity of learning (Wolfe 1985; Shiu 2001). This disruption places children at risk of social isolation from their school community (Martinez and Ercikan 2009), contributes to a skills deficit and impacts on their longer-term achievements and pathways (Power 2006).

These barriers are partly addressed by hospital-based education programs. It is not uncommon for paediatric hospitals and larger general hospitals to house a school or employ teachers to encourage educational continuity and a culture of learning (Nisselle, Green and Serimshaw 2011). Hospital-based educational support for children includes technologies such as email, blogs and teleconferencing, with Internet technologies contributing to a culture of learning across hospital and school settings, and providing opportunities to connect hospitalised children with their schools (Nisselle et al. 2011; Wilkie and Jones 2010).

While existing communication technologies are efficient in exchanging information between the hospitalised child and the school (Wilkie and Jones 2010), challenges associated with managing health issues and hospital settings, such as vulnerability and unpredictability (Yates et al. 2010), have ramifications for the design and use of technologies in mediating the hospital-school separation. For example, a child feeling nauseous and self-conscious from chemotherapy would find a high bandwidth video connection to their classroom inappropriate. Similarly, contextual aspects of the classroom often make technologies such as email and teleconferencing inappropriate. For example, a classroom engaged in a learning activity may find text-based communication (synchronous or asynchronous) disruptive to the flow of the lesson.

Thus information and communication technologies are generally not sufficiently sensitive to the context of either the classroom or the hospital. Those technologies are effective tools for exchanging information, but tend to lack adequate support to create a sense of belonging and feeling of connection between the classroom and the hospitalised child. In this paper we argue that a stronger sense of belonging can be fostered when the connection is explicitly concerned with social presence, and when the technology is more attuned to the sensitive contextual issues.

AMBIENT AND PHATIC TECHNOLOGIES IN A SENSITIVE SETTING

Given the complex nature of issues associated with the hospital setting, we propose the use of ambient technology. Ambient technologies are characterised as being peripheral, lightweight and aesthetically pleasing (Mankoff et al. 2003). These technologies are peripheral because they do not demand attention and operate in the background to some other primary activity. They are lightweight in as much as they deal with non-critical information, and so would not
Ambient technologies have much in common with 'phatic technologies' (Gibbs et al. 2005; Vetere, Smith and Gibbs 2009; Wang, Tucker and Rihll 2011). These are a class of technologies that support phatic communion (Malinowski 1949), where 'speakers' relational goals supersede their commitment to factuality and instrumentality" (Coupland, Coupland and Robinson 1992, 207). Phatic technologies create the possibility for communication. They are not concerned with information exchange per se. They are primarily orientated toward establishing, maintaining and nurturing human relationships.

Both ambient and phatic technologies downplay the significance of factual information exchange, and both are important in mediating the hospital-classroom connection. Ambient technologies stress the peripherality of the interaction, which is critical in the classroom setting where attention is constantly shifting between teacher, child and activity. Phatic technologies stress the social connection, which is critical to the hospitalised child. Together they help to establish a sense of belonging.

RESEARCH GOAL: CREATING A SENSE OF BELONGING

Our research aimed to minimise the sense of disconnection with school experienced by the hospitalised child, and to address the 'out of sight, out of mind' attitude toward the absent child. We were particularly interested in the effect of technology in the hospital context where face-to-face connections are not appropriate. To address this we utilised technology that embodied the notions of ambient presence (Dey and de Guzman 2006) and phatic interactions (Vetere, Smith and Gibbs 2009). This technology was in the form a glowing orb (discussed below). The main aims of the research were:

- To develop a prototype for improving children's sense of belonging to peers and school community during periods of school absence
- To test ambient technology as a feasible means to mediate co-presence, awareness and connectedness for children absent from their classroom due to hospitalisation
- To assess the response to ambient technologies across the hospital-school setting for children, their family, teachers and classmates.

THE AMBIENT ORB

The technology employed in this study was a glowing orb that used mobile broadband to connect the hospitalised child with his/her classroom (Figure 1). The orb was a large light globe, shaped somewhat like a human face, containing an internal LED that allowed it to glow in different colours. The orb created ambient presence through lightweight, peripheral and aesthetically pleasing representations of colour (Mankoff et al. 2003) and phatic interactions by providing a feeling of connection without building another formal communication channel (i.e., without using text, voice or video).

The orb was purposefully designed to have minimal functionality. The placement of the orb in each child's classroom varied, although it was always proximal to key spaces such as the communal sitting area or whiteboard. The orb in the classroom had a wireless connection to a nearby laptop, which in turn was connected to the Internet via the 3G network. The child in hospital used a netbook computer with password-protected software to control the colour of the orb in the classroom. Through a colour-wheel interface on the netbook, the hospitalised child could remotely light up and change the colour of the orb in the classroom, thereby suggesting a sense of the child's presence into the classroom.

Colour-change was the only function available to the hospitalised children. No messages or signals could be sent from the classroom. The system was administered through a web
interface that allowed us to register users and collect usage log data (on/off, duration and colour).

Figure 1 - Ambient orb in a classroom

RESEARCH APPROACH

This study predominantly used qualitative techniques, which provided information on an unexplored context, such as the proof-of-concept approach of this research (Daly et al. 2007), and allowed us to interact with research participants (Willis et al. 2007). Qualitative data collection methods also enabled us to collect multiple and overlapping forms of evidence (Gillham 2005; Steel 2006) that included semi-structured interviews, observations and class group discussions. Quantitative data comprised usage log data from the web-based application. The project received approval from the relevant Human Research Ethics Committees.

HOSPITAL SETTING

This study was conducted at The Royal Children’s Hospital (RCH) in Melbourne, Victoria, Australia. The RCH is the major provider of paediatric health care in the state of Victoria, and oversees the admission of approximately 10,700 school-aged children (6–18 years) each year.

DATA

Qualitative data from each of the participants were collected at the hospital and classroom at three times: prior to installation of the ambient orb into the classroom (to establish baseline demographics and experiences of connections with school); during the implementation and testing of the orb (to capture responses); and after installation of the orb (to assess any changes in experiences of connection with school), either immediately (parents, classmates, hospital teacher), or when the hospitalised child returned to school (hospitalised child, school teacher). Three types of data were collected: individual interviews, observations and group discussions.

PARTICIPANTS

With the assistance of hospital teachers, four patients were identified and recruited from the hospital’s wards and day stay areas. Study eligibility criteria required the children to:

- be admitted to hospital for significant or frequent periods of time during at least one school term in 2010
be enrolled in year 3–6 at a Victorian primary school
• have one main classroom at school
• be capable of participating in learning activities with a hospital teacher, and
• have sufficient competency in the English language to participate in the study (as assessed by the hospital teacher).

Participants were recruited between June and August 2010. Four cases were examined. Each of the four case studies included the hospitalised child, their parents, school teacher(s), hospital teacher(s) and their classmates. The total number of participants was 114 (Table 1).

<table>
<thead>
<tr>
<th>Participants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalised children</td>
<td>4</td>
</tr>
<tr>
<td>Parents/carers</td>
<td>5</td>
</tr>
<tr>
<td>Teachers</td>
<td></td>
</tr>
<tr>
<td>School teachers</td>
<td>5</td>
</tr>
<tr>
<td>Hospital teachers</td>
<td>6</td>
</tr>
<tr>
<td>Classmates</td>
<td>96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>114</strong></td>
</tr>
</tbody>
</table>

Table 1 - Study participants

Hospitalised Children

The hospitalised children were aged from 9 to 11 years (Table 2). Two children were from the Melbourne metropolitan region and two from rural areas in Victoria. The children's frequency and length of admissions varied, capturing a variety of hospitalisations and length of absence from their school community. The hospitalised children continued in the study for the duration of their stay in the hospital; after-discharge contact was maintained with children until they returned to school, via their parents and school teachers.

<table>
<thead>
<tr>
<th>Case study*</th>
<th>Sex</th>
<th>Age</th>
<th>Frequency of admission</th>
<th>Typical length of stay each admission</th>
<th>Approximate distance between home/ school and hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jerry</td>
<td>F</td>
<td>9</td>
<td>3–4 times a year</td>
<td>2 weeks</td>
<td>10 km</td>
</tr>
<tr>
<td>Sarah</td>
<td>F</td>
<td>10</td>
<td>Single</td>
<td>3 months</td>
<td>20 km</td>
</tr>
<tr>
<td>Felix</td>
<td>M</td>
<td>10</td>
<td>Weekly</td>
<td>1 day</td>
<td>120 km</td>
</tr>
<tr>
<td>Lucy</td>
<td>F</td>
<td>11</td>
<td>Single</td>
<td>11 months</td>
<td>250 km</td>
</tr>
</tbody>
</table>

Table 2 - Demographics of hospitalised children (* pseudonyms used throughout)

Jerry is a 9-year-old girl who has three or four hospital admissions a year, with a length of stay of about two weeks each time. While Jerry was in hospital, she thought of school and missed her friends, but did not communicate with her class. She looked forward to returning to her friends at school, but she did not really want to connect with school, or do schoolwork while in hospital.

Sarah is an 11-year-old girl whose hospital admission lasted three months. While Sarah was in hospital, she missed her school and thought of her friends often. She wrote letters to keep connected with her friends, and her parents set up a Facebook page to manage information flow to family, friends and classmates regarding Sarah's medical progress. Although sometimes resistant to do schoolwork while in hospital, Sarah was concerned about "falling behind". Her school principal and teachers were enthusiastic to help Sarah feel included and be part of the school.

Felix is a 10-year-old boy from a regional city who had been attending the hospital weekly for almost two years. Given his one-day-per-week admission to the hospital, Felix did not feel he
missed out on school or was falling behind, and brought schoolwork with him each week. However, he did miss his friends and found hospital to be a bit lonely and boring.

**Lucy** is an 11-year-old girl from a country town who had spent 11 months at the hospital and in adjacent family accommodation. With the assistance of the hospital teacher she had stayed engaged with her learning and maintained a connection with her school, through cards from classmates and occasional Skype™ video conference sessions.

**Parents**

Three mothers and two fathers were interviewed before and after installation of the ambient orb. Before installation, parents reported a disconnection between their child's hospital life and their school life. While all parents referred to their children as enthusiastic learners who enjoyed school, they also reported a general lack of direct communication between the child and their school while they were in hospital.

**Teachers**

Five classroom teachers were interviewed: four usual classroom teachers and one substitute teacher. Prior to this study, two teachers had implemented some form of contact or connection with the hospitalised child. This included classmates making cards for the child to *"show she's not forgotten about"*, and printing photos and newspaper articles about the child to display in the classroom. One teacher had visited the hospital. Six hospital teachers who had worked with the four children were also interviewed. Their ability to gauge the children's attitude to school and schoolwork, and connection with their peers, varied with the type of hospital admission, with longer admissions resulting in closer ties between the child and hospital teacher.

**Classmates**

Four classes (96 classmates) participated in orb installations, observations and post-installation group discussions. Classmates worked on curriculum-based learning during the observations. Having the orb in the classroom stimulated thought and discussion about the hospitalised child. Classmates considered what the hospitalised child might be doing, how they were feeling and what the different colours of the orb may mean (in terms of hospital activity and/or feeling).

**FINDINGS**

We now present the themes that emerged from cross-case analysis of the data.

**Away But Not Forgotten**

For the child in hospital, the experience of the ambient technology was overwhelmingly positive. Hospitalised children wanted their classmates to be aware of their presence and wanted to stay in touch with their peers and teachers. The orb supported this desire. Children liked the idea that their classmates were being reminded of them and that the children at school were, or might be, thinking of them. For example, Lucy was excited to participate in the study and thought her classmates would find the orb *"fun [and] exciting, like that they know that I'm changing the colours and stuff"*. Afterwards, Lucy and her hospital teacher commented on her reaction to the experience:

"I reckon it was good ... because some of my friends said when it changed colours it reminded them of me and I liked it 'cause everyone would think of me".

(Lucy, post-interview)

"She liked the idea that that would be her ... She'd sort of giggle and laugh, and go, 'I'm switching it on. They'll know I'm busy doing work!'"

(Lucy's hospital teacher, post-interview)
The feeling of "being with another" (Biocca, Harms and Burgoon 2003, 456) was important within the school setting. The classmates associated the orb with the hospitalised child, demonstrating that, despite the physical separation, the orb mediated social presence (Markopoulos et al. 2005). The changing orb colour was experienced as something like a signal, sent by the child in the hospital, to let the class know that he or she was somehow there in the classroom.

The orb prompted the classmates to mention the absent children by name, and ponder the reasons for the hospitalisation. There were instances where classmates addressed the orb in the first person, as though the orb was a proxy for the absent child, pointing to the orb and greeting it, for example "Look! It's Felix!... He's there! [pointing at the orb]... He is! That's him". In this way, the orb was personalised as a social entity (Lombard and Ditton 1997) in ways that took on the identity of the absent child (Figure 2).

![Image](image_url)

**Figure 2** - Personalised labelling of the orb in Felix's classroom

School teachers and parents also noted the sense of the child being away but not forgotten.

"It sort of gave me a sense that Felix was around".

(Felix's school teacher, post-interview)

"I think it [the orb] made them [the classmates] aware ... that she's still part of the class ... They were aware of her and aware of her situation and I think that helped her coming back [to school], in my opinion anyway. But they all thought it was fantastic and it was great".

(Lucy's mother, post-interview)

**BEING THOUGHT ABOUT**

In addition to the positive experiences of the parents, teachers and classmates, the hospitalised children benefitted from imagining that their peers and school community were thinking of them. It was considered an effective medium for children to think about one another and made them feel "good":

"I think it [the orb] is a smart idea because it's like I'm in school, when I'm not at school, and they can know I'm thinking of them, and they can think of me. And that's good. It's a good idea".

(Felix, pre-interview)
"They [the classmates] are more aware, because the orb was there ... They are thinking, 'Oh, that's Jerry. What's she doing?' ... It's good from both sides... if Jerry changed the colour, she'd be thinking, 'What are they doing in class? I'll change it to pink.'"

(Jerry's mother, post-interview)

This observation was borne out by comments from Jerry's classmates:

<table>
<thead>
<tr>
<th>Student</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>It's cool how it lights up and stuff and you know that Jerry's there.</td>
</tr>
<tr>
<td>Student 2</td>
<td>It reminds us of Jerry, if, like, we forget about her... Since we haven't seen her for a long time maybe when we see that it reminds us of her, like she's here. ...</td>
</tr>
<tr>
<td>Student 3</td>
<td>It feels like Jerry's in the classroom.</td>
</tr>
<tr>
<td>Student 4</td>
<td>Well, she's just sitting there! [points at orb]</td>
</tr>
<tr>
<td>Student 5</td>
<td>If you didn't have this [orb] you wouldn't be thinking of Jerry that much.</td>
</tr>
</tbody>
</table>

(Jerry's classmates, post-class discussion)

Evident in class group discussions was the possibility that the child in hospital was changing the orb colour because he/she was missing classmates or experiencing loneliness ("I'd be pretty lonely, so I'd want to do this [changing orb colour] to connect with school") and that the orb played a role in mitigating loneliness ("If you [sic] don't have the orb, it might make her feel lonely"). This concept has been explored in other populations who are physically distant and at risk of alienation and loneliness, such as understanding emotions of distance adult learners (Kim 2011), and offers promise for future use in children's distance education settings.

'KNOWING' WHAT IS GOING ON IN THE HOSPITAL

The ambient orb generated vigorous class discussion of what the child in hospital was doing and feeling. Speculation on children's physical or emotional wellbeing and progress was prompted by the colour changes of the orb, as the following group discussion illustrates:

<table>
<thead>
<tr>
<th>Researcher</th>
<th>What do you think she was doing when the orb wasn't on?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classmate 7</td>
<td>She was too tired.</td>
</tr>
<tr>
<td>Classmate 8</td>
<td>She was eating.</td>
</tr>
<tr>
<td>Classmate 9</td>
<td>She had lots of work.</td>
</tr>
<tr>
<td>Classmate 11</td>
<td>Getting tests done.</td>
</tr>
<tr>
<td>Classmate 12</td>
<td>She wasn't around then.</td>
</tr>
<tr>
<td>Classmate 13</td>
<td>She could be asleep.</td>
</tr>
</tbody>
</table>

(Sarah's classmates, post-class discussion)

The classmates imagined an association of the different colours of the orb with different feelings or activities of the child in hospital, for example, "Blue means he's crying", "I reckon green for calm", "Orange might be a little bit hungry", "If he was feeling purple it might be lonely", "Probably asleep", "Probably needed to go and have some medication" or "Might have finished her studies".

The orb was not designed to offer a faithful representation of the hospitalised child's emotional state to the classroom. Rather, this speculation of what the child in hospital might be feeling suggests that encouraging discussion about the child's likely emotional state (rather than representing the actual emotional state) can be effective in nurturing awareness. We
argue that the orb’s ambiguity and lack of representational fidelity was a strong motivator for awareness and presence.

Similarly, ambiguity and ambience were also instrumental in helping to imagine the hospitalised child’s physical setting. Classmates’ questions and comments about the hospital reflected an awareness of some of the physical features of location (Benerecetti, Bouquet and Bonifacio 2001; Kostakos et al. 2005). For example, "Does she [Jerry] have a light globe [orb] at the hospital?", "Could Felix move his arm [in the hospital]?" and perceiving having an orb whilst in hospital as being good, "instead of just lying there doing nothing". This association of ambience with place is not typically discussed in the ambience literature, suggesting scope for future exploration.

PRIMED FOR CONNECTION

The presence of an orb in the classroom and the ability to control it from within the hospital created a desire in both the hospitalised children and their classmates to initiate or escalate communication with one another. Hospitalised children expressed a desire to send emails to class teachers and classmates to stay in touch as a direct result of the orb installation.

Researcher: Every time it changed colour, you all asked 'What does it mean?'
Classmate 13: ... and we were thinking when the colour changes we could go on and email her.
Researcher: OK, are you going to do that? ...
Classmates: Today ... After lunch [in technology class].

(Lucy's classmates, post-class discussion)

The orb was not intended to replace existing communication technology, but rather to augment it by creating an environment where the desire for communication was nurtured. The orb successfully served as a prompt to think about making a connection and experience a sense of being part of the regular group and community (Kim 2011). Classmates expressed enthusiasm and requests included to set up Skype™ or to email their hospitalised classmate to inquire about the meaning of colours, and to visit the child in the hospital. However, unlike other synchronous communication options (such as Skype™), the classmates noted the advantage and flexibility that the orb offered the child in hospital:

"We have to have arranged timetables to Skype™ Lucy, but when she's got the orb, we don't have to [connect at the same time]."

(Lucy's classmate, post-class discussion)

The fact that there was no exchange of messages via text, voice or video also had benefits for the hospitalised child. The technology appeared to transcend the physical details of their illness to create a feeling of being present in the classroom and a sense of togetherness (Lombard and Ditton 1997) and belonging to their social group. This was regardless of physical health and classroom activities, which is of central importance to children and young people with health conditions more broadly (Yates et al. 2010). This finding is also consistent with the benefits associated with phatic interactions that support social cohesion without relying on the content of exchanged messages.

SUBTLE YET CENTRAL

The orb had an impact on the classroom environment in subtle yet central ways, with teachers' responses to having the orb in their classroom varying. Lucy's teacher embraced the opportunity by using the orb installation to motivate classmates to think about Lucy in hospital when teaching a curriculum on emotional wellbeing, and choosing the word 'empathy' as the 'word of the day.' However, the orb was not always central to the activities of
the class. Over the duration of the observations it was sometimes ignored by classmates, especially when they were absorbed in their schoolwork. We consider technology that can be appropriately ignored as a positive finding, as it would not be appropriate for the orb to have been a constant centre of attention in the classroom. The orb remained peripheral but significant, suggesting a presence but not dominance. In a learning environment, where attention is constantly shifting between teacher, child and activity, the peripherality of the interaction emerges as congruent with the classroom setting and can successfully operate in the background, secondary to other primary activities.

IMPLICATIONS AND LIMITATIONS

The findings in this study clearly indicate that the ambient orb technology had an overall positive impact on the hospitalised children and also their classmates. Felix and Lucy responded enthusiastically to the experience, clearly enjoying controlling the orb and commenting about school, classmates and schoolwork in a positive light. Jerry and Sarah were a little more reserved in their reactions, not able to separate the impact of the orb experience from their overall excitement at returning to school. In all cases, 'out of sight' need not mean 'out of mind' for the hospitalised child. The positive response to ambient technology across the hospital-school setting for children, parents, teachers and classmates suggests this technology is a feasible means to mediate presence for children absent from their classrooms, for health or other reasons.

To some extent, ambient technology transcended the physical details of reality. The fact that there was no formal exchange of messages between the two parties had benefits for the hospitalised child. The child would remotely change the colours of the orb in the classroom and often believe that their classmates were thinking of them regardless of what was actually happening in the classroom. Unlike other investigations of presence technologies, where the ability to interact within a mediated environment is understood to enhance presence (Lombard and Ditton 1997), the absence of a formal exchange of messages had advantages. However, we do not suggest that formal communication be replaced with ambient displays of ambiguous representations. Rather we believe the ambiguity was an important positive influence on creating a strong sense of awareness and presence and thus deserves further attention, especially examining its effects over longer periods of time.

We acknowledge that four case studies of children aged 9–11 years may restrict the extent to which our findings can be generalised. While this study suggests that this ambient technology may have assisted with school re-entry by heightening presence and awareness to create a sense of connection, we are unable to report conclusively as to the effect of the technology on children's short to longer-term engagement with their mainstream learning environments. This also requires further research.

CONCLUSION

The results of this investigation show the potential of ambient technology to provide benefits to children away from their school environments due to hospitalisation. The presence and awareness felt by children towards their remote classmates highlights the social impact and the significance of place in awareness systems. The ambient technology stressed peripherality and phatic interactions, which are critical in the classroom setting. Together they helped to establish a genuine sense of connection.

Further work extending notions of ambient presence beyond the current study will focus on aspects of the sense of 'being together' across other primary relationships and settings for hospitalised children, such as the home environment, as well as the durability of increased presence over an extended period of time.
ACKNOWLEDGEMENTS

Our research team would like to acknowledge 'Jerry,' 'Lucy,' 'Sarah' and 'Felix,' their hospital teachers, school teachers and classmates for participating in this study. We would like to thank the Institute for a Broadband Enabled Society (IBES), The University of Melbourne, for funding the research. We acknowledge the support of the Victorian Department of Education & Early Childhood Development, the National Health & Medical Research Council's Health Professional Research Fellowship and the Victorian Government's Operational Infrastructure Support Program.

REFERENCES

Antón, Pablo; Muñoz, Antonio; Maña, Antonio; Koshutanski, Hristo. 2010. 'Security-enhanced ambient assisted living supporting school activities during hospitalisation'. Journal of Ambient Intelligence and Humanized Computing: 1–16.


Daly, Jeanne; Willis, Karen; Small, Rhonda; Green, Julie; Welch, Nicky; Kealy, Michelle; Hughes, Emma. 2007. 'A hierarchy of evidence for assessing qualitative health research'. Journal of Clinical Epidemiology 60 (1): 43–49. Available from: http://dx.doi.org/10.1016/j.jclinepi.2006.03.014.

Dey, Anind K; de Guzman, Edward S. 2006. 'From awareness to connectedness: The design and deployment of presence displays'. A paper presented at the CHI 2006 Conference: Awareness and Presence, Montreal, Quebec, Canada.


Lombard, Mathew; Ditton, Theresa. 1997. 'At the heart of it all: The concept of presence'. *Journal of Computer-Mediated Communication* 3 (2)


Steg, Horst; Strese, Hartmut; Loroff, Claudia; Hull, Jérôme; Schmidt, Sophie. 2006. 'Europe is facing a demographic challenge: Ambient assisted living offers solutions'. In *IST Project Report on Ambient Assisted Living*, European Ambient Assisted Living Joint Programme

Vetere, Frank; Smith, Jeremy; Gibbs, Martin. 2009. 'Phatic interactions: Being aware and feeling connected'. In *Awareness Systems: Advances in Theory, Methodology and Design*, edited by Markopoulos, Panos; De Ruyter, Boris; Mackay, Wendy. London: Springer.


Willis, Karen; Daly, Jeanne; Kealy, Michelle; Small, Rhonda; Koutroulis, Glenda; Green, Julie; Gibbs, Lisa; Thomas, Samantha. 2007. 'The essential role of social theory in qualitative public health research'. *Australian and New Zealand Journal of Public Health* 31 (5): 438–443. Available from: http://dx.doi.org/10.1111/j.1753-6405.2007.00115.x.


Yates, Lyn; Bond, Lyndal; Dixon, Mary; Drew, Sarah; Ferguson, Peter; Hay, Trevor; Moss, Julianne; St Leger, Pamela; Walker, Hannah; White, Julie. 2010. *Keeping Connected: Identity, Social Connection and Education for Young People Living with Chronic Illness*. Melbourne: Graduate School of Education, The University of Melbourne.

Central to discussions about NBN-enabled applications and services is the potential for innovative ways of learning, particularly in relation to online and interactive education. This paper reports on trials of the collaborative software tool Adobe Connect in NSW schools, and reports on two field studies for Zoo Connect, an interactive, multimedia, remotely-delivered class lesson. Results from the trials support those who advocate the NBN as a means to extend classroom learning, and provide evidence that may prompt educators to transition to virtual classrooms sooner rather than later. Recommendations are made for the wider development of NBN-style education programs, regardless of whether or not they fall into the early rollout category/regions, in order to fast track innovation, encourage educators and assist communities to better envisage how the NBN will impact the education domain.

INTRODUCTION

Amongst the most cited opinions on the likely impact of broadband on the economy are those of the distinguished US economist Raul Katz and his team at the Columbia Business School (Katz & Suter 2009, Katz 2010). As a result of modelling, Katz posits that broadband’s economic impact is higher ‘when promotion of the technology is combined with stimulus of innovative businesses that are tied to new applications’. In these circumstances he is optimistic that the ‘network effect’ (Katz 2010: 6) would apply to jobs creation and economic growth; however, Katz cautioned that without critical mass, broadband’s economic effect would be minimal (Katz 2010: 1-3).

The current struggle in Australia, which sees a nation caught in the midst of a political battle to justify (Department of Broadband, Communications and the Digital Economy (DBCDE) 2011:13) or decry (Comer 2011; LeMay2012) the building of the National Broadband Network (NBN) is cause to reflect on Katz’ observations. According to his thinking, the opportunities presented by the NBN could be squandered were Australia to have a high-speed broadband utility that lacked useful services and therefore subscribers; or, on the flip side, were Australia to have an unconvinced and therefore, under-subscribed customer base; this could cause new services to stall. Either scenario would see a diminishing of the NBN’s promised returns. The aim, then, should be for wider and earlier public inclusion in the development process in order that a healthy and concurrent growth in services and subscribers occurs. But how to do this?
From the user experience design perspective, the users of currently available broadband applications are an important source of information to shape and design future NBN-enabled services (Leonard et al 1997; Norman 1998; Bell et al 2011; Barr 2010).

In the education sector, the likely place for this to occur is within a classroom. One strategic approach is the Government initiative, the ‘NBN Enabled Education and Skills Services Program’ (Department of Education, Employment and Workplace Relations (DEEWR) 2011a), a $27.1 million plan to conduct education projects ‘within or between communities to first benefit from the NBN’ (DBDCE 2011). Despite good intentions, only a small percentage of the nation can participate because the Program’s eligibility criteria limit participation to those living in designated ‘early roll-out’ zones. This pushes a large majority of potential ‘lead users’ (Hippel 2005) out of the innovation picture. Taking NSW as an example, 273 of the State’s 4,563 suburbs (Australia Post 2012) are in the early rollout scheme (NBNCO 2012); that is, 6% of the NSW population stand to benefit from the DEEWR funded program.

At risk of being overlooked are several software platforms already in use and readily available for immediate deployment. Although proprietary, they are affordable, especially as they do not require development costs. Moreover, their specifications appear to be suited to most schools’ budgets and bandwidth (DEEWR 2011a). One such platform, the online collaboration and communication tool, Adobe Connect (AC)2012, is being used for a number of NBN-style digital classroom activities. One of these is Zoo Connect (ZC), a science lesson developed by Taronga Zoo educators, delivered from the zoo to two secondary high schools. As an exposition of remote and blended learning using streaming rich media, ZC was runner-up in the international Adobe Exchange 2011 Education Choice Award (Adobe 2012).

This paper presents an annotated report on two evaluation trials of ZC and discusses the study’s relevance within an NBN-enabled classroom paradigm.

To begin, we contextualise ZC by discussing what a fully realised NBN classroom might be. It is important to do this so that the case study, which has some clear successes within schools’ existing broadband limits, can be considered as a useful indicator as to how classroom learning will likely evolve under the NBN, rather than, as some otherwise may be tempted to conclude, evidence that a ‘gold standard’ (Conroy 2010), FTTP service is simply not necessary.

**WHAT IS AN NBN-ENABLED CLASSROOM?**

Writing evocatively about NBN-enabled classrooms, Monash University’s Deputy Vice-Chancellor of Education, Adam Shoemaker, describes the NBN as removing the ‘digital rain-shadow’ that currently runs along the educational digital divide. He describes the NBN-enabled classroom as:

"... multipoint and immersive, "many way" instead of two-way. It will make a baseline of high-quality learning available to every individual, every class - while teachers will be able to collaborate with each other across state and territory boundaries as never before.

They will be able to work across states to assess new forms of curriculum and to give them "local engagement". They will be able to develop their own pedagogical skills through peer-to-peer communities. And when students from Alligator River want to enter a science fair with young people in Deloraine, they will be able to share a "digital project" enabling Year 8 students from the Northern Territory and Tasmania to work together in a whole new way" (Shoemaker 2012)

Rather more prosaic is the DBCDE’s checklist of NBN-enabled benefits to education; it includes, ‘supporting access to curriculum resources’, ‘new opportunities to extend specialist resources’, ‘educational opportunities to all Australians no matter where they live’, ‘the connectivity to develop and collaborate on innovative and flexible educational services and resources’ and ‘the opportunity for online virtual learning. (DBCDE 2012:5). DEEWR lists ‘communication’, ‘collaboration’ and ‘interaction’ as core principles (DEEWR 2011b).
Specifically, the NBN-enabled classroom will make huge demands on bandwidth due to each classroom’s amassed digital activities. This could entail working with multiple digital services at the same time to crunch data, produce content and participate in online communities. There are complex privacy issues to be resolved in the classroom use of social media; but presuming these are solved, one group may be (in today’s terms) uploading photos to Flickr or similar, another managing a project using Facebook. In the course of the day, students may be variously posting their music on YouTube, watching HD video, and conducting Skype-style conferences with remotely-located class colleagues and specialist teachers. They may be creating content within graphically dense and rich media virtual environments, and viewing it on mega-pixel wall screens. Schools could have the facility for tele-presence, where objects and people ‘appear’, projected in 3D. With all such tasks, and many others, highly symmetrical upload and download speeds will be mandatory in order to achieve quality of service.

Then, within the campus, smart objects could be exchanging data and information: sensors could monitor rainfall in the vegetable garden, a smart inventory system in the office could alert school suppliers when stocks are low, security cameras could monitor the staff car park. In addition, there may be innovation labs within the school, with classes working with open source code to configure their own niche services such as games and apps. All of these activities will need to be scaled across some 9,435 Australian schools (Australian Bureau of Statistics (ABS) 2012), at the same time. The pipes will need to be much wider than the present to allow for the concurrent use of multiple services. The ‘big data’ movement will eventually enter the learning space, further increasing the need for high bandwidth.

**Zoo Connect**

**Background**

The project was conceived by educators within the NSW Department of Education and Communities’ Curriculum and Learning Innovation Centre (DEC CLIC) (New South Wales Department of Education and Community (NSW DEC 2012) in anticipation of digital classrooms, and the revised national curriculum implementation, both part of the Commonwealth Government’s Digital Education Revolution (DER). The ZC trials took place in August 2011 and June 2012, using the readily available proprietary web conferencing and the collaboration software platform AC. Evaluation was undertaken by DEC CLIC with some of their Smart Services CRC (SSCRC) partners, including the authors of this paper. Many similar collaboration digital platforms exist (Wikipedia 2012); however the trials documented in this paper were commissioned specifically to evaluate AC, which is being used across a range of DEC CLIC purposes.

Specifically, the two ZC trials used AC to deliver a science lesson from Taronga Zoo in Sydney to Stage 4 (aged 12-14) students situated in the remote location of their secondary schools in NSW. Trial 1 took place at the co-educational Carlingford High School in August 2011. Trial 2 took place at Epping Boys High School in May 2012. In total, 111 students, three classroom teachers and three educational officers from Taronga Zoo participated.

In Figure 1, the left hand image shows Epping and Carlingford to its west, and the right hand image shows Mosman where Taronga Zoo is located, outside the NBN’s early release zones, indicated by ‘A’ and ‘C’.
Aims

The primary objective of the trials was evaluation research of the AC platform to assess its efficacy and value in the secondary classroom as an e-learning environment using the DEC network. The evaluation aimed to support decision-making; was specific to AC rather than being generalised; and was designed to yield firm data on the value of AC rather than its characteristics (Gall et al 2007).

The secondary objective was exploration and investigation of usability, learning and engagement using emerging collaborative communication technologies.

Research focus

The areas to be evaluated, together with focus questions and indicators are summarised in Table 1.

<table>
<thead>
<tr>
<th>Area of evaluation</th>
<th>Focus question</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student outcomes</td>
<td>Does AC enhance student learning?</td>
<td>Ease of use, optimal use, levels of interaction and engagement, remote access, evaluation of pedagogy, identifying threats and obstacles</td>
</tr>
<tr>
<td>Teacher outcomes</td>
<td>How does AC impact on teaching practice and pedagogy?</td>
<td>Connectivity with students, flexibility of lesson, quality of resources developed and preparation required</td>
</tr>
<tr>
<td></td>
<td>How does the use of AC in government school classrooms impact on remote participants such as experts?</td>
<td>Resources, costs, preparation required, outreach to students, reuse of materials, outreach to other entities</td>
</tr>
<tr>
<td>Technical and operational outcomes</td>
<td>Can AC be readily deployed in government school classrooms?</td>
<td>Resources, costs, stability of platform and set-up time, identifying threats and obstacles</td>
</tr>
</tbody>
</table>

Table 1 - Research focus of ZC trials

The Software Platform

Adobe® Connect™ is an enterprise web conferencing platform for online meetings, eLearning, and webinars. An AC session is hosted and run by a nominated “administrator” who handles the collaboration tools, which are displayed as “pods” on the screen user interface. Pods include text chat, notes that can be saved and emailed, questions and answers for multiple presenters, “whiteboard”, integrated audio and video conferencing, interactive
attendee list, and survey polls/quizzes. Content can be presented in a variety of content types including animated presentations, images, audio, video, and more. It can be saved as reusable templates and stored in libraries. Files can be shared. AC should be capable of running on a range of platforms including Windows, Mac OS, Linux, Solaris and most Mobile platforms. A minimum bandwidth of 512Kbps is recommended for end users such as participants and meeting attendees. Wired connections of cable DSL are recommended for administrators, presenters, teachers and meeting hosts. Minimum network requirements are 100Mbps Ethernet, with 1Gbps recommended. The AC configuration used in the ZC trials can be seen in Figure 2.

![Diagram](image)

**Figure 2** - Diagram design by Stephen Sergis, courtesy of DEC CLIC

**NETWORK SERVICES**

The AC software is hosted at CLIC and within the DEC network. Access is by invitation. Typically, the number of concurrent user groups number between 10 and 20, although Adobe claims the environment can handle up to 1000 users concurrently. AC’s performance was assessed using current urban broadband bandwidth parameters. As at 7th August 2012, Carlingford High School and Epping Boys High School are using high capacity campus distributer servers, Figure 3.
1. Telstra node > Epping and Carlingford Schools’ DER Campus Distributer (main server) delivered via fibre optics. Bandwidth: 100 Mbps, symmetrical.

2. Schools’ Main Server > campus blocks (buildings) delivered via fibre optics. Bandwidth: 1 Gbps, symmetrical.


4. Connectivity mode and speeds at Taronga Zoo could not be confirmed.

Source: NSW DEC ITD Network Solutions Team

**Figure 3 - Bandwidth configuration at the test schools, Carlingford HS and Epping Boys HS.**

**THE ZOO CONNECT LESSON**

The lesson content was taken from NSW DEC Science Syllabus Stage 4. Outcomes relevant to the lesson were:

1. Describe features of living things.
2. Classify living things according to structural features and identify that they have patterns of similarities and differences.

Present on the screen throughout most of the lesson were:

a). the live Webcam pod of the presenting zoo teacher and
b). the chat pod for students to ask questions.

Live audio of the presenting zoo teacher accompanied parts of the session that occupied the full screen (presentation/slideshow, quizzes and surveys). The lesson was in the following format:

- Attendance register pod where students could insert symbols to acknowledge their presence
- A video to refresh their memory of their zoo visit
- Pre-test
- Two presentation/slideshows with live narration by the zoo teachers
- Webcam of a zoo teacher with a live mammal to illustrate the lesson
- Post-test
- Experience survey

Figure 4 shows the screen at the beginning of the session. From left to right, the attendance register, the still of a video that was about to start, the chat pod and webcam of the zoo presenter.
THE RESEARCH DESIGN

The research design incorporated both qualitative and quantitative methods. In a pre-test/post-test control group design, the experimental lesson was delivered remotely by specialist teachers at Taronga Zoo using AC, whereas the control lesson was delivered by the regular science teacher in the regular classroom. Quantitative assessment of learning was supplemented by qualitative analysis of the experiences of student and teacher participants. In both groups, data from student and teacher surveys was supplemented by interviews with teachers and observation of classroom behaviour captured on video. In addition, the experimental session yielded logs of text chat entries and screen capture of the entire online lesson. Steps in the method were identical for control and experimental groups.

In summary, 111 students returned 100 complete sets of pre-tests and post-tests and 73 lesson experience surveys.

RESULTS & DISCUSSION

LEARNING

Results confirmed that ZC was extremely effective for learning. ANCOVA analysis of post-test scores adjusted for differences in pre-test scores indicated that scores of the ZC groups were higher than those of the control groups, with the Trial 1 ZC group’s score significantly higher than those of the other groups ($F(3,95)=7.07$, $p<.0005$). In circumstances beyond the control of the experiment, the Trial 1 group was in an accelerated learning class, whereas the other groups were in regular classes. Although the significant gains made by this group could be attributed to ability, the qualitative findings support the quantitative data in suggesting that the technology was the major contributing factor.

Remote access to expertise

Survey responses and the chat transcript revealed strong agreement that students were cognisant, and extremely appreciative, of remote access to expertise and a live environment that is unavailable in the classroom. The close-up webcam images of the instructors and live animals invoked enthusiastic and empathetic responses from the students who were well aware of their privileged role as an audience. Both students and teachers commented that...
exposure to live examples together with discussion driven by content experts would have enriched the potential for learning in most students.

EASE OF USE

Survey responses, interviews and observation confirmed that both students and teachers became competent in using the software within two minutes. The only aspect of ZC usability that received negative reports arose from insufficient bandwidth; 46% of responses to the question “What would most improve the lesson?” referred to blurry images, lag, and frozen sound and video. Even worse, at times teacher narration was out of step with the images they thought students were viewing, which was extremely confusing for all involved. The poor quality of streamed media could have been caused by several factors, including:

- The recommended minimum bandwidth for AC supports suboptimal quality media in some conditions
- The zoo connection, which could not be confirmed, did not comply with the minimum requirements
- The AC bandwidth preference was set too high, which would have increased both bandwidth consumption and CPU usage beyond acceptable levels, with a consequent reduction in media quality (AC 2012).

We suspect that insufficient bandwidth is the most likely of these factors because the system, including the zoo connection, was carefully configured.

Resources and reuse

The zoo teachers who prepared the lesson reported that the initial preparation was time consuming but no more so than other new lessons or technologies. Importantly, the lesson and its resources prepared for the first trial were easily reused in the second trial by both zoo and classroom teachers who had not prepared them. Furthermore, the video and presentation materials delivered by the classroom teacher offline in the Trial 2 control lesson were reported by students to be their preferred feature of the lesson.

LEVELS OF INTERACTION AND ENGAGEMENT

Statistical analysis of Likert-scale lesson experience questions and content analysis of video observation, chat pod transcript, and open-ended questions indicated extremely high levels of engagement and interaction in the ZC groups, when compared with the control groups. The teachers noted that in its use of webcams and instant messaging, AC harnessed technology currently popular with the student cohort but rarely employed in an educational context. The enthusiastic response to a delivery format with relevance to everyday life and self-concept was apparent in sustained attention, which in turn would have supported learning outcomes.

For research purposes, the teachers did not establish behavioural protocols or convey any appraisals of the platform; however students were told that every entry they posted identified them, would be stored and was easily retrievable. In these conditions, two unanticipated and striking student behaviours indicate that real-time online learning could involve new approaches to classroom management, as well as quite different learning and teaching paradigms:

Classroom behaviour

Behaviour management presented far fewer challenges in the ZC classroom than in the regular classroom. ZC participants displayed complete concentration and absorption in the lesson during both trials. They gazed at the screen intently, occasionally pausing to type, appearing particularly focused during the quizzes and surveys. The pairs of students on shared terminals appeared to collaborate politely and quietly with each other. This was in marked contrast to the moderately noisy and unruly behaviour of all Trial 2 students in the classroom and during the zoo visit when they required constant admonition. Furthermore, very little collaboration was observed at times other than the ZC session.
Student-teacher dialogue via chat pod and webcam

During the 35 minutes of each ZC session, a staggering number of entries were posted in the chat pod: 795 entries in the first trial and 1165 entries in the second trial. Textual analysis of the chat pod transcript revealed that instead of the anticipated question/answer session, students used the chat pod to express their individual identities through ‘back-chat’ commentary on the lesson, see Figure 5. In this way, a sense of community appeared rapidly and spontaneously, and students looked to their cohort rather than teachers for clarification or extension of information. Behaviour management problems arose when some students misused the chat pod with silly postings and spam (repeated entries that blocked other participants from contributing and scrolled the pod so fast that relevant postings were erased from view) preventing zoo teachers from answering questions. The accelerated learning group in Trial 1 self-regulated to rapidly eliminate the disruptive behaviour, but in Trial 2 it was necessary for the zoo teachers to temporarily hide the chat pod.

Figure 5 - Student-student clarification of information and discussion in the chat pod in Trial 1

The remote teacher perspective

The zoo teachers felt that although ‘backchat’ is a valuable means of focusing attention and building a sense of community, guidelines and protocols are needed to prevent students impeding the learning process by taking control of the discussion to ‘talk’ rather than ‘listen’, see Figure 6. They also felt strongly that a team of at least two instructors was needed so that one could present the material and communicate via webcam and the other could manage the
equipment and the chat pod. Communicating via the webcam with a class that couldn’t be seen invoked a sense of ‘disembodiment’ or isolation in the presenters whereas the chat pod managers felt strongly engaged and developed relationships with the students they chatted to. Likewise, students appeared to develop relationships with both the delivering instructor and the chat pod manager. In common with the presenter, some suggested that two-way webcams would improve communication.

![Impressions of the Session’s Chat](image)

<table>
<thead>
<tr>
<th>Thomas</th>
<th>Awesome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas</td>
<td>This was awesome</td>
</tr>
<tr>
<td>Edna</td>
<td>It’s fun...</td>
</tr>
<tr>
<td>James</td>
<td>Ikr</td>
</tr>
<tr>
<td>Chris</td>
<td>Nguyen: awesome session</td>
</tr>
<tr>
<td>Jordan</td>
<td>Shiu: awesome</td>
</tr>
<tr>
<td>Renee</td>
<td>Great</td>
</tr>
<tr>
<td>Rachel</td>
<td>I’ll bring more animals?</td>
</tr>
<tr>
<td>Benjamin:</td>
<td>It’s</td>
</tr>
<tr>
<td>Caitlin</td>
<td>It’s ROMANTIC!</td>
</tr>
<tr>
<td>Thomas</td>
<td>It’s better than school</td>
</tr>
<tr>
<td>Rachel</td>
<td>I see</td>
</tr>
<tr>
<td>Song</td>
<td>Fang’s awesome session</td>
</tr>
<tr>
<td>Michelle:</td>
<td>Cool...</td>
</tr>
<tr>
<td>Zakharov:</td>
<td>It was good, I liked it</td>
</tr>
<tr>
<td>Joshua:</td>
<td>I see</td>
</tr>
<tr>
<td>Shi Hau</td>
<td>Keung: I enjoyed it definitely</td>
</tr>
<tr>
<td>Lydia:</td>
<td>a lot</td>
</tr>
<tr>
<td>Gilbert:</td>
<td>spectacular!</td>
</tr>
<tr>
<td>Jordan</td>
<td>Shiu: yep</td>
</tr>
<tr>
<td>Julia</td>
<td>Wilson: It was interactive and a fun lesson</td>
</tr>
<tr>
<td>Jordan</td>
<td>Shiu: yep</td>
</tr>
<tr>
<td>Rachel</td>
<td>It is maybe bring in a orangutan :)</td>
</tr>
<tr>
<td>Rachel</td>
<td>It was great! 10</td>
</tr>
<tr>
<td>Alyssia</td>
<td>I loved this lesson. It was the best ever!</td>
</tr>
<tr>
<td>Watkins, Howard:</td>
<td>Yeah, but I couldn’t type fast enough</td>
</tr>
<tr>
<td>Caitlin:</td>
<td>15 OUT OF 15</td>
</tr>
<tr>
<td>Song</td>
<td>Fang: agreed Thomas:</td>
</tr>
<tr>
<td>Edna:</td>
<td>The animals were cute... more live animals</td>
</tr>
<tr>
<td>Jordan</td>
<td>Shiu: it’s more fun!</td>
</tr>
<tr>
<td>Charles</td>
<td>Pizzotto: I’ve really enjoyed this session and hope we can do it again sometime!</td>
</tr>
<tr>
<td>Rachel:</td>
<td>I see</td>
</tr>
<tr>
<td>Minus</td>
<td>Mathew: It was very educational and informative learnt new stuff</td>
</tr>
<tr>
<td>Gilbert:</td>
<td>Great work</td>
</tr>
</tbody>
</table>

Figure 6 - Unsolicited responses from the class as the teacher concluded the session

**THREATS**

While protocols and training should address the challenges presented by chat-pod behaviour management, two threats in particular could impede the deployment of platforms like ZC in schools. Firstly, poor sound and video quality due to insufficient bandwidth can distract both students and teachers, and can impede learning. A more complex, and possibly greater threat, was identified during interviews with teachers from the classroom and the zoo. Unwillingness amongst the teaching community to adopt new educational technologies, or to use them in appropriate ways, was seen as the primary threat to deployment. Only relatively new teachers were willing to participate in the trial, and more experienced teachers were recruited with difficulty, in one case passively obstructing the trial. We suspect that this resistance stems from time pressure and that teachers would be more likely to integrate the technology into their teaching practice if they were aware that their workload could actually decrease through reuse, shared resources, and delegation to experts.

**CONTEXTUALISING THE ZOO CONNECT EXPERIENCE FOR AN NBN-ENABLED REMOTE LEARNING/WORKING ENVIRONMENT**

The ZC experience inspired the zoo and classroom teachers to envisage many other innovative uses of online web-conferencing tools. Within the framework of the DBCDE...
checklist of NBN-enabled benefits to education, the following section summarises the ZC results and some of the innovations envisaged by the teachers.

**SUPPORTING ACCESS TO CURRICULUM RESOURCES**

The ZC experience showed that materials developed for entire and partial lessons can be reused easily by the same or other teachers. Review of the captured lesson could assist both students and teachers. Furthermore, the lesson could be set up to provide a range of experiences that senior students could tap into with a range of resources, outside the classroom context.

**NEW OPPORTUNITIES TO EXTEND SPECIALIST RESOURCES**

ZC exemplified the provision of specialist resources to remote locations. Other ways of extending specialist resource could be:

- Students and teachers could benefit from lessons delivered remotely by content experts in other schools. Possibly centres of excellence could be established in clusters of schools with teachers with particular expertise conducting lessons in other schools within the cluster.
- Students could connect with experts in the field who can’t come to the school, for example, scientists in a laboratory, astronomers in an observatory, cabinet-makers in a workshop, or authors of books they are studying.

**EDUCATIONAL OPPORTUNITIES TO ALL AUSTRALIANS NO MATTER WHERE THEY LIVE**

Programs like’ Zoo Connect’ can provide educational opportunities otherwise unavailable to students living in distant rural areas, or in institutions like hospitals. Regardless of location:

- Students could attend field trips and seminars that are currently unavailable to them because of distance and travel time. Instead they would need one or two periods in the classroom or laboratory.

**THE CONNECTIVITY TO DEVELOP AND COLLABORATE ON INNOVATIVE AND FLEXIBLE EDUCATIONAL SERVICES AND RESOURCES**

In ZC, classroom teachers collaborated with zoo experts. They suggested other collaboration activities such as:

- Group work with students presenting and recording their work, for example, four break-out groups from one or more classes or different schools
- Student to student work, for example, provide resources for students to present their argument in a debate from one or more classes or different schools
- Teacher collaboration and in-service training, in particular within clusters of expertise

**THE OPPORTUNITY FOR ONLINE VIRTUAL LEARNING**

ZC did not comply with this checkbox; however, several platforms that might comply, such as *Xbox ‘Kinect’, Nintendo ‘Wii’ and virtual world environments such as Open Sim, Real Xtend and Second Life* are freely available. Several others, designed specifically for educational application, such as SSCRC’s *iSee*, are currently in advanced stages of development.
CONCLUSION

This paper documents an extensive evaluation of an enterprise web-conferencing platform in remotely delivering a topic in the NSW secondary science curriculum. As one of a number of AC assisted lessons, the ZC program suggests that Adam Shoemaker’s vision of NBN-enabled classroom has to some extent pre-dated the NBN, albeit with limitations. These obstacles notwithstanding, affordable platforms capable of supporting DEEWR’s core principles of ‘communication’, ‘collaboration’, and ‘interaction’ are readily available for immediate deployment using existing cable DSL.

Most frustrations associated with the trial platform arose because the recommended minimum bandwidth failed to support the desired quality or functionality. The NBN roll-out should rectify these problems with improved streaming for better quality images and sound; webcams with a view of all participants, and not only teachers; and innovative technologies such as immersive environments and augmented reality, games and multiple learning modalities. These constraints aside, online collaboration platforms can still be usefully considered and ready-to-go for many schools across the nation, early roll out or not, in the transition to an internet-based curriculum.

In trialling the collaborative software platform AC in students’ and teachers’ own setting, (the classroom and Taronga Zoo), the use case and the successes/limitations of the platform were clearly demonstrated, as was the enthusiasm of the participants for this type of learning.

The trials confirmed strong student engagement and the same or better pedagogical results, compared to traditional classroom methods, achieved with less travel. They demonstrated efficiencies of scale and teacher preparation time. They discovered that new and unexpected learning paradigms emerge when students use collaborative software familiar from their everyday lives. New behaviour management techniques and protocols are required to adjust to those new paradigms.

Importantly, a receptive teaching cohort is fundamental to deployment of programs for the NBN-enabled classroom, with resistance from time-poor teachers identified as a major threat. Teachers may need to understand that their workload could ultimately be reduced. They may need additional support in situ, with the assistance of an experienced co-teacher. They may need a reduced workload in order to make the time to learn new skills. Centres of collaboration lead by technology champions could be a good place to start.

Without the impediments of poor quality delivery, and with experience in the use and pedagogical and behavioural implication of the platform, the results would have been even stronger. It is recommended, therefore, that digital services which bring greater flexibility to learning and work environments be prioritised for development and implementation, as they provide communities with useful tools for the here-and-now, assist managers in their thinking about organisational and cultural change, and give future NBN customers a strong sense of the possibilities that lie ahead.

Finally, a word of caution: the positive findings from ZC should not be used to support arguments for an ‘NBN-lite’; it would be all too easy to extrapolate from the study that as so much can be done with less, why do we need more? Yes, bandwidth to schools has been expanded to meet the increased demands of the DER’s laptops-for-schools distribution scheme (Epping Boys High School for example, has over a thousand student laptops running pretty much all the time); but, as we move further into the 21st century, multiple millions of students are likely to synchronously use multiple known and yet-to-be-known digital services. Additionally, the network will be needed for distance education and home learning, with a greater prospect for students to continue accessing resources out of school hour. This will far outstrip capacity gains made under the recent DER upgrade. The more constructive approach to schools’ latest improvement in bandwidth capacity is to opportunistically experiment, as DEC CLIC have done, developing lead users, student mentors and public advocates for a new style of learning along the way.
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REFERENCES

<http://edexchange.adobe.com/pages/home>

<http://helpx.adobe.com/adobe-connect/kb/connect-bandwidthcalculation.html>


<http://www.postcodes-australia.com/areas/nsw>


<http://www.youtube.com/watch?v=xRHbeONYdUc&feature=player_embedded>


Internet Protocol TV (IPTV) is best known as a platform for the provision of entertainment services, such as movies-on-demand, and which provides sizeable revenue streams for telecommunications and Internet service providers in various markets across the globe. Less appreciated are the intriguing possibilities IPTV offers in the education domain where operators are also in competition. They, too, are constantly seeking innovative services and delivery mechanisms for their ‘customers’, who increasingly demand their education via non-traditional modes of delivery to fit in with changing lifestyles and expectations. This article will outline the basics of IPTV technology and provide examples of its being used in a variety of situations across the educational spectrum, including tertiary education, continuing professional development (CPD), and personally tailored education services in the home for the wider community.

INTRODUCTION

Internet Protocol Television (IPTV) utilises broadband data networks to deliver live and pre-recorded channels as well as video-on-demand (VoD) to consumers. Although the term ‘IPTV’ is often loosely used to describe unmanaged, or ‘over-the-top’ best-effort Internet video services, it really means a fully managed, broadcast quality data service that offers high definition (HD) as well as potential to deliver 3D, excellent Quality of Experience (QoE) and the highest levels of reliability (Arberg et al. 2007). In short, the service is fully managed from playout to set-top box by the IPTV service provider. The IP protocol is used to convey the audio and video streams as well as the necessary management and control overheads. To achieve all of this, consumers must be subscribers to the service, which also requires them to log-in, and authenticate in some manner. This also provides secure payment mechanisms for those situations requiring it. IPTV has traditionally been used successfully in the entertainment sphere to deliver sports, movies, drama and a host of other consumer channels to millions of customers in many instances across the globe across the USA, Europe and Asia (Zhu et al. 2009).

More recently, IPTV’s potential in education is starting to be explored (Pohradsky et al. 2010) with particular interest in China (Zhu et al. 2008). Students of all ages and types increasingly expect to have access to more flexible alternatives to campus-centric models of learning. Often they want to fit their learning around other commitments, such as jobs and family, and access educational services in multiple ways. This is one of the major drivers for the current interest in using IPTV to provide the necessary 24/7 access via multiple screened devices such
as tablets and smart-phones as well as domestic TV’s. The result is ‘blended learning’: a model where students receive their education in a mix of face-to-face and online, or ‘eLearning’, experiences.

IPTV’s ability to provide such services in a variety of situations across the educational spectrum, from school age children, through higher education to continuing professional development (CPD), as well as for the general population, will be described in this article. Firstly, some details about generic IPTV services and technology will be provided as background information.

**Figure 1** - Multi-screen IPTV is a commercial reality today, available across multiple devices (source: Ericsson)

### GENERIC IPTV FEATURES

Users in the home or hotel room, for example, require a set top box (STB), which is connected to a video service provider directly or via the Internet with a broadband connection. This provides the link to the IPTV service provider. The STB is also connected to their domestic TV and decrypts the incoming data to provide the TV with a standard video and audio signal. The STB can be seen as the middleman in IPTV transactions: it takes the user commands and interacts with the IPTV management and control layer to provide the requested channel and any associated user functions (Chae 2007). Access to IPTV channels and services normally involves some form of login and authentication. This can mean simply entering a four digit pin number via the STB’s remote control, or selecting a user from a list and then entering a password via a remote control which can have a mini-keyboard built in. In any open setting such as domestic lounge or hotel room authentication allows for some form of secure pay-per-view mechanism if required: the IPTV management system knows who is logged in, and this person can authorise payment for particular movies, for example, via their account.

A typical IPTV platform provides two standard services. One is so-called ‘linear TV’, which is rather like traditional broadcast TV in that, via the STB remote, users can select from a number of channels that are delivered according to a published schedule. These can be live events such as sports as well as pre-recorded material. The second service, video-on-demand (VoD), presents the user with a list, or a more user-friendly series of ‘thumbnail’ images, of videos that can be selected and viewed at any time as shown in figure 2. The user then has full control of ‘trick-features’ such as pause, channel record, fast forward, rewind etc, from their STB remote control, just like having a DVD player or personal video recorder attached to the TV. This is where the critical issue of latency, or system delay, has most impact: if the user feels that the IPTV system is slow to respond to their commands then this quickly degrades the quality of experience.

STB functionality can be built into the TV set or have its function mimicked by a ‘Smart TV’ (basically a TV with a built in microprocessor and browser). Other platforms can be used with software clients that replace the STB entirely such as PC’s, smart-phones, and tablets.
IPTV HARDWARE

An IPTV service requires some basic elements in terms of hardware.

- A server architecture that takes into account the locations and spread of its users so that it can efficiently host and deliver a wide range of video content with low latency and low cost.

- Encoding platforms that take various video and audio feeds from a range of sources, live or recorded, and compress them into MPEG2 or MPEG4 data streams. These data formats are then ingested by the video server and allow the delivery of much smaller amounts of data compared with the originals, but still maintain the high quality necessary for a HD video.

- A high-speed, reliable broadband network that offers quality of service (QoS) differentiation so that the IP (TV) packets can be delivered to end users with priority over other broadband traffic on the same connection, such as Internet best-effort traffic (Arberg et al. 2007). Uni-cast and multi-cast capability must also be supported by the network. For example, when a user makes a request for a particular VoD item the video server will return it in a uni-cast stream. This means the data stream is directed on a one-to-one basis from the server to each STB. Alternatively, live channels can be ‘broadcast’ to multiple simultaneous viewers analogously to terrestrial broadcast TV. This involves the use of multi-cast data which is an efficient way of distributing video through a network: additional data streams are only created where required, rather than sending multiple copies entirely from end to end (NBNCo 2012).

IPTV MIDDLEWARE

IP Multimedia Subsytem (IMS) is a standardised architecture for providing IP-enabled services, and is designed to have the flexibility to deliver new types of combined telecommunications and Internet services into the future (Mas 2008). It allows users to access all of their multimedia and voice services from any platform, fixed or wireless.
IPTV ‘middleware’ refers to the software that provides communication and delivery of data and connects the separate parts of the IPTV ecosystem. It can be integrated with IMS to enable the service provider to give their IPTV customers an interactive, customised, or even mobile experience (Nguyen 2010). For example, IPTV can be delivered to multiple screens, not just large screen TV’s, so that users can watch and have control over video streams on mobile devices such as tablets and smart-phones. Messaging, social media and other telecommunications services can also be integrated with the IPTV service to add to the user experience (Beck 2007).

IPTV IN EDUCATION

Now that the IPTV basics are covered, we take a look at the possibilities IPTV has in education.

TERTIARY EDUCATION

IPTV has been used in educational institutions on many campuses worldwide, but often with entertainment rather than education in mind: to rebroadcast terrestrial TV channels and VoD into student residences, for example (Klick 2012). Other institutions have used IPTV in some form to deliver live or recorded lectures, sometimes along with the entertainment channels, but still falling short of offering the innovation in services, interactivity, or delivery of content to multiple devices that the platform is capable of.

In one example of what is possible, The University of Melbourne recently investigated the potential of IPTV for truly innovative educational services in a pilot lab-based proof-of-concept (PoC) called ‘Uni TV’ (IBES 2012). This PoC proved that the IPTV platform was well suited to the provision of educational services. This ranged from more traditional online lectures, tutorials and fact-based programming, to more forward-looking implementations for eLearning such as lectures filmed in 3D at the University (IBES 2011). Figure 3 shows a 3D chemistry lecture using physical models to explain the molecular dynamics of CO$_2$.

![Figure 3 – 3D chemistry lecture with IPTV STB and active glasses.](image)

3D is also becoming more prevalent in the education domain thanks to the development of various training simulators, particularly in medical faculties, which was also demonstrated as part of the ‘Uni TV’ PoC. The details of this are described in the section on continuing professional development later in the article.
The cost of 3D technology, such as domestic TV screens and high-definition (HD) camcorders, has fallen dramatically in the past twelve to eighteen months thanks to its wide uptake and ongoing development by the entertainment industry (Deal News 2011). This means that 3D can now be used for practical, cost-effective educational purposes in many scenarios, and IPTV can extend 3D’s reach out of the laboratory, clinic, and class-room and into the homes of users via broadband data networks. For a considerable period of time, the usage of 3D has been recommended to facilitate learning in situations that would be impractical in the real world, to transfer knowledge through the contextualisation of learning, to enhance intrinsic motivation and to create spatial representations of complex concepts (Chitaro 2007). IPTV’s ability to store, to provide easy repeated access, and to display 3D HD reliably at broadcast quality makes it an excellent choice for these situations.

The IPTV platform chosen has also shown its ability to stream video material to iPhones, Android phones, laptops, PC’s, and tablets with the addition of encoders that can serve the material in the appropriate format for each device. It can also take into account the bandwidth of the network connection and scale the resolution appropriately, which may change in real-time, particularly with wireless connections.

The successful PoC has more recently led to ‘Uni TV’ being rolled out by The Melbourne Dental School (MDS). At the time of publishing the IPTV platform is in the installation and commissioning phase and is due to go live for staff and students early in 2013. The roll-out consists of delivering IPTV to various sites across Victoria via both the National Broadband Network (NBN) and Australia’s Academic and Research Network (AARNet) infrastructure, including local and remote campus locations in Melbourne and Shepparton, as well as home use in the first wave NBN build area of Brunswick.

The MDS is an interesting test case for IPTV’s real-world efficacy in an educational setting, because it has so many video-content creation avenues. As well as lecture and tutorial capture cameras, the School’s pre-clinical and clinical areas between them have a range of specialist cameras and simulation tools as part of their daily teaching and patient treatment activities. There are microscope cameras which can be monocular (2D) or stereo (3D) according to the type of beam-splitters used; podium cameras which look down on the clinical-tutors’ hands as they demonstrate complex procedures; wide angle cameras that capture dentist-patient interactions; 3D haptics simulation work-stations; intra-oral dental cameras which can be used for tele-dentistry with the confined elderly, and remote patients.

MDS has identified scenarios where IPTV could have major impact on both future learning and business opportunities for the school, and these are to be the subject of IPTV trials in the coming year. These opportunities range from improving outcomes for existing undergraduates, providing services to staff and students on remote campuses, and improved continuing professional development (see below).

**Primary and Secondary Education**

Kindergarten to year 12, or K-12, school-age children are well placed to benefit from innovations in educational IPTV, particularly for those subjects often identified with serious teacher shortages in many areas across Australia (MCEECDYA 2005). These usually occur in outer metro, rural, and remote areas and highlight the importance of the National Broadband Network in delivering services to these regions. However, particular subjects also suffer from shortages in metro areas: mathematics, the sciences, as well as music and arts training fall into this category.

Educational IPTV offers an opportunity to get high quality teaching into class-rooms that have no local specialist teacher. Master-classes in music tuition could also be delivered. Depending upon requirements and circumstances, the IPTV experience can be facilitated by the simultaneous use of video-conferencing, via either a second screen or a ‘picture-in-picture’ approach that allows a central tutor to appear alongside video material. This can provide for live one-to-many and many-to-many ‘Q&A’ sessions for a number of students spread across various locations.
CONTINUING PROFESSIONAL DEVELOPMENT

Part of the ‘Uni TV’ rollout described above is aimed at improving pathways to continuing professional development (CPD) for existing dental practitioners. Provision of educational services locally via IPTV can save lengthy and costly travel to city locations for training which, in turn, improves the range of locally provided dental expertise in outer metro and rural communities. Such cases make it is easier to understand how educational IPTV can provide spin-off benefits to the wider community as CPD training can occur in many areas inside and outside the health domain.

Although CPD is usually based around traditional lecture and tutorial style courses, it is possible for sources other than cameras to provide content for these specialised IPTV channels: ‘haptics’ simulators are increasingly common and provide a virtual environment where realistic touch feedback is provided to the user via a number of motors that resist the operator’s movements whenever a virtual obstacle is encountered (Minogue 2006). This is combined with a 3D (anatomical) display which provides for a more immersive environment. For example, the user picks up a pen-like control held in a motorised cradle. The simulation can show a virtual drill or scalpel, or similar hand-held tool, and reposition it according to the hand movements of the user. If the virtual drill contacts virtual bone in the 3D simulation, the hand-piece no longer moves forward, giving the user the feeling that they really are cutting into bone with the genuine article. If the drill touches virtual flesh, slightly less resistance is felt and even virtual blood can be spilled, giving the user a literally ‘hands-on’ training experience without risk to real patients (Hutchins et al. 2005).

Such haptics tools have direct applications in CPD environments: in the ‘Uni TV’ PoC a live IP video stream from a haptics cochlear implant surgical 3D simulator was captured by the IPTV platform, and then made available as a live surgical training IPTV video channel (IBES 2011). The Melbourne Dental School is also planning to use such haptics trainers for the practice of various types of clinical procedures.

The IPTV system is able to automatically record such inputs so that they then become available as VoD material for subsequent view by (CPD) students unable to attend the live demonstration, or for those who were present but also wish to go over the material at a time and place of their choosing. This is the so-called ‘time- and place-shifting’ model: students increasingly expect to have access to such flexible online, or ‘eLearning’, alternatives.

PUBLIC EDUCATION

IPTV obviously has potential in delivering education services of a more general nature to the public, but there is also ample scope for it to be used in targeted ways for particular applications in the community. For example, there are large numbers of the population in lower socio-economic categories, such as migrants (English as second language), indigenous, and the aged. These segments of the population tend to have difficulties with personal computers and Internet tools: they are less likely to have adequate finances or the required skills to use the technology. This means that their access to vital information is often compromised, which negatively impacts on their financial and health literacy for example (Schillinger 2002).

(I) TV offers the above-described groups the potential to reach what is, for them, otherwise inaccessible information via a more familiar and friendly interface. Making information accessible via a remote control and TV makes it much more likely to get through to the target group. Equally importantly, the provision of a relatively inexpensive STB means existing TV’s in the home can be used without incurring high levels of additional expense. IPTV can easily be provided at alternative venues such as libraries, health centres, and other public places to improve access even further.
The IPTV integration example below describes one approach to improve health literacy. An existing web-based system called SeeCare is used to provide online access to personalised health information to older people and to people with chronic conditions such as diabetes and cancer. It also provides personalised information to the carers in their support networks. The personalisation is achieved from the details entered both by their health professional and by the patient themselves: the patient can set the necessary permissions for family members or friends to access information about their condition. Figure 4 shows how this service is integrated with IPTV to provide personalised video content. The IPTV middleware seeks only the relevant health information from the SeeCare server to enable it to select the appropriate material for view by the currently logged in viewer. It then provides a list of content based on these parameters to ensure the patient or carer receives exactly the right material based on their current status.

**Figure 4** - Integration with a health literacy platform to deliver personalised video content

The system still maintains patient privacy via the authentication mechanisms between the viewer and IPTV platform, as well as between the IPTV platform and SeeCare server. The integrated SeeCareIPTV system thus provides people in need of care and support, and their carers, with a personalised health literacy TV channel using familiar technology, the television, in a familiar setting, the home.

The same approach can be used for future services that will cater for other areas of interest via the additional of IPTV channels integrated with the relevant IP-enabled platforms.

**CONCLUSION**

IPTV can have genuine pedagogical impact in education, not only for tertiary level students seeking alternatives to campus-centric learning models, but also for many in the wider community. These include those undertaking continuing professional development courses to maintain and improve their skills, and ‘K-12’ school students who often lack access to teachers in certain subjects. The general public can also benefit from educational IPTV and, in particular, those in lower socio-economic groups, who lack the requisite skills and access to personal computers and web-based tools. This group could use their home (IP) TV as an
educational resource for improved lifestyle choices and to strengthen the quality of their support networks.

IPTV’s ability to be integrated with other IP-enabled services will be a major driver of its use into the future.

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REFERENCES


Pohradsky P; Londak J; Cacikova M. 2010. ‘Application of ICT in pre-school education’. ELMAR conference proceedings. 159-162.


Mas I; Berggren V; Jana R; Rice C. 2008. ‘IMS-TV: An IMS-Based Architecture for Interactive, Personalized IPTV’. IEEE Communications Magazine. 156-163.


NBN VIRTUAL SCHOOL OF EMERGING SCIENCES
HOW TO TRANSFORM THE WORLD ONE SCIENTIST AT A TIME...

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The National Broadband Network (NBN) creates new opportunities for collaborative education. John Monash Science School, Monash University and Pearson Australia have joined together to provide the NBN Virtual School of Emerging Sciences (NVSES), linking together Year 10 students who are passionate about science.

The programme provides access to experts in leading fields such as nanotechnology and astrophysics, and gives students the opportunity to be knowledge creators as well as problem solvers. With their experience designing real-world research projects to solve today and tomorrow's problems, graduates of the programme will be well-placed to contribute in their future workplaces.

INTRODUCTION

The future of Australia's economy lies in well-educated innovators in the knowledge workplace. It is well understood that science plays a key role in the research and development capability of a nation. However, current participation in science in secondary schools is in decline. The National Broadband Network (NBN) Virtual School of Emerging Sciences (NVSES) aims to inspire and equip senior secondary students to be explorers and agents of change, particularly in the "discovery" fields of science.

Modern sciences like nanotechnology, astrophysics and bioinformatics are a source of great interest to many students, but most schools do not have the resources or expertise to explore them. To address this need, John Monash Science School (JMSS), Monash University and Pearson Australia are joining together to provide a world-first programme of emerging science education to schools across Australia.

The NVSES programme will use the NBN to create virtual classrooms of students drawn together from multiple schools. These students will get the opportunity to connect with world leaders in the emerging sciences, exploring the latest insights and designing a research project that applies this knowledge in students' local context.

The NVSES will use a variety of social, collaborative and self-directed learning tools to ensure students are both challenged and supported in their learning experience by peers and teachers. This will include leading cloud-based solutions such as Google Apps for Education and innovative educational technology from leading vendors such as Pearson Australia and
Cisco Systems Australia. Open-ended enquiry will be supported with remote access to real and virtual research equipment.

The programme provides broader access to scarce resources; teachers, experts and equipment, which many students across Australia could not otherwise access. The social approach provides an opportunity for the learning experience to be shared beyond participants to their local classmates and their families.

Students will graduate from the NVSES programme with hands-on experience of researching in the emerging fields of science and applying scientific practice, including the opportunity to defend their work to peers and leading academics. Students will learn that science is not a passive learning of formulae and facts, but an active search for new meaning and a deeper understanding of our world.

It is also hoped that a powerful, positive experience of science as a continually emerging field, in their formative years of schooling, will impact students' selection of science in higher education and future career paths.

Teachers from the participating schools also have the opportunity to engage with and learn from the experience, with mentoring and professional development provided by teachers from JMSS and academics from Monash University. This powerful dynamic of teachers learning alongside students and the blurring of traditional roles, spaces and pedagogies will make the NVSES a very exciting "place" to learn.

BEGINNINGS – THE JMSS REGIONAL SCIENCE EXCHANGE

The NVSES builds on a successful 2011 and 2012 'Regional Science Exchange' programme conducted by John Monash Science School (JMSS) in partnership with Monash University Faculties of Education and Science), the Victorian Education Department (DEECD) and 14 regional and rural schools.

JMSS is a specialist science school established by Victoria's Education Department to raise the profile of science education and demonstrate new approaches to exploring science in secondary schools. Working with Monash University, JMSS developed a programme of science electives targeted at Year 10 students. The semester-long electives provide students with a chance to engage directly with Monash scientific researchers and outside experts in fields such as:

- Nanotechnology
- From Cells to Systems (Biomedical Science)
- From Bugs to Drugs (Pharmaceutical Science)
- From Quarks to Quasars (Astrophysics)
- Our Dynamic Earth (Geoscience)
- Bioinformatics
- Imaging Science (imaging and visualisation)
- Marine Science
- From Logic to Magic (mathematical pattern, logic and beauty)
- Computational Thinking

In studying these electives, JMSS students are also exposed to world leaders in scientific research (eg. a recent lecture by Nobel laureate Brian Schmidt on the big bang and the future of our universe).

Students not only learn from experts, high quality resources and experimentation, but there is an equal emphasis put on collaborative research in a real world context. Students explore
questions, through a model of scientific enquiry, which are meaningful to them and in many cases are the questions being explored at the cutting edge of scientific research in labs around the world.

Students share their research findings through an annual science fair where they have to explain and justify their work to peers, parents and academics from Monash and beyond. These projects are the lynchpin of the programme – students are not only exposed to these emerging fields of science but are participating in how they can be used to solve current and future problems, becoming knowledge creators as well as knowledge consumers.

**Taking the Emerging Sciences Beyond JMSS**

With a mandate to facilitate change in science education across Victoria, JMSS leaders worked with regional directors in Loddon-Mallee and the Grampians to extend access to the programme to students in rural and regional schools. Students visit the JMSS campus for five weeks of on-site participation, and then collaborate with JMSS peers and teachers from their home school for a further ten weeks.

Although the programme has limited participation (as few as one child per school, including one who flew in each week to participate), the continuation of the programme at the student's home school gives both their peers and their teachers an opportunity to share in the experience. Teachers also access professional development around innovative educational approaches in teaching the emerging sciences through enquiry and technology.

The programme has been a huge success in terms of developing links between remote learners and teachers which revolve around a passion for science and a building of capacity to engage in scientific learning which is cutting edge, challenging and critical in developing the skills needed to continue work in scientific research. In addition, the experience of learning in a school so closely linked to a university has changed the aspirations of some students in terms of participating in higher education.

Although JMSS and regional schools will continue the programme, it is necessarily constrained in scale by its on-site nature and the physical housing of students in homestays. The NBN provides an opportunity to massively scale up the approach, providing students around Australia a chance to engage with these emerging sciences, and thereby increase their desire to study science, enter University and become explorers and agents of change in Australia's knowledge workplaces.

**Feedback from Students Participating in the 2011 Regional Science Exchange**

Feedback from participants in the programme has been very positive. Comments from participants in the 2011 programme include:

"Going to Uni and seeing what kind of sciences you can do in jobs, it's shown me there are a lot more job opportunities than just medicine. I'm now thinking of a career in either orthodontics, geology, zoology or palaeontology.

"I was actually thinking that maybe I wouldn't go to uni, but now I'm thinking that I really want to go."

– M, 2011 participant

I'm thinking [of pursuing a career in] physics, whereas before I came here, I was thinking more towards medicine.

"When you experience all the different sciences first-hand – not just second-hand information from other people and off the Internet – it's really good."

– D, 2011 participant
"I definitely want to do stuff in science, which I wasn't too sure about when I first came here. But now I know what I really want to do: I'd like to be a zoologist."

– S, 2011 participant

PROJECT RATIONALE

Beyond just providing access to scarce resources, such as qualified physics and chemistry teachers and scientific experts, this project is also about changing the way people engage with and think about science. Science should be more than just a history lesson. It should be an active exploration of modern insights to modern problems.

When students are exposed to the emerging fields of nanotechnology, astrophysics and pharmaceuticals, their interest in science and university engagement increases dramatically. The NVSES project equips students as active researchers in these fields in a national network of students and teachers passionate about science. Perhaps most importantly, it provides this opportunity to students regardless of the limitations of geography or local school facilities and resources.

The Victorian Department of Education and Early Childhood Development's strategy, 'Energising Science and Mathematics Education in Victoria' (2009), highlights the critical need for young Victorians to engage with higher education studies and more importantly to pursue careers in the enabling sciences: 'The future of Australia and Victoria depends on the next generation being excited by careers that use science, maths and technology. We need a strong pool of talented mathematicians and scientists to push the technological and scientific boundaries of innovation.'

Similar statements and accompanying strategies are published in other states and at a national level. It is publicly recognised that the emerging sciences are the key to economic growth for countries in the developed world. However, student participation in science is in decline (Thomson et al. 2010), with particular issues evident in physics, chemistry and mathematics (Office of the Chief Scientist 2012).

Despite a number of programmes and an increasing sense of urgency, interest in high school science continues to decline (e.g. Ainley et al. 2008) leading to a corresponding decline in university science enrolments (e.g. Scoullar 2008, Office of the Chief Scientist 2012). Together, these needs are leading most governments to invest more heavily in Science, Technology, Engineering and Mathematics (STEM) education and in the fundamental sciences underlying them.

Unfortunately, the impact of these new opportunities may not be widespread enough and, generally, student exposure to science is from the more traditional applications within curricula that reflect little of the radical developments in the last 20-30 years. Bioinformatics, astrophysics, pharmaceutical science, bio-medicine and nanotechnology are just a few fields that are barely mentioned, if recognised at all in current secondary science education. Not surprisingly, student desire to participate in these sciences wanes well before their exposure to these topics at university.

Furthermore, many schools (especially in rural and remote locations of Australia) do not have access to specialist science teachers in disciplines such as senior physics and maths. As a result, these subjects are often taught by teachers from other disciplines with limited insight or expertise (Panizzon et. al. 2010).

The NVSES will connect students with teachers and academic experts who are well-qualified in these fields and the latest emerging trends. This connection to the human or personal side of science is a critical factor in reshaping the way students think about science, which is clearly demonstrated by the inclusion of the Science as a Human Endeavour strand in the Australian Curriculum: Science and Senior Science (K-12).
PROJECT DELIVERY

The five partners contributing to the initial design and delivery of the NVSES are the Australian Science and Mathematics School, Gungahlin College, Tasmanian eSchool, Willunga High School and Cisco Systems Australia.

In the first instance, the programme is intended to be select entry, focusing on students who are excited and enthusiastic about a science career and equipped to undertake 8 weeks of active learning and a research project.

Year 10 students from across the country will be nominated by their school to participate in one or two term electives. Teachers from the NVSES will work with local teachers and student mentors (past graduates from the program) to lead participants in an invigorating, application-oriented and research-informed learning experience.

Schools will identify appropriate teachers, support staff and students to participate in the programme who will be supported through the process with online professional development and a thorough change management programme, ensuring that the current needs and capabilities of each school are incorporated into the delivery of the programme.

In addition to the NVSES teacher's availability during online lessons and asynchronously, teachers in situ will support students during the 8-week modules, enhancing their own knowledge of the subject and the mode of learning.

THE EDUCATIONAL EXPERIENCE

The programme will often adopt a "flipped classroom" approach, with students preparing before each class by engaging with online learning resources, simulations and assessments. In class time, the teacher will review what the students have studied, exploring challenging concepts and supporting students in applying what they have learnt.

The challenge and one of the objectives in designing this project has been to ensure that the art of the classroom teacher in supporting and personalising learning with students is translated into an online environment, synthesising the best pedagogy with the best technology, going beyond best practice into the realm of next practice.

Through a blend of live and asynchronous guest lectures, experts in the field will provide insight into current trends, with an opportunity for students to ask questions about current applications and really understand the challenges and joys of scientific research at the cutting edge.

The burgeoning online community of teachers, experts and most importantly peers will be of invaluable support as learners engage in their own research and inquiry in preparation for the concurrent online and physical science fair. Learners will develop an understanding of themselves as learners in a virtual space and the importance of community, open-mindedness and critique when learning collaboratively at a distance.

PROJECT SCHEDULE

The programme will be run from January 2013 to December 2014. Major project milestones include:

- October 2012 – Initial project design complete
- February 2012 – First class commences with partner schools
- April 2012 – Further schools invited to participate
- June 2014 – Conclusion of demonstration trial
- December 2014 – Final report and evaluation complete
The trial starts with an initial teaching programme across four states and territories, and, subject to demand and network-readiness from other states, will expand to support all areas of Australia with appropriate network connectivity (NBN or equivalent). It will integrate secondary, tertiary and corporate educational resources and services to provide a high-quality educational experience for both students and teachers.

Importantly, given that NVSES will be cross-jurisdictional the curriculum used will address components of the three strands of the Australian Curriculum: Science Understanding, Science as a Human Endeavour, and Science Inquiry Skills.

NVSES will develop and deliver four 8-week modules, two for Quarks to Quasars and two for Nanotechnology:

<table>
<thead>
<tr>
<th>Emerging Science</th>
<th>Leading module</th>
<th>Research module</th>
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<tbody>
<tr>
<td>Quarks to Quasars</td>
<td>Astrophysics</td>
<td>Quantum Physics</td>
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<tr>
<td>Nanotechnology</td>
<td>Principles and Concepts</td>
<td>Applications and Implications</td>
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Table 1 - Two subjects and four modules taught in NVSES.

Each module will be discrete, and the leading modules can be studied independently. However, the research modules (which include a research project) require the prerequisite leading module.

**POTENTIAL BENEFITS**

The need for increased engagement in science education and its link to productivity and innovation is well documented. Providing enthusiastic students with these kinds of opportunities can lead to "super-engagement" that extends beyond these areas to impact students' other studies, their classrooms and teachers, and ultimately, their school. Students are validated and inspired by peers and educators who are equally passionate about science. This may impact tertiary progression, as students reconsider previously held views about the intimidating nature of universities to one of excitement, intrigue and motivation based upon their positive experiences in the NVSES.

Professional development of teachers is also a crucial component of the project. Teachers will be equipped to support the collaborative and personalised education models this curriculum requires. Support for teachers is critical as they oversee the learning journey of their students. Staff from the Faculty of Education at Monash and JMSS have developed an effective professional development programme that has received strong positive feedback from Regional Science Exchange participants. The NVSES programme builds upon these proven approaches.

In 2011, JMSS' Regional Science Exchange had a demonstrable impact on student interest in Australian Tertiary Admission Rank (ATAR) performance and university studies. Equally importantly, it also affirmed the value of science education by connecting passionate students with peers who validated a continuing interest in science. The NVSES aims to scale up these existing benefits and demonstrate a new model of education – one that provides distributed access to scarce discipline-specific teachers within an engaging online environment with the opportunity for exposure to leaders and researchers in the emerging sciences.

Several thousand students and teachers will benefit from the deployment trial. The programme also aims to explore the potential development of a sustainable, scalable model that would support delivery to far greater numbers of students. There are also potential opportunities for translating the model to other disciplines. With in-built professional learning for teachers, it is hoped that the approaches and tools used in the programme will influence teacher adoption in other subjects.
These improvements can lead to significant economic outcomes. Teachers better equipped to teach with collaborative approaches will have direct impact on student learning performance; avoiding costs of student failure and resulting in more capable and productive students ready for university and the workplace.

EVALUATION AND OUTCOMES

In the short term, the programme will be evaluated by:

- feedback from participating students, teachers and schools;
- changes in student career aspirations and university intentions;
- growth in the programme; and
- the interest generated in extending the model to other disciplines and/or countries.

The ultimate measure of success of the programme is students changing the way they think about science, applying scientific thinking to the problems they face in everyday life, no matter what field they study and work in and developing an outstanding capacity to work collaboratively, virtually and independently, choosing the best technology for their needs.

Modern workplaces face constant and rapid change requiring complex problem solving skills. Students with experience in solving problems that cannot just be "Googled" will be sought after by employers. These outcomes could lead to real economic benefits.

"Establishing a National Centre of Pedagogy" (Loughran et al 2008) provides a thorough analysis of the impact of improved teacher capability and improved education on Australia's economy. Based on their most conservative model, a program such as this could deliver tens of millions of dollars in benefits.

Increased participation in science also has direct benefits to the Australian economy. Reports from the Productivity Commission (2006 and 2007), indicate that over $6 billion is spent by the Federal Government on research and development and nearly twice that by industry, with a return on investment of 13-26%. If this programme can increase that workforce by just 1% (less than the students participating in the deployment trial), it could produce further returns in the tens of millions of dollars.

FUTURE DIRECTIONS

During the final semester (early 2014), explorations will be underway to determine the ongoing sustainability of the programme, in the hopes that the NVSES might continue after the Government-funded demonstration trial completes. It is hoped that access to the program could be expanded to include a broader selection of students from years 9-12, depending on interest and availability.

CONCLUSION

This programme has the potential to kick start significant change in Australia's education system. In such a large country with limited resources, new approaches to education are crucially needed. Beyond this, improvements in education the potential to fuel further growth in Australia's third largest export industry (Education).

Combining a National Broadband Network and all of the benefits that brings in terms of high speed access to rich multimedia resources and platforms for collaboration, with a dynamic curriculum which continually realigns itself with scientific thinking as it emerges will be a model for learning in a new and exciting space.

The NVSES will continue to grow and change ensuring that the best of pedagogy, science and technology combines to enthuse and challenge the next generation of Australian scientists to
be amongst the best in the world, with exceptional knowledge, skills and attributes along with a truly connected and collaborative outlook.

ACKNOWLEDGEMENTS

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REFERENCES


Loughran, J.J; Berry, A.K; Clemans, A; Lancaster, G.R; Long, M.G. 2008. Feasibility study: Establishing a national centre for pedagogy, Teaching Australia - Australian Institute for Teaching and School Leadership, Canberra, Australia.


The Internet has transformed the possibilities and helped to change the practices for universities as media organisations. This discussion explores two new media initiatives at the University of Melbourne: *The Conversation*, an online news and information service launched in March 2011, for which the university was a founding partner, and *The Citizen*, a new online publication to be launched by the Centre for Advanced Journalism in 2013. Jock Given spoke with the director of the Centre for Advanced Journalism, Margaret Simons, and the managing editor of *The Conversation*, Misha Ketchell, in Melbourne on 25 September.

**INTRODUCTION**

In the Internet age, every organisation has become a media organisation. Universities always were. Academics were supposed to perish if they didn’t publish. University presses were among the most prestigious publishers of scholarly work and university print rooms became prolific publishers once photocopiers and collective copyright licensing arrangements enabled them to produce course readers for individual subjects instead of prescribing textbooks. Journalism schools published newspapers and operated radio and TV stations.

The Internet has allowed academics to publish faster and more widely and their universities to set up online ‘institutional repositories’ that keep all their work in one accessible place. University presses have established e-presses for short-run, print-on-demand or e-book monographs on specialised topics. Teachers have shifted subject materials online. Now, social media is providing new opportunities to change teaching practices but it is also requiring university administrators and educators to communicate with students in new ways.

The University of Melbourne has had a publishing company for more than 80 years and a theatre company – the Melbourne Theatre Company – since 1953. It was one of the founding partners of the online news and information service *The Conversation*, launched in March 2011, whose offices are located at the Parkville campus. In 2013, the university’s Centre for Advanced Journalism will launch a new online publication, *The Citizen*.

TJA editorial board member and Swinburne University media and communications professor Jock Given spoke with Misha Ketchell, managing editor of *The Conversation*, and Margaret Simons, Director of the Centre for Advanced Journalism, in Melbourne on 25 September 2012.
Misha’s entire career has been in journalism. He edited the student paper at Melbourne University, The Big Issue Australia and the Melbourne Weekly; worked at The Age for six years as a reporter, feature writer and leader writer; edited Crikey; then spent four years working at ABC TV’s Media Watch as a producer and researcher before joining The Conversation in 2011.

Before taking up her position at the University of Melbourne, Margaret was at Swinburne University for three years as a research fellow and coordinator of the journalism program. She has been a professional journalist for about 32 years, working freelance for most of the last 20 years and before that at The Australian and The Age.

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JG You have both spent a long time working for mainstream media organisations – organisations like The Age, the ABC – but also for organisations that are not so mainstream. Why have you come to work for universities now, and what it is that they enable you to do that you might not have been able to do in a mainstream media organisation?

MK For me it’s really about a public sector space. Lindsay Tanner released a book last year called ’Sideshow’ in which he talked about what he saw as a collapse of quality journalism or serious public interest discussion. My career in journalism has been coupled with a pursuit of, wherever possible, places where I feel the work you do is not compromised by commercial agendas or vested interests, where what you're doing is actually performing a democratic journalistic function or being part of a conversation that’s in the public interest. That’s definitely what I tried to pursue when I was at the ABC and what I enjoyed when I was working at The Age.

Because of the disruptive impact of Internet technologies, the conversation is happening less in certain places than it used to – for example broadsheet newspapers, which are suffering greatly because their revenue streams have decreased. I still see universities as a great public sector location. University academics are, to some extent, publicly funded (also privately funded through tuition fees from students and other sources of funding) but they're essentially set up in a way that they are sort of disinterested contributors to public debate. That was the sort of space I really wanted to work in.

MS I find resonances with most of what Misha said, but the truth is, my entry into the university was really a bit accidental. One of the main freelance gigs I had from about 2005 onwards was writing about media: a meta-journalist some people have called me. That was largely for Private Media Partners (publishers of Crikey),
including the period when Misha was editing *Crikey*. Through that, I became increasingly interested in the way journalism was changing and needed to change. I also had some sense of dissatisfaction about the ways it’s done at present. So I got increasingly interested and concerned about that and engaged with some of the academic researchers in the field. That led to Swinburne approaching me with the suggestion of a research fellowship which I took up; and that led to being asked to design the journalism program; and then that led to my current job being advertised and me applying for it. So I didn’t at any stage sit back and think, ‘now I’m going to be an academic’. In fact I still feel like I’m pretending most of the time. Having said that, I think everything Misha said about the university is true, and also that the notions of academic independence that you find at a good university are not a million miles away from the notions of editorial independence that I was raised to value.

**JG**

Can either of you give a specific example in commercial media where there was something – a story you were working on, a story you might have worked on – where you felt pressure to take it in a certain direction or not ask particular questions? An example where you think someone working within a university might be able to handle the story in a different way?

**MK**

I’ll give you an example, not an example of an incident where I was asked to do something, but of where commercial imperatives direct the coverage. An academic at the University of Technology in Sydney did some research into the impact upon infants of sitting in a pram which is facing forward. For her research, she strapped a camera to a pram, took it through a shopping centre, and got evidence of all the kinds of stimulus the child will be exposed to. Basically her argument was that because of the developmental stage of the infant brain, if you're in a shopping centre and you're getting a lot of stimulus, the child could be over stimulated, and it’s better for a child to be facing the parent than not. This academic gave the story to a journalist from the *Daily Telegraph* in Sydney and she said: 'Look I don’t want to make parents feel guilty, the research is tentative at this point, but this is the conclusion, that probably on balance it’s better for the infant to be facing the parent'. And the story came out and it was: ‘Academic slams cruel parents for putting their children in their prams’. It turned it into a massive fight. That academic got threats, somebody came and left a leaflet on her car, she had a very traumatic experience. Now her agenda in trying to communicate that research was just to try to explain what her research findings were.

The journalist’s agenda in a commercial media outlet like the *Daily Telegraph* is to attract readers, to attract eyeballs, to entertain people. That’s part of what you do and it’s part of what you do in any media organisation. That agenda is still there at the ABC or *The Age* or anywhere else. But in a particularly commercially oriented organisation, that agenda can overwhelm what you do and it can mean you present information in certain ways. I would just prefer to be in environments where that’s not the predominant thing in your mind when you think about how you structure a story.

**JG**

Can you explain what you're trying to do with *The Conversation* and what is different about it from other media enterprises?

**MK**

Andrew Jaspan, who founded *The Conversation*, was talking to Peter Doherty, the Nobel Laureate here at Melbourne University. Peter was saying how difficult he found it working with journalists, in particular, because of the adversarial style and the way his work was represented. He said: “Look I’m just sick of talking to journalists. I do an interview and I go home and just before I go to bed I think: how bad is it going to be, how much are they going to get wrong? And I wake up in the morning and I look in the paper and I think: Oh God here we go again.” So he said:
“What if the journalist came and sat by me and helped me express my ideas and explain my research in a clear way rather than saying I’m against you?” That’s really the idea behind The Conversation. It’s pretty much that simple, it’s saying there’s all this wealth of expertise in academia. The university is structured very much like a newsroom. You’ve got a law faculty, an economics faculty, an architecture faculty. Similarly in a newsroom you’ve got a law reporter, you’ve got an urban affairs reporter, there’s straight corollaries between the two, they sort of match each other.

So the idea is to turn the academics in the university with all their expertise – people who spend 10, 20, 30 years on a subject – into a newsroom and use them as reporters to communicate direct to the public. Rather than trying to filter it through a journalist who is in that adversarial mode, have somebody sitting with the academic helping them, subbing, rewriting, putting a headline on the story. But the key thing we do is ensure the academic has final sign off. Their research will be presented accurately, they communicate to a wide audience, the headline is not going to misrepresent them, they're not going to be quoted out of context. That’s basically the idea.

**JG** How does the commissioning process work and how many people do you have contributing?

**MK** Academics register to be on our site. There are more than 3000 academics registered to write. That doesn’t mean they're all active authors, but a significant proportion of those are. We work like any newsroom. In the morning at 9 a.m. we have a news conference. We all read the papers. There are editors in each section – health and medicine, science and technology, business and economy. They're across their areas and they say: OK this is happening, we've got a piece on this, can we do something on...? You know when Fukushima happened, can we get an expert on the impact of radiation on the human body? Is there something interesting that happened on Lateline last night that we need to pick up? How are we going to respond to Cory Bernadi’s comments equating homosexuality and bestiality? Do we get Dennis Altman from Latrobe, who wrote that famous book Homosexual? Who is the right person to write on that? So a lot of what we do is commissioning academics in the way any editor in a newsroom would commission a reporter to write the piece. That means sometimes getting an academic to write very quickly. People said to us initially that’s not going to work, academics can’t write quickly. And we found that that’s just not the case. We can get people to write within two hours if we need to. Sometimes we’ll help them, like we might conduct an interview, write some notes, send it back to the author. The key thing is because we’ve got a sign off process they see the final version. We can’t publish, our system doesn’t let us publish, unless the academic actually clicks a button saying they approve every aspect of this story.

But that’s only really half of what we do, because I always say to the editorial team I work with, that if all the ideas are coming from me, then every idea we’ve got is already out of date. All my ideas come from reading the newspapers and listening to Radio National and other media outlets. What I want is also for the editors that work in The Conversation team to be talking to academics and researchers and discovering what they're doing that isn’t being reported currently and bringing that to light. So a significant proportion of what we do is bouncing off the news agenda, but a significant proportion is also trying to find the most interesting research, the most interesting things going on in universities and sharing that with the larger public.

**JG** Margaret, The Citizen?
The Citizen isn’t launched yet of course. We just hired our editor, Simon Mann; in fact his first day was yesterday and so quite a lot of key decisions are still in development and they will be his decisions, not necessarily mine. But the idea of The Citizen is to serve four distinct but interrelated purposes. First off, it’s a teaching tool, so our students in the Masters of Journalism will enrol in a subject called Applied Professional Practice. This is a highly flexible subject that will be run in every semester across the year. There’s a number of things they might be involved in under that heading, but the main one is working for The Citizen, being assigned by the editor in a real newsroom environment with real deadlines, real assignments and so on. Simon and the other editor and staff will be bringing to bear real editorial judgements, saying: ‘You need to make five more phone calls,’ or ‘Get the other side,’ or ‘What the hell is that apostrophe doing there?’ … all those real disciplines you need as a journalist.

Purpose number two is an action research project or as the foundation for some research projects. My particular area of interest – and I think an urgent area of research – is changing journalistic methodologies and forms. We’ll be using The Citizen as the foundation for experiments. I’ve got a number of those that we’ll be doing in our first year of operation. They will include things like trying to use social media to crowd-source information, and discover ways of verifying that as reliable journalism. We’ve got an application in at the moment around the idea of the journal of record. That is an idea which has largely gone by the by as commercial media have lost their resource base, and yet the technology is there to potentially do it much better than it’s ever been done before. We will be deliberately innovative and experimental and we’ll be reporting on the results of those experiments both in scholarly publications and The Citizen itself.

Thirdly and not least, it’s a serious publication aimed at an intelligent general public and while we won’t be trying to do everything, we will tackle particular projects and issues with the idea, similar to The Conversation, of advancing debate through good journalism and advancing the spread of ideas and engaged citizenship. That’s where the name of the publication comes from.

Lastly it will be a flagship for the Centre, so you’ll be able to read in The Citizen about the public events we’ve held. It will host debates that might arise from those public events and through social media. We may well kick on things that happen as a result of a big public event and also of course we’ll be reporting on our research and our other activities.

How big are these organisations? How many paid staff do you have now and how many would you expect to have?

At The Conversation, in editorial, we have 13 or 14 full-time editors and roughly the equivalent of four full-time web developers, and some administrative and back office staff too.

The Citizen has one full time editor, a half time editorial assistant and of course the part-time efforts of the rest of the teaching staff, which at the moment is myself and Dennis Muller and a raft of casual sessionals. We will have a small contributor budget; we’re still working on that at the moment, and in the long term – and this certainly won’t be happening in the first couple of years – we would hope to hire a journalist in addition to the editor.

But most of the writing will be done by the students?

Yes.
JG And the administrative structures: are they separate companies or is it the university that employs the staff?

MS All the staff are employed by the Centre, which is part of the Graduate School of Humanities and Social Sciences which sits within the Faculty of Arts at the University of Melbourne. So that’s a three-tiered structure. This is something the vice-chancellor is interested and involved in. The University Council has endorsed a Charter of Editorial Integrity for the publication.

MK *The Conversation* is set up as a not-for-profit company [*The Conversation Media Group*, a not-for-profit educational charity owned by *The Conversation Trust*]; it receives funding from the university sector, CSIRO and some government money.

JG The university money doesn’t just come from the University of Melbourne?

MK Not at all no, there’s about 39 universities in Australia and I think about 18 or 19 are funding partners of *The Conversation*. All 39 contribute, in that we commission academics to write from any university. We are totally agnostic as to whether they are our funding partners or not editorially. Each of those funding agreements has a clause saying nobody will interfere with our editorial independence.

JG One of the strengths of large media organisations is that, in their fourth estate role, they can ask hard questions, they can publish stuff that people might not want to see published, and then stand behind their journalists and editors. What’s the expectation about universities? Do you think the university where you are located is comfortable with the idea that material might be published which opens them to new forms of legal liability?

MS This is obviously a key question. I think I’m fortunate in being in a particularly media savvy university. Both my dean and vice-chancellor are political scientists. They understand journalism and where it fits and I think that’s absolutely key. Likewise the charter of editorial independence. I was certainly planning to raise it and suggest it, but in fact my dean suggested it to me before I got to it. In terms of preparedness for controversy, I think that’s certainly here. I think this university sees itself as a cultural player. I think there’s evidence of that in its strong support for *The Conversation* as well. The vice-chancellor absolutely understands why this kind of thing is important and gives it his personal backing. Defamation? We are subject to that just as anybody who publishes anything at all is. We have to be careful and prudent. Exactly what it means we will find out if and when we run into trouble! But obviously it’s important to have professional editors who are across the risks involved and that’s what we have.

JG Misha, have you had any difficulties with that sort of thing so far?

MK Not really. I think it remains to be tested. I think there is a different culture between journalism and academia. Academia is by its nature slightly less robust about the slings and arrows of being engaged in public debate. I know for example that there’s a very interesting academic at Latrobe called Ken Harvey who’s run some campaigns about the Therapeutic Goods Administration. He did a campaign about a drug called SensaSlim which is allegedly a diet nasal spray. I heard him give a talk about the issues and how the university deals with somebody who is campaigning in that way and whether academics get support. Latrobe has, as most universities do, something written down that guarantees a level of academic independence, but it generally tends to come with a caveat that you have to be speaking within your area of speciality.
Anybody in a newsroom knows that these issues come up and nobody can really anticipate the pressures. At Swinburne, I tried to put forward a research project about hyper-local journalism and of course the pressure was there for me to go for an ARC Linkage. It seemed to the other researchers that a natural partner would be a local government body, which of course is the last person you want funding a hyper-local journalism operation. I had to explain that and people were saying ‘oh yes but we do research all the time with Linkage partners and our research is always independent.’ But it was clear to me that nobody in that environment actually understood what the pressures are like when you publish something very prominently, something very controversial, and it gets picked up by other media and it’s all over the front page. All of which is what you aspire to do as a journalist. People in academia who haven't been through that firestorm don’t understand what it’s like. You only really know whether you’ve got editorial independence when you're in the middle of one of those shit fights.

At The Conversation we have a disclosure statement for all academics who write for us. They have to answer three questions about any funding and conflicts of interest. The practice in academia is different to what you get in journalism. For example when we’re commissioning people to write (say) about flu vaccine, it’s very hard to find academics who haven't received some funding at some point in their career, whether it be matched funding or whatever, from companies that produce those vaccines. Our attitude is that, at the very least, you need to declare it and let readers make up their own minds, but obviously it’s preferable to avoid situations where those potential conflicts exist.

Yeah I think that’s right, but it’s an issue for ARC funding, which, as we academics know, is the lifeblood of these institutions. Whenever you’ve got a research project the pressure is there to try and frame it as an ARC application and Linkage is the flavour of choice. And I do think that the ARC is set up in all sorts of ways which probably don’t tend to support journalistic projects. That’s a concern, because we at the moment have an industry which is in desperate need of innovative research and is itself not equipped to resource it. Legacy media is basically going broke, and emergent media is emerging; neither side has any money and the ARC structures make it hard really to apply for research grants about journalism. My submission to the Finkelstein inquiry suggested that an informed and active population or informed citizenry or some such form of word should actually be adopted as one of the national priorities for ARC funding. As far as I know that idea has gone nowhere.

The pressure for Linkage is understandable; I understand what the government is trying to do with that. They're trying to say we want to make sure academics are doing relevant research that other people care about outside the academy, and I support that as an aim. But I think it does tend to mean that certain areas of research where there simply is no industry partner with money are neglected and I think journalism is one of those. Not the only one I’m sure, but it’s one I’m aware of obviously.

Misha, what do you know about people who read The Conversation?

Quite a bit actually; there’s a detailed survey. Gender is pretty much 50/50; the geographic mix is slightly skewed towards Sydney and Melbourne; but otherwise it is what you’d expect given the distribution of population across Australia. The Conversation is clearly going to be read by a reasonably curious, reasonably well educated sort of readership. At the very least it is going to be the sort of people who listen to Radio National and maybe read the broadsheet papers and read Crikey and are reasonably engaged. Our big plan though is to spread out from that, is not to stop there, but to try and find the widest possible audience we can. One of the
things we do is that in the software in which academics write on our site, we have a readability index which measures how readable the article is. We encourage academics to write for a reasonably well-educated 16-year old, so that the language is as clear as possible, so that it can get to a broad readership. And we do things like explainer pieces, explanatory journalism where we get, for example, an economist to explain the difference between an ETS and a carbon tax. Or we did an explainer that was incredibly successful in the US; it was an explanation of Einstein’s theory of relativity which got a massive audience.

JG Are people accessing the site from outside Australia and inside Australia?

MK They are. Some stories obviously get more domestic readership than others, but the big stories, big developments in physics, astronomy, those sorts of things, they can get massive international audiences. Tens of thousands of people will read them all over the globe. That Einstein piece got something close to 100,000 readers and most of them were in the US – and that’s actual page views, so you can measure people that have actually clicked on the article and spent three or four minutes reading it.

JG That’s a kind of ‘explainer’. What about something that is more news driven?

MK There was an environmental story about soil that went very well. It’s the science, maths, technology type pieces. In fact our technology coverage is a really good example. There’s a writer from the University of Western Australia called David Glance who writes a lot about things like commenting on the flaws and strengths of the latest iPhone. That sort of information has a global audience. It’s a really important point; one of the things we’ve learnt is that there are two audiences, there’s a domestic audience and a global audience and you can actually try to access both. Science, technology, health and medicine, we can get global audiences for those stories. Obviously for political commentary on whether Kevin Rudd is challenging Julia Gillard – we try to steer clear of that horse-race style of journalism, but when we do it, when we get political scientists to delve into those areas – the audience is an Australian one.

JG Margaret: who do you think is going to be reading The Citizen? Is this a project for Carlton and Parkville residents?

MS No. I imagine it will be read by Carlton and Parkville residents, but it’s not primarily aimed at them. It’s aimed at the same sort of general population that might read The Age online or another broadsheet newspaper, with the difference that we can’t possibly do everything The Age at its height did. We simply don’t have the resources. I might aspire to starting a new news organisation at that size, but we will be doing particular projects in depth, probably on a semester to semester basis, and they will both find a particular readership, because there’s interest in that particular issue or whatever, and regular readers in that sort of general demographic.

JG Do you imagine it will have a similar kind of daily, news-driven focus that Misha has talked about with The Conversation? Or do you think that, given the constraints of students doing semester-long courses and that sort of thing, there’ll be less focus on what's the story of today, and more on letting students write about something they choose to write about?

MS In the long term I think we’ll certainly try and be on the news as much as possible. It is a developing project and our student numbers will rise. This is the first year of the program and next year we’ll have at least twice the students we have this year and that’s going to continue to grow. So we won’t do all of these things at once,
but certainly, at least during semester, I would have an ambition that we would be updating the site at least daily with some new content that would be on the news.

JG Is your primary focus going to be text or will you be doing audio and video as well?

MS We certainly will have video and audio on the site as well including podcasts and broadcasts of our public events. Students are all using video and audio equipment, so we will certainly aspire to have all that as part of the site. But just as important I think is the use of social media. We all know social media is good for marketing, but as an actual core methodology for journalism, it’s one of the most exciting things that’s happening right now – people like Andy Carvin using Twitter to report the Arab Spring. I think it’s becoming clear that social media is one of the things the Internet does best and is actually for.

MK We’re doing some video in collaboration with SBS and we did some explanatory videos for our Olympics coverage with SBS. But my personal feeling is that I like text and I feel that online people prefer text, because it gives them so much more control. Even a two-minute video, you’ve got to actually click and then commit for the two minutes and you can’t decide to skip a paragraph or go to the point that you want. So I really like mostly expressing ideas clearly in a text form with pictures. Yes we’d like to do more podcasting as well; it’s so intimate and it’s such a beautiful way of communicating. You really need to get the technology right; the sound quality is really important, but if you do it well it’s such a wonderful technique for conveying information. So yes we want to use those technologies, but I’m not obsessed by them.

I absolutely agree with Margaret’s point about the importance of social media. It’s something that we work on incredibly actively. We have quite a big team of editors, but we also have lots of interns in our office and part of the job we allocate them to do is to be engaged in two-way conversations online all the time. Yes we’re broadcasting and marketing our content, but we’re also trying to get feedback and engage in those conversations. We also discovered that that makes a significant difference to the quality of conversation we can host as well. So for example when I worked at the ABC I did some work on The Drum, which is the ABC opinion site, there was a real problem in that at the end of every article, no matter what the topic was, you’d get 250 people saying that climate science is nonsense and 250 other people defending it. They’d be the same people on every story. The quality of debate was very poor. Similarly we found on The Conversation that we can publish articles and get people who are quite ranty and aggressive and make contributions that aren’t very valuable. Once you get the academic who’s written the piece to engage in the comment stream to actually talk back, people change their tone instantly. Like someone says you're an idiot, why do you do this? And the academic is there, saying: Oh look I’m sorry you feel that way, there was this report in 2005 that said blah, blah, blah, have you had a look at it, what do you think? The person immediately comes back and says: Sorry about that and the whole conversation changes. You start to get a really good quality of conversation.

We’ve built a dashboard for academics. When they sign up to our site they can go to it and it’s a one stop shop for their engagement. They can see any comments on any of their stories in the last week or two weeks. They can set it so they can go into those comment streams and respond, they can see any recent tweets and they can respond to them, they can see any recent Facebook mentions, those sorts of things. It’s basically to give people an opportunity to engage in two-way conversations with their audience. A part of it obviously is promoting the articles they’ve written, Tweeting them or saying I’ve written this piece, do you want to have a read? But it’s also about trying to create a better online conversation.
JG  Do you think you get a genuine response from the academics, something that might shape what they do in the future? Does it actually change what they're doing or is it still a kind of broadcast medium? The expert comes down from the mountain to tell the non-expert reader the way the world really works?

MK  It absolutely changes the way they think about their own work. We ran a piece by a Deakin academic who was talking about Type 2 diabetes and the way people with obesity are stigmatised. At the end of the article there were dozens and dozens of very very aggressive judgemental comments about people who are overweight, which is what you always get when you write about obesity. And that's now led to a new research project where they're actually going to look at the role these attitudes play in stigmatising obesity and how that plays into the way health authorities work with Type 2 diabetes. That's a direct response to that comment stream.

We had another academic very early on who wrote a piece; he argued that bike helmet laws were flawed, because they actually decreased the participation rate in cycling. He argued it was very good for other health reasons that we shouldn't have bike helmet laws. A fantastic conversation ensued with academics from all over the world coming in and talking about different studies that actually led to new things. One of the things that’s really important is not just having the academic who wrote the piece in the comment stream, but other academics, other people who are knowledgeable who have something to offer. As an editor it’s absolutely thrilling when you see one of those conversations happen, you're like, My God here it is, you actually can do it, you can actually have a real conversation where people are respectful and they're bringing knowledge to the table and you can see people getting somewhere and learning new things, rather than just shouting at each other. It’s wonderful.

JG  Sources often have agendas. What role is there for your editors working with academics where an editor might feel the academic’s research doesn’t quite stack up, or might think this academic is a bit of a zealot on this topic, or they're reading too much into their findings? Are there situations like that where you feel you need to help reshape an agenda that an academic might have?

MK  I'll answer that in a different way. One of the things people often say about The Conversation is they're very surprised that there are so many opinionated academics and they're surprised that we allow so many opinions to flourish on the site. And there’s a bit of an attitude I think that people want to use academia in a way that’s non-threatening. They want it to be like a shop, like a mall for ideas. So if you're a car battery manufacturer in Williamstown and you want to build a better car battery, you can come to a chemist or somebody that's working on that area and pluck a bit of knowledge off the shelf and use it to make a better car battery. That’s all safe and wonderful and it helps you and then that’s it. My attitude is that good academic work is also challenging and destabilising and engaging in other ways. One of the things that encourages people to write is actually the capacity to express their views about something. I think the views would come through anyway. Ultimately whether or not somebody comes out and says “this is my opinion”, if they've spent 20 years researching an area and they know it back to front, they will form views and conclusions about it. You could either have them [the opinions] operating on a subterranean level or you could have somebody saying: This is my opinion. So my attitude is that you should let academics have their opinions, they're actually inherently valuable, they're much better out the front than hidden.

What's important to me is that the academics are passionate, but disinterested, that they are not subject to conflicts of interest. They might have formed views or ideas, but those ideas are informed in an honest way from engaging with the subject
matter. I would never try to influence somebody to change their views, that’s not what our role is. I guess the point at which we would say maybe this piece shouldn’t run or shouldn’t air is really about what it adds to the debate. So if it is just a view, well that’s not enough. You’ve got to bring something to the table, you’ve got to bring some knowledge, you’ve got to bring some expertise, you’ve got to tell me something I didn’t already know. But if you’re making a contribution and there’s an opinion with that, then that’s fine as far as I’m concerned.

Mainstream media industry codes of practice often refer to terms like ‘balance’. Is ‘balancing’ a conscious part of The Conversation’s commissioning?

It is a little. I don’t think everything is equally valid, so I don’t subscribe to that idea that everything has two sides. I don’t think that if you run something on climate science, you need to run a climate science denial. But I do think that sometimes you notice gaps in your work and you think OK there’s an area here where there are valid arguments to be made that haven’t been expressed and they should be given an airing. So yes, you need to be a little bit careful about just interrogating your own prejudices or your own ideas or your own way of seeing the world. You need to make sure you don’t get a closed feedback loop where people who think like you start feeding you things. You do need to seek out things that challenge your own ideas a little bit. But again it needs to be done in a context of understanding that underneath it all, there has to be a core level of quality and contribution. There’s got to be substantive knowledge and evidence and something to say.

I think, as you say, most of the codes of ethics and so on talk about various words; objectivity, balance, fairness are three of the most common, all of which actually mean slightly different things and some of them it’s not clear what they mean at all. I really think this is something the profession as a whole hasn’t thought through sufficiently. In most newsrooms you’ll hear words like objectivity and balance and fairness thrown around fairly loosely without anybody ever really asking what they mean and how we might bring that to bear on our practice. And that’s something which there is quite a lot of literature on, which I think is quite important. But really what you’re talking about is the ability to search out the evidence on the topic and to search it out in a broad fashion, not just looking for that evidence which backs up your pre-formed conclusion. And then to relay that with some integrity to the audience and that may mean you end up with a result which is actually not balanced in that you may research climate change and come to a conclusion about the balance of the evidence. That’s my definition of objectivity; it actually lies in the method, not necessarily either in the individual journalist or in the final result.

I agree with that. One of the things I think we risk losing in this whole proliferation-of-voices online media world is professional information handlers, journalists as people who professionally handle information. I think that’s massively important. Margaret’s definition of what that is, is absolutely right. It’s about an honesty of process, it’s about coming to a story, being ready to let the cards fall where they may, being prepared to just report what you find, even if it doesn’t meet with your preconceptions. But it doesn’t necessarily mean you tick off having two sides of politics or two sides of a debate. That’s such a clichéd and actually meaningless and ultimately distortionary way of approaching journalism.

Because notions of balance and objectivity are so much in the eye of the beholder, as soon as you set yourself up to try to do it, you’re actually setting yourself up to fail in many people’s eyes. Yet I still believe that sort of doomed endeavour is fundamentally worth it and incredibly valuable. But it’s not what The Conversation does. The Conversation offers something else, which is a real use of academic expertise, which often comes with opinion. But that journalist as professional
information sorter, as investigator, I think it’s one of the key things that’s at risk from the collapse of the journalism business model. The honest broker journalist is still utterly valuable.

**MS** I also think the definition of objectivity as being in the process of the research and the relaying is something an academic should understand. It’s actually quite close to the ideal academic method. Of course researchers choose research areas that match their interests and they may well start out with an opinion about it, but a good academic goes out and does the conscientious academic work of finding out what’s been done before, then establishing new knowledge and then relaying that. Well that’s close to the ideal journalistic method.

**MK** There’s been this whole thing that digital media sort of pushes aside the gatekeeper, this idea that the gatekeeper got in the way and the gatekeeper kept people out of conversations. That’s true, but what that’s led to is a sort of antipathy towards journalists and their role. In any new journalistic scene that emerges after the massive disruption of digital technology, it’s really important that we find ways of preserving the journalist as an honest information broker, whether it be what Margaret is doing with *The Citizen* or broadsheet newspapers or whatever.

**JG** Margaret, you're training journalists who might go on to work in other media organisations and you’re also running a media organisation. Is there a possibility that the media organisations you're training people for, who you will want to support the work you do, are going to see what you’re doing at *The Citizen* as competition?

**MS** Inevitably, yes that may happen and what can you do about it? On the one hand the industry tends to have two, both in my view relatively ill-informed, criticisms of journalism education. One is that it shouldn’t happen, because journalists are born and not made. The other is if you are going to train them you shouldn’t teach them all this academic theory, you should actually get them doing practical exercises. Well I don't think journalists are born rather than made; and we think the courses we are offering are going to give them practical, real world skills which hopefully will be slightly ahead of the curve, because we’re not aiming our graduates at *The Age* or *The Australian* or the *Herald Sun*. We’d be nuts if we did, or certainly doing them no favours. So yes they may see it as competition; but we’re not directly setting out to compete. We can’t possibly aspire to do everything a big media organisation might do, but we are out there, we are publishing and we are training the journalists of the future, so we make no apologies for that. I think Mark Scott faces this sort of criticism a lot about the ABC. *The Drum* was criticised by *Crikey*, I think, at one stage. And his response is there have always been private sector and public sector solutions to things. The fact that we have a national art gallery doesn’t mean there’s no commercial art galleries, any more than commercial art galleries should mean that the government shouldn’t be in that space as well. Now you can debate the particular lines, but every journalism school in the world worth talking about has a publication on which the students work. It’s hardly a new idea; I am hoping to do some new things with it, but it’s not a new idea in itself.

**JG** Can you imagine a time when the kinds of media organisations the university has established, *The Citizen*, *The Conversation*, Melbourne University Publishing, continue to exist, with the strength of the University of Melbourne behind them, but a commercial media organisation like *The Age* doesn’t?

**MS** Very easily, sadly. But if *The Age* ceases to exist, other things would replace it, there would be different things and they may be doing different collections of things. There’s been some interesting research out of New York City University on
this just recently taking real advertising sales figures, real audience figures in the
City of Boston, which is comparable to Melbourne in many ways, and assuming
that all the newspapers are gone, and then asking what new media business models
would be available in this environment. What they hypothesise is not a
replacement for The Age, but a whole load of other little things and I think that’s a
likely future. None of us knows for sure of course.

MK  I was talking to Ray Gill, the former arts editor of The Age. I was saying basically
that with the broadsheet newspapers cutting so many staff and paring back, there’s
whole swathes of work that aren’t being done anymore, including areas of cultural
commentary, arts coverage. Ray said it’s still going on, it’s just going on in
different spaces. Look at the Wheeler Centre, for example, and the level of
conversation that that is hosting now. Look at the blogs and other spaces in which
these things occur. I think the types of things broadsheet newspapers used to do will
continue to be done. And yes absolutely I see a role for The Conversation to take
many aspects of what I think old broadsheet newspapers used to do and do them
well online with academics. I might love to do much more literary criticism and
cultural commentary and better, stronger coverage of education. There’s whole
areas of intellectual life that aren’t catered for as well as they used to be by
traditional media and I think they will create opportunities.

MS  I endorse everything Misha said earlier about the importance of journalists as
brokers, but there are some things which actually are being done quite well on an
amateur model or by bloggers. The best cultural criticism is on blogs, the best
restaurant reviews are on blogs or through social media and they are certainly as
good as the run of the mill stuff that’s in the broadsheet press and better. Likewise
political commentary; there’s terrific examples of that done on blogs and so on.
What isn’t done, or won’t be done consistently anyway, is the disinterested research
effort. You might get it occasionally, but generally speaking a citizen journalist is
passionate about their subject. And that’s both wonderful in many ways, but also a
risk in that they’re not going to do that hard yakka of challenging their own ideas
and seeking out other ideas. I’m not saying that will never happen, but it won’t
happen consistently enough or often enough and I think it is probably the core of
the journalist’s ongoing usefulness. But things like arts reviews and opera reviews
and so on, I’m open to the idea that that might actually be done better by the
interested and informed citizenry.

JG  That’s terrific. Thank you both very much for your time.

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FROM VHS TO THE CLOUD
AUDIOVISUAL CONTENT IN EDUCATION COMES A LONG WAY

Simon Lake
Screenrights

In just over twenty years, audiovisual use in Australia’s classrooms has come a long way. The days of wheeling in a VHS recorder and television to play a program to students have gone, replaced by a myriad of new audiovisual technologies. In the face of this change, there have been two constants – teachers want ready access to fresh relevant programming that speaks to the curriculum, and we need copyright laws that provide easy access to this work, and payment to the program makers.

This article explains the operation of the provisions of the Australian Copyright Act that allow for educational copying from television and radio and the collecting society that administers them - Screenrights. It then describes a Screenrights initiative, EnhanceTV Direct, that was trialled in 2011 and is now being rolled out to educational institutions. This service makes existing and new audiovisual content, specifically curated for the education market, easily available to schools, universities, TAFEs and other licensed institutions, while ensuring program makers receive a royalty and are therefore encouraged to produce more creative work.

INTRODUCTION

In just over twenty years, audiovisual use in Australia’s classrooms has come a long way. The days of wheeling in a VHS recorder and television to play a program to students have gone, replaced by a myriad of new audiovisual technologies. Educators can show programs on smart whiteboards, they can copy, catalogue, store and share audiovisual material on digital content management systems, and they can get instant access to thousands of programs using new streaming services.

In the face of this change, there have been two constants – teachers want ready access to fresh relevant programming that speaks to the curriculum, and we need copyright laws that provide easy access to this work, and payment to the program makers.

COPYRIGHT

Provisions that allowed for educational copying from television and radio followed relatively soon after the introduction of the video recorder, with amendments to the Copyright Act in 1990. Part VA of the Copyright Act provided for educational copying from radio and television in exchange for the payment of a royalty to rightsholders. Part VB of the Copyright Act provides for a similar licence in relation to copying by institutions assisting people with an intellectual disability. Part VB of the Copyright Act also provides the educational statutory licence for copying and communication of text, images and print music. This is administered by Copyright Agency Limited.
Audiovisual Copyright Society Limited (AVCS) was incorporated on 8 January 1990 and was declared the collecting society for the purposes of Part VA of the Copyright Act by notice in the Government Gazette on 20 June 1990. It was also declared the collecting society for the purposes of Part VB of the Act in relation to the copyright in cinematograph films, sound recordings and works comprised in films and sound recordings. The latter declaration came into force on 1 July 1990. The Society adopted the trading name “Screenrights” in 1997.

The establishment of the organisation was co-ordinated by the Australian Copyright Council, and the following major rights holder organisations were the original promoters of the organisation:

- Audio Visual Distributors Association of Australia
- Australasian Mechanical Copyright Owners Society
- Australian Broadcasting Corporation
- Australian Film Commission
- Australian Record Industry Association
- Australian Writers Guild
- Federation of Australian Commercial Television Stations
- Federation of Australian Radio Broadcasters
- Film/Video Coalition
- Producers and Directors Guild of Australia
- Screen Producers Association of Australia
- Special Broadcasting Service

These organisations nominated the first Board of Directors and members (rightsholders in film, television and radio from around the world) now vote for the board.

Initially, Screenrights’ focus was on entering agreements with each of the relevant education sectors and on building up membership to make distribution of royalties as efficient as possible.

In its first decade of operations, only minor changes were made to the licence to adapt to new practices in classroom use of television and radio. This included allowing for the copying of pay television, which was introduced into Australia in 1995.

However, in its second decade of operations, more extensive changes were needed.

The Digital Agenda Bill in 2000, Copyright Amendment (Digital Agenda) Act 2000, introduced a substantive change to the educational copying provisions, for the first time allowing educational institutions to “communicate” copies of programs, again provided they paid a royalty for this use.

“Communication” includes making copies of programs available on an intranet, which meant copied programs could be put on commonly used tertiary networks such as Blackboard and Moodle, as well as commercial digital storage solutions such as Clickview. It also allowed for the emailing of copied programs to staff and students.

These have been important changes that allow for easy digital storage of programs, with students and teachers able to access the material they want across the institution. The days of borrowing a VHS tape from the library have gone, and the days of the DVD are fast disappearing.

The Copyright Amendment (Digital Agenda) Act 2000 also introduced a new statutory licence (Part VC) for the retransmission of free-to-air broadcasts.

In 2003, Screenrights made submissions to the government’s Digital Agenda Review arguing for a further extension of the educational copying provisions to allow for the copying of
podcasts and vodcasts. Section 135 C of the Copyright Act was enacted in 2007 (Copyright Amendment Act 2006).

Since then, there have been no further legislative changes to Part VA of the Copyright Act. It is a scheme that has served the education sector well, ensuring that teachers have access to content in ways that are relevant to the 21st century learning environment. It has also brought in royalties for filmmakers, with Screenrights now distributing more than $30 million a year to its members. This money helps them to continue making the programs that educators want to use.

On 29 June 2012 the Australian Law Reform Commission (ALRC) announced its Terms of Reference for its review into Copyright and the Digital Economy. An Issues Paper was published on 20 August 2012.

This review is wide ranging and poses some fifty-five questions looking at whether the current copyright exceptions (remunerated and unremunerated) which include the educational statutory licences are ‘adequate and appropriate’ in the digital age and whether use of copyright material should be more freely permitted.

Screenrights contends that the statutory licences are working well and effectively, providing easy access to audio visual programing which educational institutions can use flexibly and with certainty. Screenrights will demonstrate that the existing copyright exceptions do not require full scale amendment or deletion and that they work to the benefit of both copyright owners and users respectively.

This accords with the Guiding Principles for Reform proposed by the ALRC in the Issues Paper, such as encouraging innovation and competition, promoting fair access to and wide dissemination of content and recognising rightsholders and international obligations.

Screenrights will be making a submission to the review in November 2012.

READY ACCESS TO CONTENT FOR THE CURRICULUM

Since the educational statutory licence was first enacted in 1990, there has been an increasing thirst for ready access to curriculum relevant audiovisual material to use in teaching.

Each year, documentaries, news and current affairs, and educational programming are among the most copied programs.

The chart below shows the breakdown of the most copied genres of programs in 2011/12.
The educational licence removes copyright impediments to using this material – however this is not the only impediment that educators face. They are often time poor, and simply do not have the resources to find out what’s on, how a program works in with their teaching area, or how they can easily access other resources to use the program in teaching.


Initially, EnhanceTV (www.enhancetv.com.au) served as an online resource hub for educators across the country. Teachers could subscribe to an email guide that alerted them to upcoming programs relevant to their teaching area. Educators could also download articles and study guides to help them use programs in the classroom.

However, in 2006, this service expanded.

The educational copying provisions allow for a copy to be made by or on behalf of an educational institution. They also provide for a category of ‘educational institution’ which has as its primary function the supply of educational material to educational institutions for their teaching purposes. These entities have become known as ‘resource centres’. There are currently 7 resource centres operating in Australia of which Enhance TV is one, which supply copies of educational programs to educational institutions for their teaching purposes.

A number of these resource centres were already licensed by Screenrights and despatching copied broadcast programs to educators. EnhanceTV became a licensed resource centre in 2006 and in 2009, it began to offer an expanded version of this service, allowing teachers to download copied programs from the site rather than wait for a DVD to arrive in the post.

EnhanceTV has proved to be a popular service with educators. It now has more than 15,000 standard members and over 7,000 premium members (staff at licensed institutions able to order copied programs from the resource centre). Our contact with teachers through the site tells us that educators are particularly keen for relevant Australian content, with programs such as *First Australians*, *Go Back to Where You Came From*, *The Oasis: Australia’s Homeless Youth with Tony Jones*, and *The Apology to the Stolen Generations of Australia* often purchased, and study guides for these programs frequently downloaded.
Aside from EnhanceTV there are a number of other downloading and streaming services for educational institutions relying on a Screenrights resource centre licence to operate. For example, Clickview, a commercial content management system popular in schools has Clickview Exchange, allowing schools to upload and download programs, and many universities obtain news and current affairs programs from the RMIT-run news streaming service, Informit.

We’ve also seen the development of catch-up television via streaming (ABC’s iView for example), giving teachers another way of obtaining audiovisual content. It is important to note that these services, which simply stream a program into a classroom, do not fall within the Part VA educational licence and therefore do not generate a royalty for filmmakers. Further, there are limits to the usefulness of these services for teachers, including the following factors:

- the content is generally only available for a short period;
- these sites do not provide a comprehensive archive of the programs broadcast by the broadcaster;
- available programs haven’t been curated for the education sector and may not be safe and age appropriate content for students;
- there is no supplementary material, such as study guides, provided with the programs to assist teachers with their lesson planning – whereas they are provided free via the EnhanceTV service.

**ENHANCE TV DIRECT**

In response to these issues and the appetite for streamed content which provides instant access from any internet connected computer or tablet device, EnhanceTV has very recently undergone its biggest and most exciting development: to provide a service designed to meet this next change in the education sector’s needs.

This service, which is called EnhanceTV Direct, was trialled to 21 schools across the country in 2011. Schools that took part in the trial had streamed access to EnhanceTV’s enormous archive of more than 11,000 education programs. Programs are readily searchable by a number of criteria, including learning area and can be viewed at home or at school. Links to programs can be sent to students giving them access to selected content.

In addition, the service allows teachers to create video lessons using all of a program or short extracts. Again, these lessons can be viewed from any internet connected computer or tablet. They can also be shared with other educators.

The pilot was evaluated by the Australian Council for Educational Research (ACER), led by Dr Michele Lonsdale.

In commissioning this research, the key areas that were identified for analysis were:

1. An understanding of the participants’ existing environment and their attitudes toward film and television content
2. The suitability of the content management system
3. The value of the archive content
4. The effectiveness of the access to the archive
5. The effect of the archive on the teaching and learning environment
Findings included the following:

- Participants all saw real benefit in the use of film and television within the classroom and saw the content as an integral way of delivering parts of the curriculum. Significantly, the report concluded that in most cases, it appeared that usage would expand, given greater access to content. The report indicates that there was a “clear increase in engagement with film and television content by both staff and students during the trial period.”

- The response to the content management system was very positive. Ease of use and the functionality provided meant that most users were able to easily access material from the archive. The quality of the footage was viewed favourably.

- The content was viewed as a high quality resource that was both relevant and current. The ability to access the entire archive allowed opportunity for participants to appreciate the learning potential of the material. Educators appreciated the breadth of the content quality of the metadata provided for each program.

- The access to closed captions was seen as a very desirable feature both for hearing impaired learners, ESL students and the general classroom.

- Whilst most access to the system was within the workplace, a number of educators used the opportunity to prepare and plan lessons from home. Even though there was not extensive use of the lesson creation and editing tools, participants found the tools easy to use and, given a longer period of use, would be likely to make increased use of the tools.

- By empowering educators with access to the entire archive and enabling them to share and interact with the content in different ways, the application allowed educators to explore innovative uses of the content within the classroom.

Following this trial, EnhanceTV Direct is now being rolled out to schools across the country. The service that it provides includes the following:

- access to over 12,000 educational programs, with this archive growing by up to 100 programs a week
- content can be accessed from any internet connected computer or viewed on a tablet device
- content is age appropriate and advertisement free
- captioning is available
- content can be searched by learning area
- content can also be searched using the captions option to find a spoken word
- lesson plans can be created and shared with students and other teachers
- study guides can be downloaded
- the system is accessed via a secure login
- the system requires no copyright clearances.

EnhanceTV Direct can only be supplied to educational institutions with a Screenrights licence, and copyright owners are paid for the copying of a program streamed to an institution under a resource centre licence. The institution does not need to keep any records of the programs that it is using – this is done by the system itself.
CONCLUSION

EnhanceTV Direct directly answers the changing needs of today’s educators. It is not tied to any need for expensive storage onsite, it allows for remote learning with ease, and it provides content specifically curated for the education market. Importantly, it also meets the needs of Screenrights members – the many filmmakers who are making the programs teachers and academics use in teaching. By ensuring they receive a royalty for the use of their work a fundamental tenet of copyright law is being observed – the encouragement of further creative work.

We’ve come a long way from the video recorder – but the principles of easy and flexible access to broadcast television for educators and fair payment remain the same.

A KEY PERFORMANCE INDICATOR FOR JOURNALISTS
THE VALUE OF SYSTEMS THINKING FOR THE FIELD

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Legacy approaches to journalism education, formulated before computing and the Internet, focus on the democratising service outputs of the profession in promoting discussion, public scrutiny, commerce and entertainment. This focus has been at the cost of a reduced emphasis on the process of producing and distributing journalism, the expertise for which has largely been relinquished to engineers. This has made journalists vulnerable to economic variables and reduced their capacity to create and capture value in their markets in an agile manner. However, since the early 2000s, broadband has allowed and then required journalists and journalism educators to regain production and distribution expertise and to include systems thinking in curriculum areas. This article discusses the economic implications of this and the expected impacts on journalism practice and commercial funding. The article concludes that a ‘key performance indicator’ for journalists is now the ability to optimise where and how a digital file of text, audio, video or other computer code is placed on any relevant computer network.

INTRODUCTION

The single most important skill for a journalist to acquire in the 21st century is digital file management. This statement might be confronting for ‘traditional journalists’ who emphasise instead curiosity, ethical behaviour, an open mind, the ability to scrutinise authority, the various craft abilities of shorthand script and formulating and asking questions using newsworthiness criteria, and the ability to write in formulaic structured genres such as the inverted pyramid. These are indeed essential ingredients in journalism (except shorthand). However, in a world where some profit and others fail to profit, the one extra thing which has consistently made a difference to profitability/economic viability of journalism is the ability of practitioners (individually or grouped into large or small companies) to also manage and distribute content that audiences are willing to pay enough for. In the language of the 21st century, ‘commercially viable content’ is a digital file containing a combination of text, audio, vision, images and/or graphics usually with structural mark-up such as HTML. File management involves placement of these files in a network system to optimise audience access and transactions with each item.

This one extra thing can be called a ‘key performance indicator’ which, in business terms, means ‘what you do to increase performance dramatically’ (Parmenter 2010: 1), or to set yourself apart from your competitors. In the case of journalism in 2012, both performance and competitiveness have to go up to ensure improved productivity and profitability. Efficient and professional digital file management skills can help journalists make their work perform better, in terms of reaching bigger audiences, using broadband and internet dissemination which offers increased efficiency over other distribution methods. This improved technical performance is likely to improve the competitiveness of each item of journalism production, thus enhancing the productivity returns (sales) available.
Not everyone understands how file management fits into journalism; this is the central theme of this article.

**HISTORICAL PERSPECTIVE AND PRIOR LITERATURE**

Since the earliest days of journalism, the ability to not only create but also to manage and distribute content has been the key to profitability: what Deuze calls the ‘combination of mastering newsgathering and storytelling techniques’ (Deuze 2005). Journalists as an interpretive community (Zelizer 1993) have always known that discovering and even writing down a ‘great story’ was less than half the task. This is understood as much by reporters (one subgroup within the expert system of ‘journalism’ [Miguel 1999]) as it is by sub-editors, photographers, producers, editors and news directors, all of whom contribute to the journalistic task.

The story has had to be conveyed to a publisher with the means of production and distribution for the story to have anything more than notional existence. Thus the first reporters in the field handwrote and then mailed stories to editors who worked with typesetters and printers using engineered machines to produce saleable newspapers and magazines.

Distribution took place using more machines: horse-drawn wagons, trucks, trains, ships and later aircraft, mostly working for postal systems (Kielbowicz 1984:1). This is an illustration of a ‘broadcast network connecting one broadcaster to many in the audience … (and) the aggregate value of this network to the broadcaster is given by Sarnoff’s Law, which states that the value of the network is proportional to the size of the audience’ (Swann 2002: 418, citing Reed 1999).

Postal systems were overtaken by the telegraph, the telephone and eventually – in the 1980s – the fax machine, computer-based email and modem. In my own experience, hand and typewritten articles were commonly still provided to publishers by some reporters as recently as the 1990s but nearly all publishers now require journalists to provide reports as digital files created on a computer of some kind. When compared with broadcast, these offer the possibility of two-way (Swann 2002: 418) or transactional (Reed 2001:23) communications and have increased value.

More recently, the management, distribution and sale of computer files takes place using a system of routers, local-area and wide-area networks, also designed and constructed by engineers and now generally (though not always correctly) referred to as the Internet. And broadband, whatever else it describes, is how the general community understands ‘fast internet’. These local and wide-area networks facilitate the formation of a third and even more valuable kind of network, a ‘Group-Forming Network … (where) roughly speaking, the value … is given by Reed’s Law, which states that the aggregate value … is proportional to the number of non-trivial groups that can be constructed from n users (Swann 2002: 418, citing Reed 1999): ‘If n is large, then aggregate value according to Reed’s Law is proportional to $2^n$.‘

*It’s the many-to-many – or group-forming – network, which allows network members to form and maintain communicating groups. Examples … include on-line communities, business-to-business exchanges, and buyer cartels (Reed 2001: 23-24).* Reed’s Law strongly suggests that for journalists to have access to the greatest available value opportunities, they have to be involved in such Group-Forming Networks, not merely the broadcast or transactional networks of history. They can do this either as ‘participant-followers’ (Norman et al 2010: 351) or as what I call ‘actor-drivers’. Participant-followers may derive some benefits as employees but actor-drivers are likely to derive more benefits since they will control the means of production and revenue collection.
CONCENTRATION OF ACTORS

When I trained and entered the journalism profession in 1981, only 30 years ago, the sector was populated by capital-intensive media corporations – which owned the means of production and as such filled the roles of actor-drivers and recouped available returns on investment – and participant-followers, including journalists and other workers, mostly those who contributed content and/or operated the machines of production.

The professional demarcation was sharp and clear among the participant-followers, between journalists and the people who worked the machines. In large industrial enterprises such as metropolitan newspapers, journalists – whose ranks included reporters, subeditors and photographers – were members of one particular trade union (the Australian Journalists’ Association, AJA) and they created content by hand, using their skills, inquisitive instincts, wordcraft, contacts, charm, ethics, intellects … and their pens, typewriters, cameras, enlargers, chemicals and paper. The typesetters, compositors and printers were members of another trade union (the Printing and Kindred Industries Union, PKIU) which jealously guarded its members’ workspace and when the AJA members had created their content, the PKIU members took over, exclusively. Thus the management responsibility for the content passed out of the hands of the creators into the hands of engineers so that it could be delivered to the end users, the audience. Similar demarcation was present in the production of radio and television bulletins, the printing union members being replaced by people also called technicians and engineers.

Within the next 20 years, the actors in this play changed but the roles remained the same. I watched as computerisation gradually eliminated the roles of print typesetter, the hand compositor, and then many other roles associated with the pre-press preparation for printing, and then one day the last of those employees left the company where I worked (News Limited). But as the pre-press trade unionists departed, their ‘engineering’ role was gradually usurped and then overtaken by engineers of another kind, providing network systems and software which also have gradually taken over the task of manufacture and delivery of the news product. In the mid-1990s I observed News Ltd and Fairfax Ltd invest billions of their shareholders’ capital in enormous print infrastructure in each of the Australian capital cities; in 2012 we have watched the first of those sites being decommissioned. Another kind of engineering has taken over: user-experience design, populated by software engineers, programmers and human-computer interaction specialists. These are the *wunderkind* who build content management systems which combine to create news products for our mobile engineering devices such as smart phones, tablets and whatever comes next. But they remained in the class of participant-follower.

CHANGES

Now a strange thing has happened. For journalists, including myself, to operate these content management systems, we have had to try to understand them and learn how they worked. Information technology specialists have been required to pass on their knowledge of network architecture and systems operations so that journalists can perform their tasks in the news supply chain (Cokley 2002; 2003). This knowledge has subsequently been incorporated into journalism curricula (Cokley et al 2000; Cokley & Eeles 2003; Cokley & Capel 2004; Cokley 2010) and it has become evident in newsroom operations, such as the restructures of major newsrooms this year (Jackson 2012).

Further, these skills have now diffused into the wider journalism community, outside the confines of large industrial enterprises sometimes called ‘Big Media’. Since at least 2007, the number of paid employment opportunities for journalists of any kind *outside* Big Media has exceeded the number of jobs *inside* Big Media, without the total number of jobs having significantly decreased (Cokley & Ranke 2011). The sector which is expanding, and where journalism investment is moving, is that of small-to-medium sized enterprises of up to 10 reporters and editors or producers, but many of which contain only one or two editorial staff. These are what institutional journalists used to call ‘niche’ publications but ‘niche is the new
large’. In the years before the early 1980s and the emergence of desktop computer typesetting and pagination in the 1990s, the entry costs for journalists into this sector were relatively high; now they are low, thanks to the network architecture of all those engineers, and the knowledge they have passed on.

Some of that knowledge continues to be passed on, online, in the diffusion of proprietary and open-source content management systems which power the blogosphere. I have been able to compare the in-house systems of News Ltd up to the present – systems including Vignette and Fatwire (see IDM 2009) – with those available and used by social media systems such as Facebook, WordPress, Tumblr and Blogger, shopping sites such as EBay, and citizen journalism enterprises such as Noozdesk, IndyMedia and OhMyNews in Korea. They are essentially similar in operation and user interface, suggesting that an understanding gained in social media CMS can be very useful in training-to-work transition for journalism graduates. Existing systems in News Ltd will soon be replaced by another, Méthode (EidosMedia 2012) which is XML-driven and requires even stricter file management skills as well as code and mark-up literacy. For journalists to complete their new editorial creation and publication tasks, efficient management of digital content files has become a business-critical necessity. But it has also become clear that some journalists have been able to change classes, from participant-follower to actor-driver, by understanding, learning how to operate, then controlling and even owning the means of production.

ACCURATE MANAGEMENT

Network theory and the experience of computing-in-practice strongly suggest that how effectively the journalist completes this digital content management task and makes the transfer from participant-follower to actor-driver is directly related to the size of the audience reached and the potential revenue available. This is because the Internet is constructed as a series of tables and nested databases related by links, and where files are placed influences how many connections can be made to them (an illustration of network effects, see Katz & Shapiro 1994:94).

Tables organise the World Wide Web and make the network ‘work’. ‘Tables ... provide a compact method for presenting relational information in an immediate and intuitive manner, while simultaneously organizing and indexing that information’, notes (Hurst 2006). Grannell (2007) contextualises the modern table even better when he suggests that ‘tables were initially intended as a means of displaying tabular data online, enabling web designers to rapidly mark up things like price lists, statistical comparisons, specification lists, spreadsheets, charts, forms, and so on’. When you search iTunes looking for music you like, you’re using a set of tables (the Internet) to visit a table (the online shop) to sift through searchable tables (the database of range and price). Social media websites such as Facebook are essentially databases of each member’s likes and dislikes, tabulated so they can be compared with, and linked to, the likes and dislikes of millions of other people on the same network. The algorithms behind everything enable and encourage the fundamental habit of people to compare this with that. Tables can exist in three dimensions as well as in two but the most common tables are two-dimensional. They are directly related to how we represent items in graphs, on axes commonly labelled known as X and Y.

Network science explains what happens next (see Newman et al 2006 for a wide ranging explanation). Network science began in 1736, when the mathematician Euler solved the Konigsberg Bridge Problem using a graph, derived from a table. What emerges in a graph is a relationship which can be solved (and possibly predicted) using mathematical formulae (Newman et al 2006:3). People who habitually use graphs and tables use these tools to uncover and see relationships, and this explains why graph theory has become very popular.
WHO USES GRAPHS AND TABLES ... AND WHY

Use of tables and graphs has become so popular in a range of disciplines external to journalism but two especially are relevant here: sociology and engineering.

‘[N]owhere has graph theory found a more welcome home than in sociology’ (Newman et al 2006:3), especially in interpreting data from ethnographic studies. It would be difficult to overstate the pervasive impact sociology in all its forms has had on 19th, 20th and 21st century living. Sociologists, along with economists, have formulated more theories about human life, which subsequently work their way into commercial and political life, than any other discipline with the possible exception of mathematics. These theories, often derived from ethnographic data, are used by ordinary citizens as well as businesses and governments to make decisions about how we live our lives, and these data sets are often translated into visual representations. Some examples can be viewed at the Australian Bureau of Statistics new BetaWorks site2.

Engineers use graph theory to improve – and hopefully ensure the quality of – their outputs. An engineer, Tim Berners-Lee, designed the World Wide Web and engineers developed Google, which proudly proclaims itself as ‘an engineering company’ on its website3 and engineers like them help daily to develop social networks at Facebook, Yahoo and many others. Google has become explicitly involved in the carriage of tabulated data to Web-browsing citizens through its Search function, and visualisations of search shown through its Maps application.

Because tables, visual representations and maps allow connections to be made between various pieces of data, and are innately suited to publication and viewing on the World Wide Web in a format that is easily understandable by the reader, they have become useful and popular among communicators who use the Web professionally, especially journalists. Books such as the Data Journalism Handbook (an initiative of the European Journalism Centre and the Open Knowledge Foundation, published by O’Reilly Media4) and websites such as Journalism in the Age of Data5 attest to this popularity.

MEMBERS AND CHARACTERISTICS OF GROUPS

Imagine a group of human beings as a potential network. In this network, each individual is a vertex and ‘vertices in networks typically have various properties associated with them’:

For instance, individuals in a social network have age, income, race, nationality and so forth. Pages on the Web have textual and visual content, location, topic, link patterns and so forth. It seems very likely that these properties would affect where edges in the network fall and indeed this appears to be the case: ties in social networks are found to depend strongly on race, for instance ... this phenomenon is called assortative mixing. (Newman et al 2006: 554-555)

In lay language, this suggests that ‘like links with like’ in assortative mixing while ‘like linking with unalike’ is known as disassortative mixing. Newman et al 2006: 555) note that ‘there is one property that every vertex in every network has, namely degree’ where the degree of a vertex is the number of edges (lines connecting vertices) which include the vertex v. They explain (p.555) that vertices which mix with other vertices of similar degree are known as ‘assortatively mixed by degree’ but high-degree vertices which mix with low-degree vertices are said to be ‘disassortatively mixed’. Finally they note (p.555) that ‘most social networks are found to be assortatively mixed by degree, while other types of networks, including technological and biological networks, seem mostly to be disassortative’.

Online web 2.0 social networks have features not seen in other kinds of networks (p.556) chiefly that ‘individuals in social networks can find short paths to others despite having only very limited information about the structure of the network’ and individuals in such networks have the ability ‘to categorize themselves and each other into socially meaningful groups, that is, to construct notions of social identity’. The extent of ‘social distance’ (Watts et al 2002, in
Newman et al 2006: 556) is reduced due to the effects of assortative mixing by degree. The bottom line for journalists is that where and how stories and pictures are placed and shared on the Web is positively and directly related to how easy those stories and pictures are to find and thus, by extension, the reduction of the social distance between each person accessing those files.

Finally ‘a number of individuals browsing the internet’ becomes a ‘system’ or ‘an audience’ and that’s what attracts revenue through advertising. Advertisers know that the skill of reducing the distance between people and things (products being advertised) on the internet is worth paying for, and there lies a clear revenue stream for journalism.

**SYSTEMS THINKING**

This brings us to consider the general concept of ‘systems thinking’ in relation to journalism and what other effects this might bring. Journalism has long been considered by some observers outside the newsroom as an individual discipline working with found artefacts: that a writer just reports an event or situation which he or she encounters; or a photographer merely captures an image from the world by virtue of being there and nothing else. But those with professional experience of newsrooms and journalistic practices – or observers who have studied from the inside – understand that journalism is an expert system (see Miguel 1999, as noted earlier), the components or inputs of which can be separated from its products or outputs.

Systems thinking (sometimes referred to as **systems engineering**) ‘focuses on a variety of elements, analysing, designing, and organizing those elements into a system that can be a product, a service, or a technology for the transfer of information or control’ (Pressman 2005:122), and recognises the production inputs of journalism as well as the layered nature of all its outputs.

This helps us to understand that everything we do in journalism is ‘produced’ and interconnected, and that an improved understanding of the production inputs, connections and layers can lead to improvements in the product. Thus, the value of a ‘good story’ can be measured not merely by the nature of the event or situation encountered by the journalist as newsgatherer (reporter or photographer), but by what the journalist as producer or storyteller (reporter, photographer or sub-editor/producer) does with the story (cf. Deuze 2005, noted earlier). This allows a different and perhaps challenging and disruptive way of understanding the ‘award-winning story or picture’ and challenges students and educators to reemphasise the systems at work in journalism, especially from now on.

Journalists of the past and present have been able to incorporate systems thinking unconsciously into our work when we assiduously gathered, nurtured and jealously guarded our contact books, which were fundamentally written-down and searchable databases of ‘vertices’ in networks. Each vertex was a person and the edges were represented by the organisational or personal links between each one, as well as their phone numbers and more recently their email addresses or social media ‘handles’. Journalists often would be hired on the basis of their networks of contacts and promoted as these grew and matured. For generalist reporters, ‘disassortatively mixed’ networks have been more highly valued but for specialist reporters working on what are known as rounds (within finance, sport, politics, education, crime or the courts, for example) ‘assortatively mixed’ networks are more highly prized.

Systems thinking has also been clearly present, if again nascent, in the ways sub-editors and line-up producers have assembled newspaper layouts and broadcast bulletins into recognisable packages which had meaning and could be reproduced again and again.

More broadly, the hiring and other human resource practices of journalism enterprises represent systems at a much more abstracted level. The range and connection nature and capacity among journalists which an editor assembles can influence the success or failure of the whole system. More disassortatively mixed staff might be beneficial for a mainstream, mass-market publication servicing a diverse audience or one which is widely distributed such
as a global wire service or a multinational such as News Corp. But more assortatively mixed staff would be better for a specialist local sports magazine, or a website servicing the automotive, craft or scientific sectors.

The challenge now is to make that systems thinking explicit in journalism education for several reasons. The first is that students should be able to predict their path through journalism by the way they build up their networks and how they mix their contacts (vertices) and thus to target potential employers more effectively. The second is more prosaic: without a clear understanding and application of systems thinking and knowledge in the broadband world, all the contacts and all the award-winning nous, grit, creativity and flair will count for nothing.

CONCLUSIONS

This article has suggested that a ‘key performance indicator’ for journalists is now an ability to optimise where and how a digital file of text, audio, video or other computer code is placed on any relevant computer network based on Reed’s Law of Group-Forming Networks. This is supported by historical data which highlights the importance of control of the ‘engineered’ and ‘engineering’ aspects of journalism, and the capacity of journalists (reporters and editors) to move from participant-follower to actor-driver. This seems to have had more effect on productivity and revenue performance than other business inputs. It is similarly supported by contemporary data that journalists are being called upon to understand and use systems as part of their daily employment, whether or not they are part of large media enterprises or smaller concerns. In fact, the comparative ascendency of small-to-medium sized journalism workplaces suggests that effective network management is essential for all journalists seeking employment.

Finally, network science strongly supports this article’s suggestion that the journalist’s ability to construct an assortatively mixed network of contacts, content and audience members is the key to commercial viability and return on investment. Broadband is essential for the fast and efficient movement of large multimedia files and as such is an important part of journalism and journalism education.

REFERENCES


ENDNOTES

1. Understood as the opposite of participant-follower, not in the information technology sense referring to device drivers.


INTRODUCTION

When Alcatel-Lucent was awarded the recent ACOMMS industry award for environmental responsibility, it was a hollow victory. Of course, we were thrilled with extra recognition for our work at Melbourne’s Centre for Energy Efficient Telecommunications (CEET), but victory from a field of one entrant is hardly a licence for wild celebration.

My concern is that our solitary nomination for this national award belies industry complacency (and possibly, even ignorance) about the challenges the IT and telecommunications sectors face when it comes to booming network energy consumption.

The equation is quite simple. The Internet today accounts for up to two percent of the world's energy consumption. That might sound small unless you consider that if the Internet were a country, it would already rank as the fifth largest for energy consumption, slightly bigger than Japan and just smaller than Russia.
We all use the Internet and I cannot imagine anyone predicting they’ll use it less in the future. In fact, our researchers estimate that based on current growth calculations, the energy demands of our global Internet could rise to up to ten percent of energy supply by 2020. That’s a lot of power.

Do we really want an Internet that consumes ten percent of the world's energy? Can we afford an Internet that consumes ten percent of the world's energy? What are the things we can do as an industry to begin to solve this challenge?

These were the questions we had in mind when we helped convene the recent Australian Energy-Efficient Internet Summit. We wanted to bring together equipment and system vendors, operators, service and application providers, researchers and others, to highlight existing activity in this area and develop a platform for collaboration in the future. The event's success, bringing together a leadership group of industry players, is testament to an increasing industry understanding and concern that these issues are ours to solve.

Australia can take a strong and effective position on Internet energy efficiency. With infrastructure investments in NBN and LTE, combined with a strengthening innovation approach, we have the opportunity to lead the world, setting an example and developing solutions for export. Of course, Alcatel-Lucent sees CEET as a great starting point, and early outputs suggest we can make great progress.
GLOBAL CONTEXT

Addressing the carbon output of telecommunications is a major part of Alcatel-Lucent's global sustainability program. Our program also includes action to improve rural inclusion and to transform economies with digital technologies.

We're very proud of what we do, and the reputation we have built, including recent recognition by Dow Jones as the best performing technology company in its Global Sustainability Index, with a score of 87 out of 100, up against companies like Microsoft, HP, IBM and Dell.

Dow Jones analyses about 1,500 companies for the index, measuring a range of economic, environmental and social criteria, like corporate governance, environmental risks and stakeholder relations. Interestingly, it places a special focus on industry-specific risks and opportunities – exactly the type of issue we are taking on with our efforts in energy efficient networks.

Alcatel-Lucent's program recognises that there is a lot more to sustainability than environmental programs. However, there is certainly a case to be made that energy and its related problems is the most significant sustainability issue facing our industry.

We take a three-pronged approach to energy efficiency. Like most companies, we work on our own operations: tracking our global emissions, reducing travel, managing our real estate and other things.

Secondly, we recognise and promote – as we all should – that the solutions we enable are in many cases helping to reduce energy use in other areas. Cloud computing and teleworking for businesses are great examples.

But the most important contribution we are making is to develop the eco-sustainable networks of the future. Alcatel-Lucent is leading the way and doing some very cool things with network innovation to make our products do more with less power. For example, our lightRadio small cells solution provides up to 50% reduction in the power requirement for a regular mobile network, while our new FP3 chip-sets that we're putting at the centre of our latest routing systems, provide four times the speed of today's networks, while reducing power consumption by up to 50%.
We’re investing in this innovation because it's a step in the right direction, but also – and this is key to the discussion – because it makes good business sense.

Today, network components make up around 75% of carrier energy requirements (that's up to 20% of opex), and often more – and traffic is growing. Our customers are increasingly demanding that new systems address that problem. It's something we now factor into design. It's interesting to note that telco customer demand is an even stronger trend in Asia, where power is sometimes less reliable and more expensive.

But making today’s technologies better is not enough. It's not enough today and it certainly won't be enough tomorrow.

**COLLABORATION**

You may be aware that Alcatel-Lucent is home to Bell Labs, one of the great R&D institutions over the past century. As you can imagine, Bell Labs researchers are actively involved making our network solutions more efficient, and lightRadio is certainly one of their more exciting recent developments, marking our recent entry to MIT Technology Review's list of the world's 50 most innovative companies.

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**Figure 3** - Innovation and Collaboration

Bell Labs is taking seriously the work needed to re-imagine the network and put in the long term solutions needed in this area – innovation way beyond the incremental gains we will continue to put forward in new product developments.

This is precisely the work that is helping Australia take such a leadership position through the Centre for Energy Efficient Telecommunications (CEET).

CEET was launched in 2009 as a collaboration between Alcatel-Lucent, the University of Melbourne and the Victorian State Government. Today, there are 28 local researchers and nine PHD students collaborating with Bell Labs scientists around the world on a whole range of projects. In the past year they have produced three patents and a weight of meaningful contributions to global research efforts.

CEET is very much part of Alcatel-Lucent's global approach to energy efficiency; it is born out of a principle to collaborate as much as possible, to harness the best possible intellect, resources and leadership to create the best result. Additionally, CEET is a fine example of an effective industry-academic research partnership; a model that I think can provide significant benefits to all stakeholders and will gain additional traction in the future.

CEET is also a member and strong contributor to Greentouch, a collaborative research program initiated by Bell Labs in early 2010 and with members from across the sector, including Alcatel-Lucent competitors. Greentouch has the ambitious stated aim to increase network energy efficiency by a factor of 1,000. By 2015 it wants to have the architecture, specifications and roadmap – and to demonstrate key components – needed to reach that goal.
This is a serious ambition and, I might say, unattainable without those involved – such as CEET and by association the broader Australian telecommunications sector – having the courage and vision to encourage collaboration between some unlikely players.

CONCLUSION: MANY PARTS, MANY ACTIONS

Collaborative approaches such as CEET and Greentouch recognise the inherent complexity of our challenge around energy efficiency in telecommunications. In an environment as complex as the Internet, incorporating literally millions of network elements, applications, devices and users, working together is the only way to fully understand the problems and to implement solutions.

![Network Dynamics](image)

**Figure 4 - Network Dynamics**

In Australia, we have the beginnings of what should become a globally significant collaboration on energy efficient telecommunications. The leaders of that local industry collaboration were in attendance at the recent Energy-Efficient Internet Summit, and my hope is that we can build that support to create a program that combines strengths and positions Australia as a leader in this space.

I expect us to build momentum quickly in areas like consumer awareness and the development of a framework for an Internet energy star rating, an extraordinarily complex initiative already on the drawing boards at CEET. I’m already looking forward to an expanded Summit next year.

Australia has the infrastructure to innovate and we know that customers are motivated to get smart. We are an industry of smart players, with many taking leading positions on matters of sustainability and renewable energy.

Together, we need to draw attention to those activities and create a platform where we can all work together to make the difference. CEET can be the focal point for those efforts and I’m happy to offer it as a beacon as we begin this journey, and encourage the entire industry to join us on our mission.

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SUSTAINABLE ICT

Bob Hayward
Chief Technology Officer for CSC Australia and Asia, Chairman of the AIIA Council for Environment & Sustainability Leadership

Australia has the potential to reach its carbon emissions reduction targets through the use of modern ICT solutions across both commercial industry value-chains and public sector services. But only if the ICT industry itself raises its game to be a far more efficient user of expensive energy resources, and the users of ICT put in place best practices around sustainable ICT.

INTRODUCTION

As the world becomes more digital and the spread of the Internet goes global, the use of energy by ICT and the associated impacts on the environment are coming under more scrutiny. This essay analyses the issues around sustainability and ICT. There is much that is being done, and that can be done, by the ICT industry itself to improve the efficiency of ICT as well as to put in place best practices around sustainability. But the use of ICT is usually to automate, improve, enhance or replace other processes that are themselves a greater burden on the environment, and there is huge potential to use more ICT to reach aggressive carbon remissions targets.

POWER USAGE IN THE ICT INDUSTRY

There is no doubt that the global ICT industry is contributing a significant and growing amount of carbon emissions through its voracious appetite for electricity. And with current trends expected to continue, this thirst for power is certainly going to get worse in the coming years.
Figure 1 illustrates some of the facts around ICT and energy consumption:

In 2010, the Australian research firm Connected Research undertook an exhaustive and comprehensive study on the use of ICT in Australia and its effects on the environment. This work, which was partly sponsored by the Australian Computer Society, found that ICT use in 2009 in Australia was consuming over 7% of all electricity and that, in turn, was responsible for close to 3% of all carbon emissions. The report concluded that by 2020, emissions from ICT use in Australia would be over 4% of the total for the country.

The costs of electricity have grown (and are growing) at such a fast pace in this current period (for a variety of reasons, not just the introduction of a carbon tax) that finally some attention is being paid to the problem of energy consumption by ICT. Nothing grabs attention more than the impact on budget bottom lines.

**SUPPLY CHAIN INEффICIENCIES**

One of the biggest challenges faced by the ICT sector is the gross inefficiencies that exist in the supply chain of electricity from generation through to actual use by a piece of IT equipment doing constructive work. Figure 2 illustrates the problem:
In the Australian context, a huge quantity of coal has to be used to generate enough electricity to pass through the transmission and distributor networks, to get to a data centre and make its way to server, network switch or storage device after navigating through all the peripheral hardware in a modern data centre. But only 15% of the time (on average) are those pieces of equipment actually acting on live data – most of the time they are waiting for work to do.

**IMPROVING DATA CENTRE EFFICIENCY**

Of course, there is huge scope to improve matters within the electricity industry itself (through the use of smart grid technologies, dynamic demand management, increased transparency and details of energy use data at point of consumption, and so forth). But there is also a need for the ICT industry itself to focus on the inefficiencies under its control – such as the Data Centre.

Figure 3 illustrates the challenges that exist in Data Centre design:
Not that long ago, managers of Data Centres would boast about the physical size of their facilities – in square feet or square metres. More recently, they would compare their energy use measured in millions of watts, such as a 5 MW or 10 MW data centre. The good news is that currently, most people charged with running data centres are using new metrics such as DCE (Data Centre Efficiency) or the more commonly used PUE (Power Usage Effectiveness) to assess and compare their respective facilities.

PUE is a ratio of the amount of electricity that enters a Data Centre relative to the amount of electricity that reaches a piece of ICT equipment. In a perfect world, this would be 1.0. It is surprising how high this ratio can be in the majority of Data Centres today. Numbers between 3.0 and 3.5 are quite common, meaning that less than a third of the electricity coming into the facility actually reaches a computer server, storage device or network switch. Some more modern data centres which have been designed from the ground up to be highly efficient might reach PUE figures closer to 1.2-1.6.

But PUE does NOT take into account the huge waste of energy involved by ICT equipment not actually doing anything productive (being ‘idle’) and simply burning energy while waiting for work. Here, technologies like virtualisation have a major role to play to create more efficiency and reduce both costs and emissions.
ENERGY EFFICIENCY OF SERVERS

The energy challenges within ICT are not limited to the Data Centre, but also to servers themselves. This set of issues is illustrated in Figure 4:

Figure 4 - Energy challenges for a data centre

The simple fact is that innovation around energy efficiency of servers has not been keeping pace with Moore’s Law, which is the gauge of innovation in raw computing performance. In 2000, a $3,000 server (CapEx) would deliver 1 unit (for the purposes of illustration) of raw computing power, and would have cost roughly $150 per year (OpEx) to power and cool.

By 2015, a $3,000 server will deliver 64 units of raw computing power (the wonder of Moore’s Law at work) BUT might – with current trends extrapolated – cost as much as $3,000 a year to power and cool! The ratio of capital to operating costs has changed dramatically.

In addition, during the same time span, a typical rack in a data centre (which can be thought of as the size of a very large family refrigerator) moves from consuming about 2 – 4 kW to between 20 – 26 kW (the equivalent of having 260 100W light bulbs permanently on in the space of a large fridge), and the weight moves from about 200 – 400kg to over 1600 kg (or more than a family sized car) as devices become more dense.

These are reasons why we used to put data centres into buildings, but now we construct purpose-built facilities around a data centre.

SOME GOOD NEWS

The good news is that in recent years, providers of hardware have started to realise that there is an urgent need to innovate in energy efficiency as well as in raw compute power. The kWh measure was becoming a key decision when making ICT equipment selection. As a result, it
is hoped that the scenario outlined in Figure 4 will not come to pass, as the BAU trends of the past several years are NOT continued into the future, as we see increases in compute power more than matched by similar gains in energy efficiency.

In fact, there is more good news around ICT and sustainability that needs to be considered:

![But Not All Bad News!](image)

**Figure 5 - Some positive trends in sustainability**

It must be remembered that in most cases, the work being done through using ICT as better for the environment than the alternative. Think about using video-conferencing instead of making flights, for example. Or consider the differences in terms of environmental outcomes between what is involved in purchasing and downloading an album of music over the Internet from your home, compared to all that is involved in producing a music CD, transporting that to a store and you travelling to the store to purchase the CD to take home.

Various studies have shown the advantages to the environment of actually using more ICT. Rather than invest in improved roads or more hospital beds, investment in broadband networks to every property can see a dramatic reduction in the demand for roads and the need to spend time in hospitals. And technologies such as smart grids and meters can finally make for a more efficient electricity supply chain.

And, as was pointed out earlier, new data centres of more modern design can be vastly more efficient than most existing facilities. They may even be located near renewable energy sources (such as hydro, wind or geothermal) or might use off-grid natural gas rather than grid electricity produced from coal. This is another reason why there is so much interest in Cloud Computing, which normally takes advantage of these newer, highly virtualised and usually much cleaner data centre environments:
TOWARDS A MORE SUSTAINABLE ICT FUNCTION

About the same time as Connection Research conducted their analysis of the use of ICT in Australia, they also published a very useful set of materials to assist IT management within enterprises to set up and run a more sustainable technology function. In summary, this ‘Sustainable ICT Framework’ looks like this in Figure 7:

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**Figure 6** - The potential of cloud computing to reduce ICT energy use

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The framework consists of five areas to be considered:

- Attitude,
- Policy,
- Practice,
- Technology and
- Metrics (you cannot change what you cannot measure).

And layered on to these five areas of attention are four focus areas:

- Efficiencies within the end user environment,
- Efficiencies within the back office and data centre environment,
- Efficiencies to be gained throughout the ICT product life cycle of procurement, operational use and eventual disposal (considering things like eWaste) and finally
- Consideration of opportunities to leverage ICT investment that have greater potential positive environmental outcomes across a business, value chain or entire economy.

Most medium to large scale organisations in Australia have done a reasonable job in recent years of getting focused on the first three of these. More attention is being paid to how users can be more efficient in their use of devices like desktops and laptops, or minimising the use of printers. Data Centres and networks have come under more intense scrutiny around energy use, while the use of virtualisation and cloud has been growing. And most supply chain and procurement processes now have elements of sustainability built into them. The ‘green credentials’ of prospective providers are now taken suitably into account, while ethical and appropriate disposal of assets at end of life is given more attention.

**THE SCOPE FOR DRAMATIC IMPROVEMENT**

But there is still far more scope for business and government to realise and seize the potential for ICT to actually dramatically improve environmental outcomes across all sectors and value chains. Reports such as the GeSI Smart2020, World Wildlife Fund and others have shown that a country such as Australia can actually meet its commitments, targets and obligations for reducing carbon emissions through a more focused attention to appropriate ICT investment,
even without the need for carbon taxes or trading schemes. It is this last area, of gaining positive environmental outcomes through more use of ICT, that is not yet gaining sufficient traction in the national debate or investment by business.

The following graphic (Figure 8) tries to illustrate many of the points made in this document:

**Figure 8 - Progress towards a sustainable ICT environment**

Any business starts at the left. They are most likely poorly prepared for the transition to a low-carbon economy, have immature emissions, waste and other types of non-financial systems in place and have inefficiencies within their own ICT environment, within their business and across their respective value chains.

By following the guidance of sustainable ICT frameworks as spelt out by Connection Research (and others), a business can gradually make changes.

Initially, they would put in place better and more sophisticated systems to track energy use, emissions, waste, water use and other environmental metrics across their business. Using this information, they can start to make their own ICT environment more efficient. Then, somewhat paradoxically, they might increase their ICT investment (and therefore ICT-related emissions!) in order to see far greater benefit in improved efficiencies within their own business and across industry value chains. The end result will be an organisation that is much better prepared for the inevitable transitions required to work effectively in a carbon-constrained world.
CONCLUSION

While there are urgent and pressing needs to improve the sustainability and efficiencies within the ICT industry, there are also persuasive arguments for increased use of ICT in order to gain far more impressive beneficial environmental outcomes across value-chains, supply-chains and the entire economy. This “High Tech, Low Carbon” approach needs to be better understood by business leaders, government policy advisors and within the ICT industry itself. What is really required now is more thorough, fact-based research to highlight the opportunities to more effectively leverage contemporary ICT solutions to reach carbon emissions reduction targets in a modern economy such as Australia.

The Internet and the ICT (information and communication technologies) are now accepted as building blocks for economics, technological and social advancement worldwide. The Information Age and the evolution towards an e-society promise substantial benefits as the availability of broadband access continues to spread around the globe. However, the infrastructure on which our e-society relies is consuming ever-increasing amounts of power. The generation of this power is producing a rapidly increasing carbon footprint. Today ICT contributes approximately 2% of humankind’s carbon footprint and this contribution is growing exponentially. This raises the question of whether or not our ongoing move into the Information Age is environmentally sustainable. The Centre for Energy Efficient Telecommunications (CEET), located at the University of Melbourne, is a new research centre with a sole focus on the energy efficiency and sustainability of telecommunications networks. This article describes the areas of CEET’s research and their outcomes to date.

INTRODUCTION

Today we are most certainly well into the Information Age. Just like the preceding Agricultural and Industrial Ages, the Information Age is dramatically changing the way we live our lives, both at home and at work. The on-going growth in Information and Communications Technologies (ICT) and the Internet is transforming society and generating even greater changes than any of the previous “Ages”. However, very soon another “Age” will be upon us: the “Sustainability Age”, if not already here, is not far into our future.

The “Sustainability Age” is that time in the evolution of our society in which we need to recognise and respond to the fact that we live on a finite planet with finite resources. We can only generate a finite amount of electrical energy and we can only dump a finite amount of pollution into our environment. Every sector of the economy must review its impact on the environment, and the ICT sector is no different.

The ICT equipment that underpins the Information Age is consuming greater amounts of electrical power than ever before, and as a result greater amounts of carbon-dioxide emissions (CO2e) are being pumped into our atmosphere. Figure 1 shows the global power consumption of the Internet projected into the future based upon current growth rates assuming no improvement in equipment energy efficiency (red dashed line), as compared with 15% improvement per year (green line) (Tucker 2011b). The 15% improvement is based on the best current trends for Internet equipment. Also shown in the figure is global electricity supply, projected into the future based on its historical growth trend of 3%. If nothing is done to improve the energy efficiency of the Internet, it will grow from consuming up to 2% of global electricity supply to well over 10% by 2025. This is not sustainable.
Even assuming a 15% per annum improvement in energy efficiency, the Internet will consume an increasing proportion of world electricity generation. Furthermore, attaining the 15% annual improvement trend shown in Figure 1 would require replacing all Internet equipment each year by the latest generation of equipment, which is not realistic as it would place an insurmountable financial burden on telecommunications service providers. In order to realise the full potential of the Information Age, new research and innovations are required that will reduce the energy consumption of the ICT industry.

The Centre for Energy-Efficient Telecommunications (CEET) is a research centre based at the University of Melbourne that is dedicated to achieving sustainability in telecommunications. CEET was established in March 2011 and is a cooperative venture supported by Alcatel-Lucent (Australia), the Victorian State Government and the University of Melbourne. The research is primarily focused on the energy efficiency and carbon emissions of telecommunications networks, including the National Broadband Network (NBN) being rolled out by the Australian Government.

**ENERGY-EFFICIENT TELECOMMUNICATIONS RESEARCH**

**ENERGY AND CARBON FOOTPRINT OF THE NBN**

Next generation broadband networks, such as the NBN, are being deployed in nations around the world to meet future demands for high speed broadband, and drive economic growth over the coming decades. The deployment of new networks provides an opportunity to improve the energy consumption of telecommunications network by replacing old and energy inefficient equipment with state-of-the-art equipment.
Furthermore, ICT is often touted as a driver of energy efficiencies throughout the economy. In 2008 a seminal report titled “SMART 2020” (The Climate Group 2008) indicated that ICT and broadband services could be applied to help abate humankind’s carbon footprint by 2020. This stimulated research into how broadband can be used to replace high carbon-footprint activities: popular examples include smart metering in the energy sector and teleconferencing to reduce travel. The report highlighted the fact that broadband can help increase economic activity while lowering a nation’s carbon footprint.

In contrast to this, it is possible that improving efficiency leads to price reductions, which then stimulates demand and so increases production. This principle is called the Khazoom-Brookes Postulate and is widely accepted in economics (Saunders 1992). In the case of the NBN, as broadband usage increases so does the energy consumption of telecommunications networks as well as end-users, who have more broadband-enabled devices, such as TVs, tablets, home appliances and other white goods. If broadband costs are lowered, this will drive more usage, which will, in turn, require more energy to power the telecommunications network and support the demand for data. Therefore, the deployment of nationwide broadband may result in increasing economic activity to such an extent that it will increase carbon production.

To date, no detailed study on this issue has been reported. However, researchers at CEET are studying the impact on energy consumption and carbon footprint of the Australian economy, resulting from deploying the NBN with a focus on the two countervailing possibilities of increased or reduces carbon emissions. The study is accounting for the increased energy consumption of the network as demand for broadband rises and the energy consumption of broadband-enabled customer premise equipment in the various sectors of the Australian economy. It also includes energy savings resulting from the use of ICT in the domestic, government and industry sectors.

The research involves applying a Computable General Equilibrium Model (CGEM) of Australia’s economy, developed in Centre of Policy Studies based at Monash University, to estimate the net social, environmental and economic impact of a nationwide broadband network, including the energy consumption and CO2e footprint. The model encompasses the Khazoom-Brookes Postulate to estimate the net effect of an NBN on energy consumption and related CO2 (e) emissions.

ENERGY EFFICIENCY OF FUTURE MODULATION FORMATS

Research at CEET is also focused on driving energy efficiencies in telecommunications equipment, in both the core and access networks. Research on the core network includes improving the energy efficiency of modulation formats as well as understanding the power consumed by routers.

Ubiquitous broadband generates massive amounts of data that needs to be transported between nations and continents, via the core optical fibre communications systems. As the demand for data grows, these systems must provide ever-more capacity. An optical fibre communications system consists of a highly complex group of inter-connected building
blocks, as shown in Figure 3. Minimising the energy consumption of each separate block does not produce a viable, energy-efficient communications link. The system must be optimised as a totality, which makes the task of designing an energy efficient high-capacity optical link challenging.

Key to achieving high capacity in optical fibre systems has been the development of advanced modulation formats that enable very high data transfer rates using available electronics (Tucker 2011a). These advanced modulation formats enable more data to be transmitted over an optical fibre, but come at a cost of increased circuit complexity in the transmitter and receiver. They also require specialised coding and decoding of the electronic data signal before the transmitter and after the receiver, respectively (Pillai et al 2012). This increased complexity may also increase energy consumption in the system.

Research underway at CEET is determining the optimal trade-off between energy efficiency and spectral efficiency when using advanced modulation formats. This involves developing detailed energy consumption models of the various function blocks of the transmission system, including the optical link, electronic digital processing and electronic-to-optical and optical-to-electronic signal conversion. With the understanding provided by these models, a framework for energy-efficient high-capacity optical system design can be developed.

![Figure 3](image)

**Figure 3** – Schematic diagram of an optical communications system link. To minimise power consumption, the all aspects of the link need to be considered. The use of sophisticated signal coding and error correction can improve overall energy efficiency of the link. Although the link consists of an interconnected group of operational blocks to minimise the overall power consumption of the link requires a global perspective.

**ROUTER POWER MEASUREMENTS**

Today access networks currently dominate the power consumption of the Internet, however this may not be true in the coming years (Baliga et al 2009). As broadband access speeds continue grow, the traffic resulting from aggregating customer traffic will generate a tidal wave of data in the Internet’s core. This core traffic is steered through the network by large routers and as the amount of traffic continues to grow, we will require more and larger core routers.

To understand and then mitigate the Internet’s power consumption, we need to ascertain its many contributors. Network equipment and routers in particular are major contributors. Routers tend to consume significantly greater power compared to other network equipment (Tam et al 2010). Routers require substantial computational capabilities in order to interrogate each data packet arriving from the network and determine the next step toward that packet’s destination. The destination is calculated using an Internet Protocol (IP) address look-up. Other network devices provide switching functionality but do not require IP look-up processing and many other computationally intensive functions that are undertaken in routers, for example deep packet inspection, security checking, traffic data collection and routing table maintenance.

Determining detailed power consumption profiles of equipment such as IP routers, switches and cross-connects are required to construct detailed power consumption models for the
Constructing power models for network equipment requires development of measurement tools to collect the required data. This is a non-trivial task, as most network equipment is not designed to enable ease of measurement. Those that provide for power measurement use specific proprietary tools, not applicable to other vendor’s equipment. Relating practical measurements to general mathematical models can also be a challenge.

CEET researchers have developed a vendor agnostic router power measurement technique that can be applied both in-service and stand-alone routers. This technique is providing crucial data for the development of sophisticated router power models.

**FUNDAMENTAL LIMITS OF ELECTRONICS AND PHOTONICS**

Minimising power consumption in network elements such as routers and switches is an important focus for research on energy efficiency in telecommunications. These network elements must undertake complex digital signal processing and computing activities implemented by large arrays of inter-connected digital logic gates. The energy efficiency of these network elements is constrained by a range of fundamental limitations determined by the laws of nature. These laws arise from quantum mechanics, statistical physics, entropic limitations, information theoretical constraints and relativistic processes, to name a few. All technologies, which include those used in ICT and the Internet, are subject to these constraints (Hinton et al 2006).

Different technologies may be subject to different constraints. One fundamental issue in the quest to “green” ICT is finding the most energy efficient technology and/or technology mix. A technology must be energy efficient and cost effective to be commercially viable. Although electronics (particularly CMOS) has been the dominant technology for digital signal processing, over recent years alternative technologies, based upon photonic interactions have attracted significant attention (Willner et al 2011).

Electronic signal processing technologies are well developed and commercially successful. The trend described by “Moore’s Law” has been possible because of the continued success in reducing the power and space demands of electronic transistors. However, it is expected electronic signal processing is unlikely to attain processing speeds much beyond 100 Gbit/s, a limit that is often referred to as the “electronic bottleneck”. This raises the question of coping with the ever-increasing signal processing load on ICT equipment due to the exponential growth of Internet traffic. A widely canvassed proposal is to replace electronics with photonic signal processing technologies. This idea is intuitively appealing because photonic technologies offer the promise of signal processing speeds up to 10’s Tbit/s, significantly faster than CMOS. Also, photonic signal processing avoids the need for Optical/Electronic/Optical (O/E/O) conversion.

To improve the energy efficiency of network equipment (i.e., reduce the energy per bit) we need to understand where these limits lie to appreciate what further gains are available from both electronic and photonic technologies. CEET is investigating the limitations on reducing network element power consumption and size arising from the fundamental properties of electronic and photonic digital logic gates (Hinton et al 2008).

Apart from low power consumption and small device size, CMOS gates are ideal for digital signal processing. In the below Figure 4 displays the switching characteristic shapes for CMOS gate and Figure 5 likewise for a photonic gate (Highly Nonlinear Fibre, HNLF). We can immediately see that, for the purposes of implementing digital processing, shape of the electronic switching characteristic is significantly superior to the shape of the photonic switch. A question being considered in CEET is: “Is it possible for photonic technologies to attain a switching characteristic the same as electronics for similar power consumption and size?” If this is possible, the ultra-high switching speeds available with photonic devices will provide a significant step in improving the energy efficiency of the Internet.
The profile exhibited by CMOS is extremely well suited to digital signal processing. However, that for HNLF presents significant challenges to using these devices for high speed digital signal processing. The challenge is to determine why this is so and to find possible ways to improve the HNLF profile in an energy efficient manner.

LOW-ENERGY FIBRE ACCESS NETWORKS

CEET researchers are also considering the energy efficiency of the access network, which is currently one of the biggest contributors to power consumption in telecommunications networks (Baliga et al 2009). Fibre-to-the-Premises (FTTP), such as that being rolled out by the NBN, is widely seen as the next generation fixed access system, and has been shown to be the most energy efficient access network (Baliga et al 2009). In the case of Australia’s NBN the rollout is primarily based upon a “point-to-multipoint” FTTP in which multiple customers share a single source in the local exchange. The average power consumption for current FTTP systems is in the order of 10 W/user (Baliga et al 2011). While FTTP is the most energy efficient access technology available today, reducing the power consumption of FTTP will have a significant impact on the total carbon footprint of telecommunications services.

Researching new access network architectures and technologies has shown that, with the right technology mix, other access network architectures may be more energy efficient than traditional point-to-multipoint FTTP (Sedighi et al 2012). Research underway at CEET is looking toward a point-to-point FTTP optical access network that can provide record low energy consumption in the order of 100 mW/ user for 100 Mbit/s access bitrates. A “point-to-point” FTTP has one customer for each source in the local exchange. It is expected that this new approach will open up new opportunities for alternative power supplies such as solar cells.

ENERGY-EFFICIENT WIRELESS TRANSMISSION

CEET is also undertaking research into improving the energy efficiency of wireless access networks. This is particularly important given the rise of mobile computing, and penetration of mobile devices such as smart phones, tablet, and netbooks. Wireless access networks are the least energy efficient access networks because power is transmitted in all directions, regardless of where the end is located.

There are two main ways to reduce energy consumption in the wireless network (Blume et al 2010):

a). Shorter distances between terminals and base stations reduce the required amount of transmit power.

b). Reduce energy consumption by using a larger bandwidth and trade off spectral efficiency for power efficiency.

CEET researchers and investigating ways to trade off spectral efficiency for power efficiency. Reducing the transmitter power can be accomplished using stronger error control coding on the transmitted signal, which allows the receiver to operate with a much lower received power, and hence a low signal-to-noise ratio (SNR). Operating with a very low SNR requires...
a re-think of wireless receiver design from the ground up. Such systems differ from conventional systems, as a significant amount of error-control coding is necessary to recover the transmitted data when the received SNR is very low. It is this coding that reduces the spectral efficiency and, according to Shannon’s information theory, allows for higher energy efficiency (Heliot et al 2012).

To attain significant energy efficiency gains using coding at a low-SNR receiver requires proper synchronisation in terms of timing, clock frequency, carrier frequency and phase. Each of these tasks is absolutely critical, and the failure of any one will result in failure of the receiver to recover the transmitted data. This work is investigating the theoretical foundations to maximise energy efficiency of a wireless point-to-point link by analysing and understanding its low-SNR receiver limitations.

WIRELESS BASEBAND MODELLING FOR LIGHTRADIO™

CEET researchers are also investigating trends in mobile base stations and how these can assist in driving energy efficiencies. Large and powerful base stations serving areas of a few square kilometres have largely delivered cellular phone services. In selected high-traffic areas including central business districts and shopping complexes, these have been augmented by lower power base stations serving limited areas. A traditional base station radiates power in all directions within each coverage area serviced by the wireless antenna, irrespective of the location of the customers. This approach wastes significant amounts of power.

A very recent trend in the wireless base station technology has been the development of compact modular wireless transmitter/receivers for base stations, of which the Alcatel-Lucent lightRadio™ cube is an example (Segel & Weldon 2011). These modules can be used singly to provide wireless coverage in a limited area such as a shopping centre or sports ground, or used in groups to build a more traditional base station. Importantly, when using several of these small radio modules together, by slightly shifting the relative signal timing (or phase) between the modules it is possible to shape the resulting wireless signal beam and deliver a stronger signal power to customer locations in parts of the coverage area. As the phasing between modules is changed, so the location of the best signal coverage can be dynamically adjusted. This technology is commonly described as an Active Antenna Array.

Active Antenna Arrays can both improve quality of service and energy efficiency. To attain these outcomes, CEET is developing models to determine the potential for each of these technology developments to lower the energy consumption of wireless access networks while delivering equivalent service capabilities. The work is building on current-technology modelling by adding an analysis of new wireless technologies and Active Antenna Array systems. The model also includes the use of pooled and shared base station control functions and accounts for the different demographic and network usage patterns in the USA, Europe and Asia-Pacific areas.

CLOUD COMPUTING, CONTENT DISTRIBUTION & INFORMATION LOGISTICS

In considering the energy consumption of telecommunications networks it is important to consider the elements of the network, as well as how the network is used. Different applications have differing energy consumption profiles. CEET researchers are currently undertaking research into the energy efficiency of cloud services.

Cloud computing offers the promise of providing organisations and consumers with on-demand computing, storage, and software services that can be accessed from any location at any time (Mell & Grace 2011). All that is needed is a network connection and a device such as a laptop, tablet or mobile phone. This has led to explosive growth in demand for cloud based services for a wide range of businesses and social applications (Cisco 2011). Cloud computing relies on large data centre facilities that house many thousands of computers (called “servers”) that provide remote processing and storage for cloud users.
A frequently stated benefit of cloud services is that they are “greener” than performing tasks on a local desktop PC (Accenture 2010; WSP 2011). Studies that have produced this finding typically focus on cloud computing in corporations. In this scenario, cloud computing is likely to be a green alternative to desktop computing, which requires IT infrastructure that typically consists of a number of desktop PCs connected to an “in-house” network and one or more local servers. Replacing this infrastructure with a cloud service enables employees to use low-power client devices networked to a large well-managed data-centre that provides significantly more processing power than several local “in-house” servers at a fraction of the price and power consumption per user (Liu et al 2009). Despite this, data centres can consume mega-watts of power and, depending upon their power source, may have quite a significant carbon footprint (The Climate Group 2008). This has lead to an active and ongoing debate about the “greener” of cloud services (Greenpeace 2010). This debate has focussed on the power consumption of data centres, not the network and equipment needed to connect cloud users to the data centre.

However it is not just the data centre that consumes power in cloud computing: end user devices, the broadband access network and the core infrastructure all drive energy consumption. As noted above, the access network consumes significant power. Therefore the recent push to extend cloud services to individual consumers via their mobile phone and/or tablet is driving the energy consumption of cloud computing. The energy consumption relating to the transmission costs is only going to get worse as demand for consumer cloud services grow in popularity and diversity, as is predicted in the very near future (Juniper 2010).

CEET research has shown that this scenario is very different to the use of cloud services in a corporation. A study of cloud-based word processing applications introduces overhead bytes that can be as high as 1000 times as the original text data bytes. The results are shown in when using cloud-based word processing applications, each keystroke typically generates a maximum size packet of approximately 1500 bytes in addition to around 1500 bytes data for document synchronization between the client and the cloud server. Thus composing a text document online using a cloud-based enterprise suite can be somewhat less energy efficient than composing on a low power user device.

Figure 6 – Plot of power consumption per user when accessing cloud based word processor for different access technologies. It shows that when a wireless (3G) connection is used the power consumed is roughly the same as for a Passive Optical Network operating at 100 Megabits/second, even though the wireless cloud service is operating at less than 1/1000 of this speed. Overall, accessing a cloud service via a mobile network is very energy inefficient compared with other technologies. These findings indicate that the greatest challenge to the sustainability of cloud services is the expectation of an “any-where, any-time, any-service” cloud.
CONCLUSION

It is becoming increasingly clear that the Information Age of tomorrow will be significantly different to the vision that existed in the 1990s when the Internet grew from an academic tool to a dominant part of the world economy. The embryonic days of the Internet did not envision the plethora of services and technologies that we see today from mobile access to cloud services, social networking, high definition IPTV and tablets to name a few.

Today’s younger generations see these services and their supporting technologies as the “norm”. They are now looking toward and/or creating the next generation of information based services. No matter what these may be, they all will consume power. They will all require equipment to be deployed around the planet and will all have a carbon footprint. The challenge if the Information Age is to ensure it is sustainable for the benefit of future generations worldwide.

The research being undertaken in CEET, along with many other similar institutions around the globe, provides a crucial building block for this future.

REFERENCES


ENDNOTES


TOWARDS AN ENERGY-RATING SYSTEM FOR TELECOMMUNICATIONS

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The Internet can provide many opportunities to improve the sustainability of society. However, it also has potentially adverse environmental impacts in terms of energy consumption. To address these negative impacts a new energy rating system for the telecommunications sector is being developed. The new rating system will serve as a systematic framework for assessing, reporting and benchmarking the sustainability of telecom products and services. In this paper, we discuss the ecosystem of the new rating system and methodologies for computing a telecom service’s green index rating. Further, we use real network measurements obtained from a research and education network to demonstrate how the green service index rating of a telecom service can be calculated.

INTRODUCTION

In recent years, the technological progress in information and communications technology (ICT) has provided digital solutions to improve consumers’ quality of life and enable energy efficiency improvements. However, ICT products and services currently accounts for approximately 7% of the global energy consumption (Vereecken et al. 2010) and the resulting ICT carbon footprint is around 2% of the global carbon dioxide (CO₂) emissions (GeSI 2010). For Australia, the figures are similar. A recent report by the Australia Computer Society indicated that ICT is responsible for approximately 2.7% of Australia's total greenhouse gas (GHG) emissions (around 7% of all electricity demand in Australia) (Philipson 2010). This issue is exacerbated by the rapid growth in both the number of Internet users and the volume of data they generate (Cisco 2011). Therefore, without the adoption of green technologies, the total contribution of GHG emissions from ICT will become unsustainable. As a result, corporate environmental responsibility practices have become a major focus for ICT companies. More importantly, there exists an expectation from customers for these companies to provide green products and services (Watson et al 2008). Recently, independent organisations such as the Carbon Disclosure Project (CDP) and Corporate Register that assist companies in measuring their GHG emissions, benchmark their green initiatives and enable
carbon footprint information disclosure, have experienced rapid growth in terms of the
number of participating companies (Carbon Disclosure Project 2012).

Various standards and policies such as the ITU-T L.1410 (Environmental impact of ICT
goods, networks and services), L1420 (Environmental impact of ICT in organisations),
L.1430 (Environmental impact of ICT projects), ETSI's TS103-199 (Life cycle assessment of
ICT) and the GHG protocol's ICT Sector Guidance Supplement have been developed by
international standardisation bodies to guide ICT companies in accounting for and reporting
of corporate GHG emissions. Furthermore, major telecom companies have also developed
“in-house” energy efficiency metrics to guide their green initiatives. Some examples of
companies that have adopted an energy-efficient metric and their improvement plans are
listed in Table 1. Transparent sustainability efforts at the corporate level provide the
possibility to promote transparency at the service/product level. Such transparency enables
differentiated ‘green’ services to be offered to the consumers.

<table>
<thead>
<tr>
<th>Telecom Company</th>
<th>Region</th>
<th>Energy efficiency metric</th>
<th>Planned improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;T</td>
<td>North America</td>
<td>Energy consumption (kWh) / terabyte of data (TB)</td>
<td>25% reduction by 2019 compared to 2009</td>
</tr>
<tr>
<td>Verizon</td>
<td>North America</td>
<td>Carbon emissions (tons) / terabyte of data (TB)</td>
<td>50% reduction by 2020 compared to 2009</td>
</tr>
<tr>
<td>Telecom Italia</td>
<td>Europe</td>
<td>Bits transmitted (bit) / energy consumption (joule)</td>
<td>N/A</td>
</tr>
<tr>
<td>British Telecom</td>
<td>Europe</td>
<td>Carbon emissions (tonnes) / unit of contribution to GDP</td>
<td>80% reduction by 2020 compared to 1997</td>
</tr>
<tr>
<td>Orange™</td>
<td>Europe</td>
<td>Carbon emissions (tonnes) &amp; energy consumption (kWh)</td>
<td>20% reduction for CO₂ and 15% reduction for kWh by 2020 compared to 2006</td>
</tr>
<tr>
<td>China Mobile</td>
<td>Asia/Oceania</td>
<td>Energy consumption (kWh) / unit of telecommunications traffic (MB)</td>
<td>20% reduction by 2012 compared to 2008</td>
</tr>
<tr>
<td>Telstra</td>
<td>Asia/Oceania</td>
<td>Carbon emissions (tonnes) / terabyte of data (TB)</td>
<td>N/A</td>
</tr>
<tr>
<td>Optus</td>
<td>Asia/Oceania</td>
<td>Carbon emissions (tonnes) / revenue ($)</td>
<td>20% reduction by 2014 compared to 2007</td>
</tr>
</tbody>
</table>

Table 1 - Energy efficiency metrics and planned improvements of major telecom companies. Sources: Corporate Responsibility reports of AT&T, Verizon, Telecom Italia, BT, Orange, China Mobile, Telstra and Optus.

In this paper, we proposed and discuss an energy rating system. The system serves as a green service index rating for Internet and telecom services. This new system allows Internet and telecom services to be benchmarked against best practice scenarios. The system is based on an energy performance concept similar to that of an energy star for white goods (e.g., refrigerators, televisions and washing machines). It aims to empower Internet consumers by providing unbiased and easily-understandable information regarding the ‘greenness’ of ICT services that they are using. Furthermore, the new system also aims to reward and encourage Internet service providers (ISPs) and network operators to constantly improve the energy efficiency of their services by distinguishing between high and low energy rating services. As a result, the new rating system is expected to expedite the deployment of next generation energy-efficient networks.

**ENERGY RATING ECOSYSTEM**

There will be three key stakeholders in the new energy rating system for Internet and telecom services, namely

(i) governments,

(ii) suppliers (Internet service providers, network operators and vendors) and

(iii) consumers, as depicted in Figure 1 below.
In recent years, governments, international agencies and regulators have been confronting the issues of rising global GHG emissions, global climate change, depletion of natural resources and the consequential increase in electricity prices. As consumers become aware of these issues, the energy rating system will provide them with an incentive to reduce energy costs and help mitigate climate change through their purchasing power. Meanwhile, the ISPs, network operators and vendors aim to gain competitive advantage through incorporating sustainability practices into their corporate strategy. Therefore, a new energy rating system for Internet and telecom services will enable differentiated green products and services to be offered to consumers. The rating system aims to empower consumers by providing them with trusted and unbiased information regarding the greenness of the telecom products or services they are using. Consequently, corporations can then be influenced by green practices with the aim of enhancing their competitive advantage based on improved energy outcomes. Finally, the new energy rating system aims to achieve better environmental impact outcomes through cooperation of all three stakeholders.

**Figure 1 – Energy rating Ecosystem.**

**KEY ELEMENTS OF THE ENERGY RATING SYSTEM**

The energy rating system quantifies the energy efficiency of Internet and telecom services. Further, it assesses the effectiveness of green strategies implemented by ISPs and network operators in a manner that promotes sustainable growth. Both effectiveness and efficiency components are taken into account to minimise negative rebound effects, (often referred to as Jevon's paradox (Alcott 2005)). As depicted in Figure 2, three key elements are required to form a service rating:

(i) energy efficiency ($\eta$),
(ii) energy consumption ($E$) and
(iii) improvements of both energy efficiency and consumption over time.
Figure 2 - Key elements of the new energy rating system for Internet and telecom services.

ENERGY EFFICIENCY AND ENERGY CONSUMPTION OF TELECOM SERVICES

Background of GHG protocol telecommunications network services (TNS) guide

Since 2011, the World Resource Institute (WRI), the World Business Council for Sustainable Development (WBCSD), Carbon Trust, Global e-sustainability initiatives (GeSI) and the industry-led European Methodology Consortium have been working together to develop and agree on an industry-wide methodology for calculating the carbon footprint of ICT products and services (GHG Protocol Initiative 2012). In the Telecommunications Network Services (TNS) chapter under the GHG protocol on ICT sector guidance supplement (GHG Protocol Initiative 2012), any telecom product or service consists of two major life cycle phases, the use-phase and the embodied emissions. The use-phase emissions represent GHG emissions associated with the energy consumed when operating network equipment, devices and accessories.

In contrast, the embodied emissions represent GHG emissions associated with raw material acquisition and pre-processing, production, distribution and transport, installation and end-of-life decommissioning of network equipment, devices and accessories. In customer domain the equipment includes servers, switches, routers and video conferencing suites. For service platforms, network equipment includes the access network, metro and core networks and transport equipment such as wireless base stations, servers, switches and routers. For operational activities, the use-phase mainly includes customer activities and the use of non-ICT equipment and vehicles for the installation, support and maintenance of ICT equipment. In contrast, the embodied emissions of operational activities include the emissions associated with manufacturing non-ICT equipment, buildings and vehicles. This is summarised in Figure 3.
Energy efficiency of telecom services

For telecom networks and services, the use-phase emissions are the major contributors due to the long equipment lifetime. The use-phase to embodied emissions ratio can range from 60% to 90% depending on the equipment category (GHG Protocol Initiative 2012). The energy efficiency is often defined as how efficiently (in terms of energy performance) a telecom service is delivered from the source to the destination. As such, the energy efficiency is often defined as the power over capacity or traffic in the units of W/bps (Kilper et al 2011). However, a more general form would be the power over functional unit of a service, since different services have different functional units as shown in Table 2. In the TNS guide, different models that utilise different granularities of network measurements are recommended to be used to calculate the energy efficiency at the service level.

<table>
<thead>
<tr>
<th>Service</th>
<th>Functional Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone call using a Telecoms Network</td>
<td>One minute call over a single carrier’s network.</td>
</tr>
<tr>
<td>Data transfer using a Telecoms Network</td>
<td>Transfer of one Megabyte of data over a single carrier’s network.</td>
</tr>
<tr>
<td>MPLS Service</td>
<td>Delivery of an MPLS service to a customer for the contract period of three years, providing 10,000 ports with average bandwidth of 1 Mbps.</td>
</tr>
<tr>
<td>Video on Demand Service</td>
<td>Number of customers, network VoD traffic capacity, geographical spread of end user connections and length of service.</td>
</tr>
<tr>
<td>Broadband Services (e.g., ADSL, FTTH, Mobile Wireless)</td>
<td>Number of customers and aggregate network capacity</td>
</tr>
<tr>
<td>Wireless access</td>
<td>Number of customers, geographical spread</td>
</tr>
<tr>
<td>Service</td>
<td>Functional Unit</td>
</tr>
<tr>
<td>Phone call using a Telecoms Network</td>
<td>One minute call over a single carrier’s network.</td>
</tr>
</tbody>
</table>

Table 2 – Functional units of telecom services.

Energy consumption of telecom services

The energy consumption of a telecom service is the product of energy efficiency (W/bps = Joules/bit) and usage (bits). An improvement in energy efficiency should lead to a decrease in energy consumption in order to maintain sustainable growth. In other words, improving the energy efficiency but increasing the usage for the same quality-of-service over time is unsustainable. For example, an upgrade to improve the energy efficiency of a content distribution network (CDN) should decrease the energy consumption per megabyte of video.
content downloaded. Therefore, downloading an identical quality 1-hour video now should consume less energy than before. However, the number of video downloads per user is expected to increase over time due to the rapid growth of both Internet users and the quality of video. Thus, energy efficiency improvement is an ongoing process. Measuring both the energy efficiency and energy consumption is mandatory to accurately assess the effectiveness of green strategies being implemented by service providers and network operators.

Furthermore, a point to note is that a telecom service may traverse networks managed by multiple providers. If the fractions of traffic handled by all other providers are significant and the efficiency factors of these providers’ networks vary significantly, the resulting service efficiency may vary considerably. Therefore, determining the service energy consumption for services that pass through networks managed by different providers is not a trivial exercise.

**Sustainable Growth**

Common energy rating systems, such as those white goods, calculate only the estimated energy consumption of the product over a fixed time period (e.g., per year). The energy consumption is based on the product model, which will be fixed over the product’s lifetime. In contrast, an improvement factor is crucial for telecom services because telecom networks are constantly evolving to accommodate more users and are intrinsically becoming more energy-efficient due to factors such as Moore’s Law (Neilson 2006; Bolla et al. 2011). Therefore, our proposed energy rating system for Internet and telecom services consists of a dynamic component – a method for factoring in the energy efficiency improvement of telecom services. This factor measures the effectiveness of the energy-efficiency improvement strategies implemented by the service providers and promotes ongoing sustainability improvement efforts by ISPs. Factors that can affect the service energy efficiency improvement rate are as follows:

1. replacement of legacy equipment with new energy-efficient equipment,
2. improvement of the central offices’ power usage effectiveness (PUE),
3. increased the use of renewable energy sources to power the central offices and (4) increased utilisation of the network. We define the improvement factor so that if it is positive, then the energy consumption of period \( t+1 \) should be less than that of period \( t \).

Finally, a **green service index rating** of a service can be calculated as a function of the three key elements discussed above. The total service energy consumption is benchmarked against the reference case, which is the best-case scenario where energy efficiency values of commercial state-of-the-art equipment classes are used.

**Case Study of Green Service Index Rating**

In this section, we demonstrate the calculation methods of a service’s green index rating over the California Research and Education network (CalREN) using the telepresence service as an example. The CalREN is a multi-tiered, advanced network-services fabric that serves the vast majority of K-20 educational and research institutions in the state of California. The CalREN backbone consists of roughly 3,000 miles of self-owned and managed fibre (including last-mile fibre). It consists of 16 sites and 57 nodes, offering a backbone speed of up to 10 Gb/s.
STEP 1: FIND THE SERVICE ENERGY EFFICIENCY

In this case, the CalREN is used as the delivery network for the service under assessment, which is the telepresence service. The total power consumption of CalREN is approximately 169 kW (assuming power usage effectiveness of 1.5 for all central offices) and the measured total network traffic is around 40 Gb/s. Therefore, any telecom service will be delivered through CalREN with an energy efficiency of 4.225 kW/Gb/s. The service and network parameters are summarised in Table 3.

<table>
<thead>
<tr>
<th>Service parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service contract (c)</td>
<td>3 years</td>
</tr>
<tr>
<td>Functional unit (Tₜ)</td>
<td>10 Mb/s (HD telepresence session)</td>
</tr>
<tr>
<td>Total number of sessions per year (S)</td>
<td>26,000 (estimated 2 sessions per customer site per working day for 50 customer sites)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Network parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption (P)</td>
<td>169 kW</td>
</tr>
<tr>
<td>Average PUE</td>
<td>1.5</td>
</tr>
<tr>
<td>Mean network traffic (Tₜₚ)</td>
<td>40 Gb/s</td>
</tr>
<tr>
<td>Network energy efficiency (η)</td>
<td>4.225 kW/Gb/s</td>
</tr>
</tbody>
</table>

Table 3 – Parameters of the delivery network and the service under assessment.

STEP 2: FIND THE SERVICE ENERGY CONSUMPTION

The service under assessment is a 3-year high-definition (HD) telepresence service contract, which covers a total of 50 customer sites at a maximum bandwidth of 10 Mb/s per session. Using the information provided in Table 3, the energy consumption of a one-hour telepresence session can be computed using the formula:

\[ E_{session} = \eta \times Tₜ \times 1 \text{ hour} = 42.25 \text{ Wh.} \]

For a total of \( S = 26,000 \) estimated sessions per year, the annual energy consumption of the service can be calculated as \( E_{pu} = E_{session} \times S = 1,099 \text{ kWh/year.} \)
STEP 3: FIND THE SERVICE ENERGY CONSUMPTION OVER THE WHOLE SERVICE CONTRACT PERIOD

As discussed in the previous section, the energy efficiency improvement factor is an important parameter in the new energy rating system. Assuming that the network operator is committed to increase the energy efficiency of the delivery network by 5% each year, the total service energy consumption for a contract length of three years can be determined using the formula:

\[ E_{total} = \sum_{t=1}^{3} \left( E_{pat} \times (1 - \alpha)^t \right) = 2,978 \text{ kWh}. \]

STEP 4: BENCHMARK \( E_{total} \) USING THE REFERENCE MODEL

To develop a best practice reference model against which the total service energy consumption can be benchmarked, the information of different classes of equipment used in the delivery network and the associated number of hops are required. Table 4 shows three classes of equipment used in CalREN and the number of hops that a typical telecom service will traverse through each class of equipment. Furthermore, the reference equipment (which is the best practice equipment in terms of energy efficiency) is selected for each class of equipment. It should be noted that, the best practice equipment for each equipment class should be decided by policy makers, regulators and telecom companies when implementing the energy rating standard. In this paper, we use some common best practice network equipment (and the associated energy efficiency values) for each class of equipment to perform the calculation.

The overall energy efficiency of the reference model can be determined using the formula:

\[ \eta_{ref} = PUE \times \sum_{k=1}^{f} (h_k \times \eta_k), \]

where \( k \) denotes the class of equipment, \( f \) is the total number of equipment classes (in this case, \( f = 3 \)) and \( \eta_k \) is the energy efficiency for the \( k^{th} \) class of equipment. In this case, \( \eta_{ref} = 248.7 \text{ W/Gbps} \). It should be noted that the energy efficiency of the best practice reference case is dependent on the chosen reference equipment and the associated energy efficiency values.

<table>
<thead>
<tr>
<th>Equipment class</th>
<th>Number of hops</th>
<th>Best practice equipment</th>
<th>Reference energy efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.6</td>
<td>Cisco 7606 VXR</td>
<td>62 W/Gbps</td>
</tr>
<tr>
<td>2</td>
<td>1.2</td>
<td>Cisco 12410</td>
<td>37 W/Gbps</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td>Cisco CRS-1-8</td>
<td>15 W/Gbps</td>
</tr>
</tbody>
</table>

Table 4 – Reference equipment and the associated energy efficiency for different classes of equipment.

Repeating steps 1, 2 and 3, the total telepresence service energy consumption for three years is: \( E_{ref, tot} = 194 \text{ kWh} \). Hence, the green service index rating = \( E_{ref, tot} / E_{total} \times 100\% = 6.5\% \). It should be noted that the energy efficiency improvement factor is not included in the best practice reference case. Therefore, the reference equipment and energy efficiency values should be updated every year if there is a significant improvement in equipment efficiency. The green service index rating describes the energy performance of the delivery network in provisioning the telepresence service. A higher green service index rating informs the consumers that the service being delivered to the end-users will have higher energy performance (i.e., is greener). The green service index rating calculation methods are summarised in Table 5.
TOWARDS AN ENERGY RATING SYSTEM FOR TELECOMMUNICATIONS

<table>
<thead>
<tr>
<th>Step</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Find service energy efficiency</td>
<td>$\eta = \frac{P}{T_N}$</td>
</tr>
<tr>
<td>2 – Find service energy consumption</td>
<td>$E_{session} = \eta \times T_S$</td>
</tr>
<tr>
<td>3 – Find total service energy consumption (over the whole contract period)</td>
<td>$E_{total} = \sum_{i=1}^{c} (E_{psa} \times (1 - \alpha)^i)$</td>
</tr>
<tr>
<td>4 a) – reference energy efficiency</td>
<td>$\eta_{ref} = PUE \times \sum_{k=1}^{f} (h_k \times \eta_k)$</td>
</tr>
<tr>
<td>4 b) – Find green service index rating (GIR)</td>
<td>GIR = $\frac{E_{ref \ total}}{E_{total}} \times 100%$</td>
</tr>
</tbody>
</table>

Table 5 – Summary of the calculation methods of green service index rating.

**SUMMARY**

The increasing energy consumption of the Internet, driven by the rapid growth of the number of users and the volume of data carried, has become a major issue for ICT companies. To mitigate the adverse environmental impacts of the growing Internet, a range of energy efficiency metrics have been developed by telecom companies to benchmark their green initiatives. The plethora of metrics dilutes their significance for stakeholders and consumers. Therefore, we propose a new energy rating system, which provides tools and methodologies for benchmarking, measuring and reporting on the energy efficiency and effectiveness of Internet and telecom services. The green service index rating calculated from the proposed energy rating system empowers consumers by providing unbiased and useful information regarding the energy efficiency of services to the consumers. It is also expected to enhance competition based on improved energy outcomes and drive industry practice toward improving energy efficiency. Service providers and network operators who constantly improve their services will be rewarded with higher ratings under the new rating system. Finally, the energy rating system will act as a vehicle for governments and policy makers to address global greenhouse gas emission objectives and achieve better environmental outcomes.

Despite clear advantages of adopting such a new rating system for telecommunications, the implementation of the system by telecom companies is expected to be challenging. Close collaboration between the telecommunications industry, academia and policy makers is essential to jointly verify the feasibility, accuracy and fairness of the proposed rating system. Nevertheless, successful implementation of the new energy rating system for Internet and telecom services could provide a win-win situation for all stakeholders.

**REFERENCES**


Bolla, R; Bruschi, R; Davoli, F; Cucchietti, F. 2011. 'Energy efficiency in the future Internet: a survey of existing approaches and trends in energy-aware fixed network infrastructures'. *IEEE Communications Surveys & Tutorials* 13 (2): 223-244. Available from: http://dx.doi.org/10.1109/SURV.2011.071410.00073.


Global e-Sustainability Initiative; Boston Consulting Group. 2010. 'Smart 2020: Enabling the low carbon economy in the information age'.


Cite this article as: Chan, Chien Aun; Wong, Elaine; Nirmalathas, Ampalavanapillai; Gygax, André F.; Leckie, Christopher; Kilper, Daniel C. 2012. 'Towards an energy rating system for telecommunications'. Telecommunications Journal of Australia 62 (5): 77.1-77.10. Available from: http://tja.org.au.
This paper focuses on the issue of broadband affordability for residential consumers in Australia, specifically those 20% of households with very low income. Using new survey data with analyses of market prices, customer segments and the relative prices and capabilities of fixed and wireless broadband, the paper argues that affordability is still a significant issue that needs to be discussed more openly in the public policy domain. Specifically, policies and programs that enable people on a low income to experience high capacity broadband services for themselves at home would help secure the considerable investment in the National Broadband Network and ensure that the benefits of the growing digital economy are equitably distributed to all Australians.

INTRODUCTION

Making the most of the benefits of the developing digital economy requires a high level of digital inclusion among Australian residents. The roll out of the National Broadband Network (NBN) is central to the Australian Government’s expectations of increased digital participation and productivity (Department of Broadband Communications and the Digital Economy 2011b). An enduring issue surrounding the NBN has been the lack of a rigorous cost-benefit analysis, which has led to ongoing debates about the magnitude of the prospective cost of the new fibre-to-the-premises (FTTP) network and the implications for pricing and affordability of services for end users. Affordability is currently a hot political potato as the following parliamentary debate shows.

Why spend $50 billion on a national broadband network just so customers can subsequently spend almost three times their current monthly fee on speeds they might not need? Why dig up every street when fibre to the node could more swiftly and more affordably deliver 21st century broadband (Abbott 2012)?

And in reply:

Mr Abbott told Parliament that the cost to consumers of NBN services could be three times higher than what they currently pay. That is just wrong. Prices for NBN plans released to date are cheaper than, or equivalent to, existing ADSL plans, but with much improved quality of service... Thanks to the NBN, competition between retail providers is increasing (Conroy 2012b).

Participation in the digital economy requires a wide range of enablers, including the availability, affordability, accessibility, safety, security, capability and usefulness of the broadband services, and the income, education, skills and engagement of users. These can all make the difference between digital inclusion and exclusion. I have previously focussed on the NBN and people with disability (Morsillo 2011), and now examine in more detail the issue of affordability for low-income residential consumers.
To reiterate, affordability has featured from the very beginning in the Australian Government’s general announcements about the NBN: "...every house, school and business in Australia will get access to affordable fast broadband" (Conroy 2009). The NBN Implementation Study specifically recommended that "Wholesale prices for NBN services should be set to meet the goals of affordability and take-up" (McKinsey & Company; KPMG 2010, 32) and suggested this could be achieved through the provision of an entry-level plan. The Government’s Statement of Expectations for the NBN explicitly mentions the need for "maintaining affordability to drive take-up rates" (Wong and Conroy 2010, 10) and, indeed, the NBN Co Business Case Summary makes provision for a basic 12Mbps/ 1Mbps "entry-level" service across all delivery platforms: fibre, terrestrial wireless and satellite (NBN Co Limited 2010b).

While the NBN has its "champions" (DBCDE 2011a), including Graeme Innes from the Australian Human Rights Commission as accessibility champion, there is no affordability champion other than the Minister himself who appears to be relying solely on increased competition among retail service providers (RSP) to ensure such an outcome.

This paper will show that digital exclusion at the household level is real today in Australia and significantly correlated with lower incomes. While the NBN will in principle resolve the availability issue, it remains to be seen whether increased retail competition in and of itself will overcome affordability barriers for low-income households who may have to resort to less capable wireless options instead. This calls for a much more considered policy discussion about affordability by Government, industry, researchers and community stakeholders.

**CURRENT HOME BROADBAND TAKE-UP IN AUSTRALIA**

This paper focuses primarily on residential broadband access as opposed to Internet access generally. Home broadband access is taken to mean fixed access to a DSL (Digital Subscriber Line), HFC (Hybrid Fibre-Coaxial) cable or fibre-optic based high capacity broadband connection (such as with the NBN). Internet access generally may be achieved through a variety of technologies such as dial-up, mobile and wireless connections, or public access by way of a WiFi hot-spot, web kiosk or public library facility.

The most recent Australian Bureau of Statistics (ABS) Household Use of Information Technology, Australia survey reports that 79% of households had home Internet access in 2010-11 (Australian Bureau of Statistics (ABS) 2011). The ABS also reports that broadband is accessed by nearly three-quarters (73%) of all households in Australia (i.e. 92% of households with Internet access). However, this still leaves some 1 796 000 households without Internet access and 2 309 000 households not using broadband access, which are very significant numbers (see also Middleton 2010).

Taking a look at industry statistics, drawn from those who supply Internet services, the most recent ABS Internet Activity, Australia report indicates that at 30 June 2012 there were 12 million Internet access subscriptions in Australia, with over 96% of connections being considered broadband. While decreasing in usage, this still equates to some 439 000 subscribers still using dial-up (Australian Bureau of Statistics (ABS) 2012).

**THE LINK BETWEEN TAKE-UP, INCOME AND AFFORDABILITY**

The ABS specifically comments that "Home Internet access is more common in households with higher incomes. The proportion of households in the highest income quintile with Internet access was 95%, compared with 55% for households in the lowest income quintile" (Australian Bureau of Statistics (ABS) 2011). Figure 1 shows households with home Internet access by relative income since 2004. While significant increases have occurred for those households in the lowest income quintile, they are still a long way behind those on higher incomes.
The most recent World Internet Project Australian survey included a question about perceived affordability. Of those who had the Internet at home 62% regarded it affordable or very affordable, while 12% regarded it unaffordable or very unaffordable (See Figure 2) (Ewing; Thomas 2011). The significance of this result is that even 12% of people who currently do have the Internet at home report that willingness to pay is a stretch for them.

Poverty and Exclusion in Modern Australia (PEMA) surveys have been carried out in 2006 and 2010 by the Social Policy Research Centre, University of NSW, rating what Australian’s regard as the "essentials of life" (Saunders et al 2007). These include such items as "medical treatment if needed", "a substantial meal at least once per day" as well as "a telephone" and "Internet access at home".

Most "essential" items were rated similarly from 2006 to 2010 except for Internet access at home, home computer and mobile phone, which all rated significantly higher in 2010, and the telephone, which rated much lower in 2010 (Saunders and Wong 2012). Figure 3 graphs these differences between 2006 and 2010.
The perceived decline in the importance of the telephone (home phone) is consistent with decreasing take-up figures: "During 2010–11, the proportion of Australia’s adult population with a fixed-line home telephone declined by three percentage points, to be 81 per cent of adult consumers at June 2011", which was down from 89 per cent in June 2008 (Australian Communications and Media Authority 2011, 7).

As well as rating essential items, the surveys also assess levels of access to, or deprivation of, these essential items. Table 1, extracted from the 2010 PEMA survey, gives deprivation results for Internet at home, mobile phone and telephone based on income source.

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Age Pension</th>
<th>Disability Support Pension</th>
<th>Parenting Payment</th>
<th>Newstart Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Internet at home</td>
<td>5.6%</td>
<td>12.5%</td>
<td>24.5%</td>
<td>26.3%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>2.4%</td>
<td>8.1%</td>
<td>16.7%</td>
<td>5.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Telephone</td>
<td>2.9%</td>
<td>0.4%</td>
<td>14.6%</td>
<td>21.1%</td>
<td>17.7%</td>
</tr>
</tbody>
</table>

Table 1 – Home Internet, mobile phone and telephone deprivation by income source
(Source: Poverty and Exclusion in Australia 2010)

So, while Internet access at home is seen as even more essential these days by the Australian community in general, the indicative levels of deprivation among low-income households dependent on Government income support is cause for concern. One acute example of lack of access is among remote Indigenous communities: "In central Australia… Indigenous households are 76 per cent less likely to have Internet access than non-Indigenous metropolitan households" (Rennie et al. 2011, 9).
EXCLUDED HOUSEHOLDS

In conclusion, there is still a very significant number of households in Australia who do not have a home Internet connection (21% or 1,796,000 households), or who are not using broadband (27% or 2,309,000 households) including some 439,000 dial-up users at last count. This level is much greater among certain consumer segments, for example, Indigenous Australians living in remote areas, people with disability, seniors, and single parent families. There is still a primary link between income and home Internet connections and this will have implications for the utilisation of the NBN by people on a low income. While other factors may also be relevant – such as digital literacy – affordability is key because it is inextricably dependent on pricing.

THE NBN AND FIXED BROADBAND AFFORDABILITY

As already noted, this is a contentious, politically charged issue at the present time. Given the NBN is a new infrastructure build with significant new capital investment it is natural to think that underlying costs (on a commercial basis) will necessarily be higher than for the legacy sunk-cost/ depreciated and heavily regulated copper network that Telstra has been incrementally extending and maintaining for over a hundred years. Because it is a new monopoly network as well there is the prospect of upward pressure on prices.

A monopoly network owner will still want to charge a monopoly price for network access. This will inevitably create a conflict between the NBN earning a ‘commercial’ return and providing affordable broadband access to Australians. Of course, it is far from obvious that the NBN should earn a commercial return. Once the NBN is constructed, marginal cost pricing will maximise economic benefits. However, as the NBN is likely to have average costs well above marginal costs, at least until it reaches capacity, marginal cost pricing for wholesale access to the NBN will not cover capital costs or lead to a commercial return (Gans and King 2010).

These sentiments were also articulated by Malcolm Turnbull (Shadow Minister for Communications) in response to an interview question.

TJA: What do you think of the current review of the Universal Service Obligation (USO). Do you have a position on that?

Turnbull: Well, basically, nobody is suggesting there should not be universal access to affordable broadband as well as voice, so the question then is: how do you define broadband and what is affordable? One of the concerns I have about the NBN is that because of what I believe is a massive overcapitalisation, and coupled with making it a government monopoly, that is inevitably going to put upward pressure on prices. It’s no different from any other business: if you spend too much on your capital, you’re going to have to try and recover that. Now if you’re a monopolist it’s easy to do that if you don’t have competitors (Fell 2011).

However, to some extent these underlying pressures have been addressed in at least three ways. First, by only requiring a modest return on the capital invested by government, versus a much higher return (perhaps double) required by private investors. The expected return is based on the five year Government bond rate, currently around 5%-6% per annum. NBN Co estimates it will generate an Internal Rate of Return of above 7%. In other words, just a little higher than the policy requirement (NBN Co Limited 2012, 71).

Second, the NBN based input costs for RSPs have been mitigated to some extent through NBN Co offering an entry-level wholesale broadband service at a price that will allow retail offers comparable to those currently in the market. Malone (CEO of iiNet) offers the view that this was a reverse-engineered outcome:
**TJA: Are you happy with the NBN’s pricing model?**

**Malone:** Yes. The NBN appears to have back-sold the pricing to match our existing cost. Now it may be much more complex than that, but the reason, I think, is that one of the policy objectives of the NBN is that there can’t be upward pressure on pricing in the retail market. That’s a Government mandate: they didn’t want to see the NBN cause prices to go up. I think one of the things they’ve done is to go back and see what the costs are of iiNet, Optus, and TPG for their existing customers on their own networks, because the pricing comes in so suspiciously close that it seems a wild coincidence otherwise (Fell 2012).

With its virtual monopoly access position, and therefore almost 100% market share, NBN Co is in a position to potentially cross-subsidise such an entry level service assuming there is reasonable take-up of higher-level, higher-price services. Initial indications are that this higher-level take-up is being achieved with Telsyte (2012) reporting that "85 per [cent of] survey respondents had a desire to connect to the Internet at 50 mbps and higher". Quigley (2012b), CEO of NBN Co, has reported to Senate Estimates:

> Overall, 38 per cent of active services on our fibre network have been on the fastest speed tier, which is 100 Megabits per second down and 40 Megabits per second up. Only 16 per cent of the active services on our fibre network are for the entry-level speed tier of 12 Megabits down and 1 Megabit up. In the data for April this trend is even stronger, with almost 50 per cent of new active services being on the highest speed tier of 100 Megabits.

However, Quigley (2012a) had also revealed that so far only 25% or so of potential NBN connections are actually being activated. While it is still early days, such take-up rates are not dissimilar to overseas experiences with fibre-based broadband services. For example, in Europe the average take-up rate at the end of December 2011 was 18.4%, which was a decrease on the year before (IDATE 2012). Asia-Pacific average take-up rates are higher at around 33% at the end of 2011 (FTTH Council Asia Pacific 2012). Hence, there may be a considerable marketing challenge to achieve the hoped for 70% Australian take-up rate in the original NBN Co Corporate Plan (NBN Co Limited 2010a, 116) so that prices can remain as low as possible and hopefully trend towards a marginal cost basis as quickly as possible. Interestingly, the second NBN Co Corporate Plan now proposes a move to a "Build Drop" model of connecting premises rather than "Demand Drop", effectively moving from an opt-in connection to an opt-out model, perhaps signifying some concern over the way activation demand is lagging supply of NBN infrastructure (NBN Co Limited 2012, 45).

Third, it is expected there will be substantial and effective competition between RSPs utilising the common NBN infrastructure that will put downward pressure on prices. Certainly, this is Conroy's consistent position: "Thanks to the NBN, competition between retail providers is increasing" (Conroy 2012b) and "Critics of the NBN who have run scare campaigns that the NBN would be unaffordable are being shown to be plain wrong" (Conroy 2011).

On the other hand, business size and market share will become more important for commercial success as the home broadband market matures. Industry consolidation is likely, perhaps resulting eventually in a handful of larger RSPs. Indeed, this process has begun already with the move from dial-up to broadband: "Small ISPs are a dying breed, as many as 200 having disappeared last year, as fixed-line broadband reaches saturation levels (Colley 2011). Malone gives a strong view that RSPs will need to "get big or get out … The top four now are about 88 per cent market share. A lot of people put this down to bulkling up ahead of the NBN" (quoted by Fell 2012). ABS figures confirm this with continuing decreases in the number of medium and large size ISPs and a growing market share of the 10 or so very large ISPs (cf. Subscribers by ISP Size, Australian Bureau of Statistics (ABS) 2012).
A sample of entry level plans announced by fourteen retail service providers offering services over the NBN shows a range from $29.95 per month to $72.90 per month (see Table 2, left columns).

<table>
<thead>
<tr>
<th>Entry-level plans over NBN</th>
<th>Entry-level naked DSL plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-paid GBytes (peak times)</td>
<td>Monthly Charge</td>
</tr>
<tr>
<td>5</td>
<td>$29.95</td>
</tr>
<tr>
<td>10</td>
<td>$35.00</td>
</tr>
<tr>
<td>50</td>
<td>$35.00</td>
</tr>
<tr>
<td>10</td>
<td>$39.95</td>
</tr>
<tr>
<td>10</td>
<td>$39.95</td>
</tr>
<tr>
<td>25</td>
<td>$39.95</td>
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<tr>
<td>10</td>
<td>$39.95</td>
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<tr>
<td>30</td>
<td>$49.95</td>
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<td>20</td>
<td>$49.95</td>
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<td>10</td>
<td>$49.95</td>
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<tr>
<td>20</td>
<td>$49.95</td>
</tr>
<tr>
<td>20</td>
<td>$59.90*</td>
</tr>
<tr>
<td>50</td>
<td>$59.99</td>
</tr>
<tr>
<td>50</td>
<td>$72.90*</td>
</tr>
</tbody>
</table>

* Includes mandatory phone service

Table 2 - Sample of NBN RSP entry-level broadband plans and Naked ADSL2+ plans sorted by monthly charge (Source: whirlpool.net.au and RSP web sites. Note: NBN and DSL samples are not necessarily the same RSPs.)

In general, the monthly price correlates closely with the monthly data allowance. What is interesting is that NBN entry-level offers appear to be priced approximately $10 per month less than Naked ADSL2+ offers but with much less data included (compare Table 2, right columns). Once you get to a more useful 10GB to 20GB per month allowance then the plans start to become quite comparable at around $40-$50 per month (cf. comparisons in NBN Co Limited 2012, 58-59). Of course, depending on the distance from the exchange, a customer on an NBN entry-level service may see an increase or decrease in speed compared to their copper-based service.

The implication of this comparability of plans at the entry level may be that the NBN will not provide a significant price-data allowance improvement to currently available offers and thus not improve broadband take-up among low income users. Further, as already described, there are still some 439 000 subscribers on dial-up Internet connections, which are at very cheap prices (e.g. $9.95 per month, or $32.90 per month including the telephone line) and suitable for email and basic web searching. Encouraging these users to migrate to a much higher minimum service level and price, with the benefit of access to interactive multimedia content, is something that perhaps needs attention.
INTENTIONS TO CONNECT TO THE NBN

The World Internet Project Australian survey 2011 also asked people whether they would be connecting to the NBN when it becomes available in their street. Interestingly, of those who are already connected to the Internet at home, the results show no correlation between current affordability perceptions and an intention to connect to the NBN. The majority of respondents (around 55%) were positively disposed towards connecting to the NBN no matter what their view about the affordability of their current Internet service. Unsurprisingly, of those who thought their current Internet service was unaffordable, a greater proportion were negatively disposed to connecting to the NBN (18%).

<table>
<thead>
<tr>
<th>Perceived Affordability</th>
<th>Negatively disposed</th>
<th>Neutral</th>
<th>Positively disposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affordable</td>
<td>12.6%</td>
<td>24.3%</td>
<td>54.8%</td>
</tr>
<tr>
<td>Neutral</td>
<td>11.8%</td>
<td>24.4%</td>
<td>55.1%</td>
</tr>
<tr>
<td>Unaffordable</td>
<td>18.0%</td>
<td>17.1%</td>
<td>57.7%</td>
</tr>
</tbody>
</table>

Table 3 - Intention to connect to the NBN by perceived affordability of the Internet
(Source: World Internet Project Australian Survey 2011)

The results from the same survey comparing the intentions of people with disability who have a current home Internet connection show a more obvious pattern with significantly less saying they are likely to connect and significantly more saying they are unlikely to connect than those who did not report a disability (see Figure 4). Given that the majority of people with disability depend on government income support, this reveals significant affordability concerns for this group.

Of course, fixed broadband connections to the household are not the only form of Internet connection available. Whether people on a low income may have to rely on other forms of Internet access such as mobile and wireless, is a question to which we now turn.
WIRELESS BROADBAND AND MOBILE INTERNET

Recent ABS figures are remarkable, indicating there are now more wireless broadband subscribers (5.53 million as at December 2011) than fixed (5.49 million), and this does not include an additional 11 million or so mobile handsets that have an active Internet connection (Australian Bureau of Statistics (ABS) 2012).^1

What does this explosion in mobile and wireless Internet connected devices mean for people on a low income? The Australian Communications and Media Authority (ACMA) notes that most people are using a combination of communications technologies to meet their needs. Rather than switching from one to another they are adding capabilities through mobiles, smart-phones, tablets, and wireless USB modems (Australian Communications and Media Authority 2010, 19-20). However, for a person on a low income, the decision is not so much "and/ add" but "either/ or" in terms of devices and services. The greater reliance on a pre-paid mobile phone by people on a low income, cited by community agencies who provide emergency relief, is evidence of this choice (Low Income Measures Assessment Committee 2012, 2).

RELATIVE AFFORDABILITY

Tablets, such as the Apple® iPad®, are rapidly changing the way people prefer to get online. They allow email, web browsing, social networking, basic word processing, photo capture and sharing and access to many information based services. They are also opening up new fronts on usability and accessibility for older people and people with disability. They may also be an affordable way of getting online when combined with a wireless Internet connection. For example, a mainstream tablet and wireless broadband connection could cost around $21.16 per fortnight (see Table 4). One prediction is that 39% of Australian households will have a tablet computer by 2013 (Neilson 2012b).

Smart-phone handsets (perhaps not ideal for seniors or people with disability due to the small form factor) may be an affordable option for highly mobile users, including people who do not have secure accommodation. For example, in-market offers start at around $99 for a fully functional Android device. The cost of the voice, text and data plan will depend on usage but generally $30 per month recharge provides for a basic amount of each (see Table 4). Smart-phones are becoming the mobile handset of choice for many people, with some surveys showing they account for 66% of new sales in the USA (Neilson 2012c) and 49% of mobile subscribers in Australia (Neilson 2012a).

<table>
<thead>
<tr>
<th>Device</th>
<th>NBN + PC (new)</th>
<th>NBN + PC (reconditioned)</th>
<th>Wireless BB + Tablet</th>
<th>Mobile Internet + Pre-paid Smart-phone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device</strong></td>
<td>$937.00</td>
<td>$220.00</td>
<td>$679.00</td>
<td>$99.00</td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>$63.00</td>
<td></td>
<td>$31.47</td>
<td></td>
</tr>
<tr>
<td><strong>Cable/ WiFi/ SIM</strong></td>
<td>$25.00</td>
<td>$25.00</td>
<td>$30.00</td>
<td></td>
</tr>
<tr>
<td><strong>Internet Plan per month</strong></td>
<td>$49.95</td>
<td>$49.95</td>
<td>$15.00</td>
<td>$30.42</td>
</tr>
<tr>
<td><strong>Total cost per month</strong></td>
<td>$92.66</td>
<td>$60.16</td>
<td>$45.85</td>
<td>$34.55</td>
</tr>
<tr>
<td><strong>Total cost per fortnight (e.g., from Centrelink benefit)</strong></td>
<td>$42.77</td>
<td>$27.77</td>
<td>$21.16</td>
<td>$15.94</td>
</tr>
</tbody>
</table>

*Assuming two year contract/ usage

**Table 4** - Comparison of some entry-level broadband access scenarios including devices (Source: Listed prices from mainstream vendor web-sites as at 26 July 2012.)
A FIXED-WIRELESS DIGITAL DIVIDE?

There are some disparities between fixed and wireless broadband services given the different underlying technologies. For example, the included data allowances are generally much lower for wireless; bandwidth is on average much less (despite peak possibilities); latency and jitter are higher; and reliability of coverage and the impacts of congestion are greater factors. These can all affect the user experience. The exponential increase in data traversing mobile networks (Australian Communications and Media Authority 2012, 26-27) is a key factor driving the rollout of 4G technologies as carriers try to provide a reasonable user experience to ever greater numbers of people connecting with their smart-phones and tablets (cf. Wildstrom 2012).

In theory, the NBN will overcome any geographic digital divide once and for all when fully implemented. However, the mix of technologies that NBN will use (fibre, fixed wireless, satellite) will necessarily mean that geography will still be a factor in people’s experience of broadband. Congestion, latency, jitter and weather will particularly affect people connected via wireless and satellite technologies. It remains to be seen whether the increasing use of high-bandwidth, low latency/ jitter applications such as video-calling and conferencing, and remote video streaming will be useable by all NBN connected customers. Further, people on a low income who may be dependent on wireless broadband or mobile Internet connections will also face these issues.

The debate between wired and wireless broadband access is now as old as the disputes about the NBN itself (cf. Given 2010). Again, there will be different choices made by different segments of the Australian population based on lifestyle and location. As alternative choices, particularly for people on a low income, the real question is whether services provided over the NBN can compete in regard to affordability.

It is clear that wireless networks should not be curtailed – for example, through holding back spectrum availability – in favour of the NBN because they will provide commercial competition to NBN Co and so keep prices lower. Further, they should not be curtailed given the possible reliance on pre-paid mobiles and mobile or wireless broadband services by people on a low income. Wireless, then, is likely to provide both affordability competition and complementarity for consumers.

While smart-phones and tablets offer many convenient services through a mobile or wireless broadband connection (e.g., banking and financial transactions), many services and web sites are not tailored for mobile access or suitable for use on a small screen. Filling out forms, signing and printing for record keeping is more difficult. Accessing multimedia rich educational sites is less reliable. Producing content beyond short messages and texts, and uploaded photos is more restricted. It is also unclear whether governments will invest in accessible apps that will support low-income people on the move (e.g. for fortnightly Centrelink income declarations). People on average incomes may be able to mix and match their devices and connections according to preference. This surfeit of options is not likely to be available to people on a low income.

SOME POLICY CONSIDERATIONS

Affordability is still a significant issue affecting the take-up of broadband services in Australia and the claimed comparable pricing of new services provided over the NBN will not necessarily improve low-income consumers’ willingness to pay. There are potentially sizeable public benefits to be gained through increased take-up of broadband services given the significant utilisation of government and government funded services by low-income groups.

INCREASING TAKE-UP THROUGH EXPOSURE TO AND EXPERIENCE WITH HIGH CAPACITY BROADBAND

Studies have shown that experience in actually using broadband services most likely increases people’s willingness to pay. For example, in the USA, it has been suggested that:
...experienced users are more aware of the full range of economic, entertainment, information and social benefits that the World Wide Web has to offer. Inexperienced users may also have less technical ability when using high-technology goods and service... If experience causes increased valuation, the policy implication is that correctly targeted private or public programs have potential to increase overall penetration... These programs could educate households about the benefits from broadband (e.g., digital literacy training), expose households to the broadband experience (e.g., public access) and/or directly support the initial take-up of broadband (e.g., discounted service and/or hook-up fees) (Rosston et al 2010).

Another example comes from the Kenniswijk program in the Netherlands. After initial take-up by over 95% of residents for a subsidised fibre-based broadband service, 75% of residents continued with their service on a commercial basis when the subsidy was discontinued after one year (Barr 2008; Sadowski et al 2009).

Singapore is also building a new fibre-based high capacity broadband network. At the same time as announcing the infrastructure project, in their 2006 budget, they also launched a number of demand side programs to encourage people on lower incomes, people with disability and seniors to take-up and utilise computers and broadband.

The [Singapore] Government will build "Infocomm bridges", so that no student will be denied computer and Internet access due to financial destitution; people with disabilities can receive Infocomm training, improve employability and integrate with mainstream society; and the less tech-savvy elderly can be at ease with technology and get connected in the Digital Age (Infocomm Development Agency 2007).

These programs, based on eligibility, include subsidised PC purchasing, subsidised broadband access for three years (including a mobile broadband option), with education and training. They also bring together government, commercial and not-for-profit organisations as partners to improve digital inclusion among these groups and to showcase compelling applications such as telehealth and virtual class rooms.

An economic basis for such public intervention is the potential social return on the investment, namely the improved social outcomes in health, education, employment and family relationships that may accrue from connecting a person on a low income to a stable broadband service. Such a scheme could test the potential for broadband to break the cycle of impoverishment through a variety of efficiently delivered services. There is also the potential, of course, for Government services to be provided more efficiently thus offsetting the cost of such an intervention.

...the government could also use the NBN to reduce its own costs of providing public services. For example, if Internet access through the NBN is ubiquitous, then it can be used to communicate with the general public and provide a variety of government services. To ensure universality, the government may wish to make a basic broadband service (say with a speed of 1 Mbps) freely available to all households. The provision of this service, together with a basic 'netbook' for low-income households, could be tendered by the government. The service could potentially pay for itself by lowering government costs in other areas such as social security and taxation (Gans and King 2010, 183).

In fact, such cost savings could potentially also fund the actual construction of an NBN-type network completely. An OECD study found:

"On average, a cost savings of between 0.5% and 1.5% in each of the four sectors [electricity, health, transportation and education] over ten years resulting directly from the new broadband network platform could justify the cost of building a national point-to-point, fibre-to-the-home network" (Enck and Reynolds 2009, 4).
This potential social and economic dividend could be used to create so-called Social Impact Bonds sold to interested private investors to provide start-up capital for such schemes, for example, in disadvantaged areas. The social benefits and cost savings would be monetised by Government and returned as interest to the holders of such Bonds (Scherer and Schenk 2012).

**GOVERNMENT TELEPHONE ALLOWANCE**

Direct government income support for access to telecommunications has existed since 1964 as a voucher scheme redeemable at the Post Office against the telephone bill, which was replaced in 1992 by the direct payment of a Government Telephone Allowance. In 2008 this was supplemented with an Internet allowance for certain people who had a home Internet connection and in 2009 it was rolled up with other allowances into a pension supplement payment for most age and disability related pensioners. Unfortunately, the current eligibility criteria appear to disadvantage people on a low income in two ways:

(i) most job seekers are not eligible; and
(ii) the higher rate is restricted to those who have a home Internet connection.

In light of the growing necessity for job seekers to have Internet access, and the growing utility of wireless and mobile broadband services, it seems anachronistic for Government policy to be so narrowly focussed. Better for all people receiving Government income support who have an Internet connection, whether fixed, wireless or mobile, to be supported to participate in the digital economy by receiving the higher rate of allowance (approximately $5.80 per fortnight indexed annually), modest as it is (Department of Human Services 2012).

**UNIVERSAL SERVICE**

Regulatory support for universal service provision continues to be restricted to the standard telephone service (the home phone), payphones and some other services. Before 2012-13 only the telecommunications industry was required to subsidise the costs of provision. However, now the Commonwealth Government is contributing a subsidy of $50 million in 2012-13 and 2013-14, rising to $100 million per annum in subsequent years (Conroy 2012a). I have previously described how accessibility and affordability of the standard telephone service have been implemented as later add-ons to the original universal service regime (Morsillo 2011).

Given that the NBN will eventually provide 100% geographic availability, albeit utilising three different technologies, a possible policy option would be to extend the notion of universality to cover broadband affordability with costs being potentially subsidised by industry and government through the Telecommunications Universal Service Management Agency (TUSMA). Such a program could be targeted through appropriate eligibility criteria and be implemented by effectively discounting the NBN wholesale charge for the entry-level service or even for a more "basic" service. This could be a way of building competition further with an incentive for RSPs to market to low income customers as a way of seeking to be net gainers from TUSMA rather than net payers. Such a policy option would require a further review of the USO arrangements and TUSMA’s remit in regard to what constitute "public interest telecommunications services" under Part 2 of the Telecommunications Universal Service Management Agency Act 2012 (cf. Corner 2012).

**CONCLUSION**

It is easy to talk about the NBN in generalities and national averages but as most marketers know consumers are not one uniform group – segmentation and targeting are important strategies in maximising take-up and consequent investment returns. This paper has been concerned with one or more such segments that make up some 20% of Australian households, namely those on very low incomes.
Affordability is a key parameter for household broadband take-up and utilisation. This has been recognised in government statements from the outset. However, given the economics of the NBN as a new infrastructure build, affordability for a significant proportion of the Australian population is unlikely to be realised in the short-term as entry level prices remain above their willingness or even capacity to pay. While there is some initial indication that the unbundling of broadband services from fixed line telephone services, which the NBN allows, will reduce access prices, it remains to be seen whether this will enable people on a low income to have their pre-paid mobile and home broadband service as well.

The NBN entry level service specification and cost may be set too high to accommodate low-income households. If this continues it will help sustain a market for cheaper but less capable wireless alternatives. Such lesser capability may particularly impact families with children and young people in education for whom access to interactive multimedia content is important. Be that as it may, it will be important to allow wireless broadband to compete with the NBN in order to maintain downward pressure on prices and thus increase affordability and improve take-up.

There are a number of policy levers the Government could use to improve take-up of the NBN for low-income households. In particular, finding ways for them to experience high-capacity broadband services for a period of at least 12 months may significantly change their willingness to pay based on household economies and efficiencies, and other benefits obtained including for health, education and job searching. Such efficiencies and benefits would also accrue to the costs of providing Government services. An early review of what constitutes public interest telecommunications services in a high capacity broadband environment is another policy lever. It is imperative that Government, industry, researchers and consumer organisations work together to ensure broadband affordability to enable all Australians to participate in the benefits of the digital economy.

REFERENCES


ENDNOTES

1. Following the ABS, the term wireless broadband is used here to mean access to the Internet by means of a dedicated data subscription. This would include USB modems, data cards and tablets. Mobile Internet refers to a mobile handset that has Internet connection capability.

Infrastructure developments under the National Broadband Network and the prominence of Web 2.0 technologies and other broadband-enabled applications and services have prompted the Australian Federal Government to address Internet use for two-way communication with citizens. Online civic engagement is encouraged and endorsed through recent policies; however, there is a significant gap in transforming visions of engagement into forms of action. Federal initiatives emphasise the role of customers over citizens and implicitly equate improved service delivery with increased online engagement.

This article explores the e-government goal of the National Digital Economy Strategy, which aims to have four out of five Australians engaging with governments online by 2020 and identifies that local and state governments will drive greater digital engagement. Improved infrastructure will not routinely transfer into increased online engagement, and local governments in particular will require additional guidance and support when advancing e-government practices. This article suggests that a cohesive e-government policy approach that coordinates knowledge and action through the various tiers of Australian government would facilitate the development of citizen-centric opportunities for e-government engagement.

INTRODUCTION

Digital Economy Goal: by 2020, four out of five Australians will choose to engage with the government through the internet or other type of online service.

- #au20 National Digital Economy Strategy, (Department of Broadband, Communications and the Digital Economy (DBCDE) 2011: 42)

In the National Digital Economy Strategy, the Australian Federal Government identifies the need to improve online government service delivery and citizen engagement through input into policy or regulatory matters (DBCDE 2011). This e-government objective seeks to capitalise on the National Broadband Network (NBN) infrastructure to have 80 percent of Australians choosing to engage with governments online by the year 2020. The strategy recognises that all levels of government must work together to achieve the visions it outlines, and identifies local and state governments as responsible for driving greater digital engagement (DBCDE 2011). In 2011, 35 percent of people used the Internet for their most recent contact with government (Australian Government Information Management Office (AGIMO) 2011). This figure has increased from 19 percent in the seven years since the AGIMO first surveyed Australian citizens’ use and satisfaction with e-government (in 2004-2005); however, it has slightly decreased from 38 percent in 2009. Overall, according to the AGIMO report, 42 percent of people would prefer to use the Internet to contact government (AGIMO 2011). These figures suggest that governments throughout Australia have a
significant challenge ahead of them to reach the Federal Government’s goal of having 80 percent of Australian citizens engaging with government online in the coming eight years.

The NBN and National Digital Economy Strategy are important steps forward for Australia’s digital future. However, local authorities in particular will require guidance and support when developing and implementing online practices designed to facilitate civic engagement. The Federal Government’s identification that local governments can drive online engagement is not surprising. As the bulk of citizen interactions with government occur at the local level (Shackleton 2010), local governments occupy key spaces for two-way online participatory practices. However, local e-government development often progresses slower than state and federal initiatives due to, for example, a lack of skills, knowledge and resources (Cohen, van Geenhuizen and Nijkamp 2005; Norris 2007).

This article explores the e-government goal of the National Digital Economy Strategy and its potential impact on local service delivery and engagement reform through e-government developments. It highlights that federal developments implicitly equate service delivery improvements with advanced civic engagement, privileging the role of ‘customers’ over ‘citizens’ and overlooking the use of information and communication technologies (ICTs) to foster and support citizen participation in two-way dialogue. Improved access to NBN infrastructure will not routinely transfer into increased online engagement with government, and the national strategy does not offer authorities recommendations on how to advance e-government practices to enable improved services and enhanced participation methods. This article suggests there is a need for a more coordinated policy approach between the different tiers of government to effectively develop and implement online spaces for civic engagement. First, however, this article provides background information on e-government and civic engagement, and offers a brief overview of Australian e-government policy.

**E-GOVERNMENT AND CIVIC ENGAGEMENT**

Electronic government, or e-government, encompasses diverse uses of networked information and communication technologies such as the Internet and mobile telephony in government operations (see Mayer-Schönberger and Lazer 2007; Norris 2005; Henman 2010). This includes, for example, ICT use for internal and external communications, service and administrative reform, and changing democratic values and practices through variations to political transparency and accountability of decision-making (see, for example, Homburg 2008; Eggers 2005; Wong and Welch 2004; Bertot, Jaeger and Grimes 2010, 2012). This article focuses on the way government policies address e-government practices as mechanisms to facilitate two-way communications between citizens and governments to encourage civic engagement.

Civic engagement broadly involves civic knowledge of public affairs; trust in the political system; and the capacity to participate in government decision-making processes (Norris 2001; see also Couldry, Livingstone and Markham 2007; Reece 2006). E-government can facilitate each of these aspects of engagement. For example, government websites can be used to provide citizens with information on issues and offer opportunities for two-way consultation, with these interactions facilitating the development of trust in political actors and agencies. While knowledge, trust and participation are deeply intermeshed components of engagement, the way e-government practices can facilitate two-way participation opportunities, where civic input informs government decision-making, is the primary concern of this article.

In 2009, the Australian Federal Government launched a taskforce to investigate online opportunities for two-way citizen involvement (see http://gov2.net.au). The concept of engagement provided the framework and focus of the investigation undertaken by the Government 2.0 Taskforce, which was reflected in the title of the report presented to the Federal Government – Engage: Getting on with Government 2.0 (Government 2.0 Taskforce Report 2009). The report recognises the importance of engagement to create public value, and
that opening opportunities for engagement requires a change in the culture of control entrenched in government operations (Government 2.0 Taskforce Report 2009). It highlights that:

/Public agencies and public servants should engage more using the tools and capabilities of ‘collaborative web’ or Web 2.0. Forming or joining existing online communities of interest around issues of relevance to government policy, service delivery and regulation will help public agencies and their officers become more informed, responsive, innovative and citizen-centric. (Government 2.0 Taskforce Report 2009: iii)

In a five-country comparison of national e-government policy, Bekkers and Homburg (2007) found that a chasm exists between ambitious goals and the actual pace of implementation. They label inevitable technological progress, rational planning and empowered citizens as myths of e-government. Similarly, Verdegem and Hauttekeete (2010) note the prevalence of government centricity in e-government policies, which often contain deterministic conceptions and neglect the inclusion of users. They suggest that a two-fold paradigm shift is needed in e-government policy in order to consider constituents’ needs through user-centred approaches and to focus on technology use for ‘effectiveness’ rather than ‘efficiency’.

There are, however, many issues that affect the implementation of participatory online practices by national governments, including problems associated with increased cost, scale and manageability, and reluctance to increase transparency and accountability of political actions (see, for example, Jimenez, Mossberger and Wu 2012; Eggers 2005; Wong and Welch 2004). Localism has subsequently emerged as a recurring theme in literature surrounding e-government and civic engagement. Despite the global ramifications of the network society, a ‘local lens’ is often necessary to consider the spatial impacts associated with the manifestation of government ICT policies and to maximise developments to suit citizens’ needs (see Bradford 2005; 2008; Chanan 1997). Policies that specifically consider places enable local priorities to be situated within national objectives, and local knowledge can inform national policies to effectively shape desired outcomes (see Bradford 2008; Wilson, Cornford, Baines and Mawson 2011).

The majority of civic involvement with government occurs at the local level (Shackleton 2010; Shackleton, Fisher and Dawson 2005), and citizens perceive democratic participation to exist primarily in terms of local involvement (Couldry and Langer 2005). The immediacy and familiarity associated with local issues encourages active involvement as outcomes have direct implications to citizens’ everyday lives (Margolis and Moreno-Riaño 2009). Common understandings, experiences and interests of community groups can be used to frame spaces for online participation (see Graham and Aurigi 1997). Moreover, participatory online practices that aid direct relationships between citizens and governments are more manageable at the local level than through state or national authorities (Jimenez et al. 2012).

These observations suggest a need for national policy developments to effectively consider and support ICT use within locales, which requires an integrated e-government policy relationship between national and local governments (see Jaeger and Thompson 2003; Bradford 2005; Wilson et al. 2011; Flowers, Tang, Molas-Gallart and Davies 2006; Goggin 2003). Jaeger and Thompson note that “lack of coordination between different levels of government can have a significant impact on the success of e-government efforts” (Jaeger and Thompson 2003: 391). The following section provides a brief overview of Australian e-government policy.

E-GOVERNMENT POLICY IN THE AUSTRALIAN CONTEXT

Australia was once considered a world leader in e-government due to its innovative service delivery reforms (Chen, Gibson, Lusoli and Ward 2007). Early e-government policy in Australia focused on ICT use for service improvements and government cost reduction through the automation of activities (Chen et al. 2007; Dunleavy, Margetts, Bastow and
This bureaucratic, business-orientated approach was common as neo-liberal tendencies in Western developed economies meant that e-government frequently followed the path of e-commerce (Graham and Aurigi 1997; Ho 2002; Homburg 2008; Margolis and Moreno-Riaño 2009). The government has, however, been slow to prioritise more complex and costly practices associated with two-way, participatory e-government (Chen et al. 2007). The government’s prioritisation of service improvements has meant that investments to date have had negligible impact on developing direct relationships between citizens and governments (Chen et al. 2007):

> The national government has largely ignored the possibility of using these technologies for policy processes. This oversight has been most conspicuous in the way that there has been limited use of electronic service delivery systems to capture or solicit information from users that could then be used to improve and expand public participation in policy-making.

(Chen et al. 2007: 167)

Australia’s leading e-government position has dwindled as its focus remained on online service delivery initiatives while other countries, such as the Netherlands and Canada, began taking more innovative approaches to ICT use to incorporate the interactivity and exchange features of Web 2.0 into the functional design of e-government practices, facilitating increased citizen participation in policy processes. In their comparative analysis of e-government in seven countries, Dunleavy et al. (2008) found that Australia ranked poorly both in terms of its policy and visions towards a digital future, and the success rates of its information technology projects.

The Australian government has, nonetheless, recognised the importance of online citizen participation and engagement through more open and transparent government operations, and that these opportunities may help build civic confidence and trust in government. This is reflected in policy documentation such as the 2006 e-government strategy (Responsive Government: A New Service Agenda, Department of Finance and Administration 2006), Principles for ICT-Enabled Citizen Participation (Department of Finance and Administration 2007), Declaration of Open Government (Department of Finance and Deregulation 2010), and the National Digital Economy Strategy (DBCDE 2011). Additionally, the launch of the Government 2.0 Taskforce was a promising development. While only in operation for six months, the taskforce’s report sheds light on the importance of two-way participatory practices and provides recommendations to the government on how to capitalise on the interactive features of Web 2.0 to improve e-government. These documents and initiatives stress the value of online citizen engagement to facilitate a greater democratic decision-making culture in Australia. There has, however, been a significant gap in transforming visionary statements from these documents into concrete forms of action that facilitate citizen participation and engagement through e-government.

In their study of the Australian national e-government framework, Geiselhart, Griffiths and FitzGerald (2003) note that two-way e-democracy practices lie beyond online service delivery, but any likely transformation will require advanced understandings of citizenship and reinforced democratic values. To date, Australian e-government policy has largely prioritised the ‘consumer’ role of individuals over their ‘citizen’ role. Livingstone and Lunt (2007) note that, while interconnected concepts, ‘consumers’ relates to economic, short-term, individual private benefits, while addressing ‘citizens’ means focusing on long-term social and community benefits, and broader public interest (see also Bourk 2012). Advancing from a business-style of e-government to incorporate greater public participation in decision-making requires greater emphasis to be given to the role of citizens. In addition to addressing consumer economic interests through the increased efficiency enabled by ICTs, a citizen-centric approach to e-government promotes community benefits and public interest by, for example, increasing government transparency, providing opportunities for consultation, and including public participation in policy development (see Bekkers and Homburg 2007). This change in focus is therefore an important shift when seeking to increase citizen engagement with government (ACMA 2010). In 2003, Geiselhart et al. noted that, “In ten years,
government Websites that do not offer citizen engagement, and consultation programs that do not make use of advanced computerized and interactive technology, may well become relics of the past” (Geiselhart et al. 2003: 230). Nearly ten years later, the Australian government’s slipping position as a leader in the e-government field can partially be explained by the fact that few participatory practices are in place for citizens.

NATIONAL DIGITAL ECONOMY STRATEGY

The National Digital Economy Strategy was released in May 2011. It aims to capitalise on the improved infrastructure intended to be installed under the National Broadband Network to drive Australia’s digital productivity and position Australia among the world’s leading digital economies by the year 2020, based on key indicators such as broadband penetration and usage rankings (DBCDE 2011). According to the strategy, becoming a digital economy leader will contribute to Australia’s productivity, maintain global competitiveness, and improve social wellbeing (DBCDE 2011).

The strategy itself contains eight broad goals, each with targets to meet in the next eight years. The goals are:

1. Online participation by Australian households;
2. Online engagement by Australian businesses and not-for-profit organisations;
3. Smart management of our environment and infrastructure;
4. Improved health and aged care;
5. Expanded online education;
6. Increased teleworking;
7. Improved online government service delivery and engagement; and

The strategy aims to have 80 percent of Australians choosing to engage with governments online. The final goal intends to significantly narrow the gap between households and businesses located in cities and regional areas (DBCDE 2011).

Under the first two goals, Australia is to be ranked in the top five of the Organisation for Economic Cooperation and Development’s countries in terms of the number of households connected to broadband and the number of businesses and not-for-profit organisations using the Internet to aid productivity. The smart technology goal intends to provide supporting applications (such as motorway management and power production) that encourage environmental sustainability and efficient infrastructure use to Australian households, businesses and organisations. The health goals aims to provide 90 percent of high priority consumers with access to individual electronic health records, and have 25 percent of all specialists participate in the delivery of telehealth consultations to remote patients. Under the fifth goal, educational institutions including schools, TAFEs and universities will have the connectivity to develop innovative and flexible services and resources to extend online learning. Under the sixth goal, Australia is to double its teleworking opportunities so that at least 12 percent of employees have a teleworking arrangement with their employer. The improved online government service delivery and engagement goal aims to have 80 percent of Australians choosing to engage with governments online. The final goal intends to significantly narrow the gap between households and businesses located in cities and regional areas (DBCDE 2011).

There is substantial overlap between these goals, and the government has recognised that, in order to meet them, developments will require action by and coordination between all levels of government as well as industry and communities (DBCDE 2011). Overall, these are considerable goals to achieve by 2020, given that the NBN infrastructure needed to support and reach them is scheduled for completion in the same year. Burns and McGrail (2012) note that the National Digital Economy Strategy and NBN were developed during considerable hype surrounding Web 2.0 and Web 3.0. They suggest that the government’s ideals are speculative bubbles reminiscent of 1990s utopian Internet rhetoric, which fail to fully consider both unintentional consequences of the NBN rollout and factors likely to influence infrastructure deployment (see also Bowles and Wilson 2012). For example, large-scale
manipulation of publics through the Internet, the impact of changes to political leadership, and local factors such as bargaining games and institutional issues, may all influence rollout and use of NBN infrastructure (Burns and McGrail 2012). Additionally, while the NBN has a national wholesale price (DBCDE 2011), civic uptake of NBN infrastructure will be influenced by the service providers that determine retail costs. Such issues challenge the promises outlined in the National Digital Economy Strategy (Burns and McGrail 2012). The following section explores the e-government goal of the strategy to highlight its potential to impact on online civic engagement.

**IMPROVED ONLINE GOVERNMENT SERVICE DELIVERY AND ENGAGEMENT**

The online government service delivery and engagement goal of the National Digital Economy Strategy directly relates to e-government development and, as previously indicated, aims to have four out of five Australians choosing to engage with governments online by 2020 (DBCDE 2011). This goal will require governments throughout the country to update their e-government practices to facilitate improved online services and engagement opportunities.

Participation through e-government is recognised in the Federal Government’s goal as aiding cost reduction, increasing customer satisfaction, promoting innovation, and (with improved access and easy to use mechanisms) increasing digital confidence and literacy levels (DBCDE 2011). Internal government uses of ICTs, such as video conferencing and cloud computing, are also identified as potential benefits of e-government. The goal outlines that:

> All levels of government play a critical role... State and local governments are also a frequent touch-point for individuals and households in managing their day-to-day affairs. Consequently, more digitally aware state and local governments will drive greater digital engagement by Australian families and communities. (DBCDE 2011: 42)

Local and state governments occupy key positions in the development of digital engagement opportunities. However, this goal outlines the fact that many local governments in particular lack the skills, experience and resources necessary to offer more advanced online practices (DBCDE 2011). While it is promising to see that the Federal Government has recognised that local and state authorities hold important positions in the future of e-government, this strategy does not explicitly require government bodies to commit to e-government development. Moreover, the document itself gives no indication to local or state governments of how to become more ‘digitally aware’ or ways to advance e-government practices to facilitate improved service delivery and increased online engagement.

However, local governments representing 40 communities from the initial stages of the NBN rollout can apply for competitive financial assistance to develop online services under the Federal Government’s digital local government program. Each eligible authority can apply for up to AU$375,000, and must contribute at least 25 percent of the total project cost (cash or in-kind) to receive funding (DBCDE 2012). While a positive provision, local governments without the skills or knowledge of the types of practices that should be developed run the risk of paying for and implementing ineffective or inappropriate e-government mechanisms (see Bertot and Jaeger 2006). Here, greater guidance may be necessary by the Federal Government to maximise the value of its investments (see Horrocks 2009).

Under the e-government goal, the Federal Government is developing three initiatives: Tell Us Once, Service Delivery Reform, and data.gov.au. These three federal initiatives each have limitations in terms of citizen engagement as they primarily focus on service delivery improvements. In 2011-2012, AU$2.3 million has been allocated under the Tell Us Once initiative to test preliminary developments to improve ease of access and use of government services. The improvements to be investigated include pre-filled forms for individuals who have previously completed a transaction with a government agency; simultaneously
communicating updated citizen details to multiple agencies; and allowing citizen communications with government to be viewed in a single location (DBCDE 2011).

Before the change of political leadership, the previous Federal Government’s 2006 e-government strategy allocated over AU$42 million to develop a streamlined online entry point website that simplifies citizen interaction with government. The intention of this development was to review departmental websites and provide a consolidated space for citizen transactions with customised settings, the capacity to simultaneously update details across government departments and conduct multiple transactions without reconfirming identity, pre-filled forms, and to track online transactions (Department of Finance and Administration 2006). The three ‘preliminary’ service delivery applications to be investigated with the additional AU$2.3 million in funding under the Tell Us Once initiative should have arguably already been funded, researched, created and implemented under the 2006 goal, which scheduled the entry point developments to take place between 2006 and 2008.

Under the service delivery reform initiative, the way people interact with the Department of Human Services (DHS) will be transformed. Online transactions to be provided include claiming benefits, updating details, registering for services, online forms and letters, and single online accounts. While such services will significantly simplify citizen transactions with the DHS and its six agencies, they are not intended to take full advantage of the interactive capabilities of Web 2.0 technologies. Moreover, similar to the Tell Us Once initiative, the development of simplified, single sign on accounts for citizens’ transactions with the DHS was a service delivery development listed in the 2006 e-government strategy (Department of Finance and Administration 2006).

The data.gov.au initiative seeks to provide an online public catalogue of national, state and territory government information, with downloadable datasets. This site was created as part of the Federal Government’s Declaration of Open Government, and aims to “promote online engagement with government and provide opportunities for greater public participation in the development of policy and service delivery” (DBCDE 2011: 7). Government data is meant to be provided in “useful formats” to encourage public access to and use of information (DBCDE 2011: 45). The data.gov.au catalogue is an important initiative in terms of freedom of information and currently contains over 1,100 datasets from more than one hundred agencies, with the site permitting the public to suggest datasets to be added.

However, at the moment, datasets on the catalogue are often limited and not user friendly. The information offered is frequently summary data in unorganised Excel documents. For example, the dataset on Australian government ICT expenditure indicates that AU$5.19 billion was spent in the 2010-2011 financial year, but offers no substantial breakdown of this cost. Citizens’ comments on the website highlight that, in its current form, this dataset is not in a format that enables the public to make use of the information provided.

For example, in response to the ICT expenditure report, ‘Jeremy’ stated that, “This data is summarised data and doesn’t seem to contain original data that would allow me to do much original or additional analysis” (9 February 2012). Similarly, ‘Greg Bean’ stated, “This data is so summarised it is almost meaningless” (16 February 2012).

The responses to these comments from the ICT benchmarking team indicate that it is the intention to provide aggregate, summarised data only, and that they are unable to publish more specific data. This type of information provides little capacity for citizens to re-use information or to engage in the development of policy, as the National Digital Economy Strategy suggests this initiative will do. At present, there is little surprise that the most commonly downloaded documents from the site are the locations of Medicare and Centrelink offices, and the National Public Toilet Map.

While these initiatives seek to improve e-government applications for civic use, they largely overlook the ‘engagement’ aspect of the Federal Government’s goal, which would require the provision of two-way spaces for civic dialogue and collaboration, where contributions inform government actions and decisions. Instead, these initiatives primarily focus on one-way information dissemination and service delivery improvements – or “client-focused tools”
that treat citizens as customers. This focus is reiterated by the e-government goal itself, which indicates that online participation aids “customer” satisfaction (DBCDE 2011: 42). Interestingly, only business-related objectives and the e-government goal of the National Digital Economy Strategy refer to ‘customers’, with the term ‘consumers’ used throughout the remainder of the document. The term customer implies a primarily economic matter, downplaying broader public interest (Livingstone and Lunt 2007).

In relation to e-government, this focus on customers parallels the economic approach of early e-government policies and practices that emphasised efficiency of service delivery over civic consultation. Additionally, the potential benefits of improved service delivery and engagement outlined in the goal are largely government related rather than citizen-centric, suggesting that public participation does not appear to be a priority as the proposed online practices are unlikely to substantially influence citizen connection with government. The government’s implicit assumption is that online service delivery and civic engagement are synonymous concepts. This observation suggests that ‘engagement’ has become a rhetorical concept in federal documentation, which is unlikely to facilitate participatory practices throughout the various tiers of Australian government.

CONCLUSION: TRANSFORMING VISIONS INTO ACTION

As it stands, the e-government goal of the National Digital Economy Strategy offers rhetoric about the potential benefits of ICTs and online engagement with government, but fails to facilitate action by suggesting how authorities throughout Australia should specifically develop online service delivery and engagement practices. Visionary statements about increased civic engagement with government are unlikely to lead to the effective implementation of online participatory practices at the local level, particularly when federal developments prioritise the role of customers over citizens by implicitly equating service delivery improvements with increased online engagement.

The success of the e-government goal will be bound within the Australian federal system, with different requirements, priorities, structures, resources and expertise influencing implementation at federal, state and local levels. Budde (2011) recommends that community engagement processes need to be formalised and structured throughout the country.

This article suggests that more explicit implementation guidance and assistance from the Federal Government would help local authorities to develop their e-government practices to enable greater online engagement. Further frameworks for the adoption and use of ICTs by governments and citizens may include, for example: information regarding educational programs to address digital skill inequalities within communities and authorities; functionality specifics and how to develop online content, applications and spaces that enable citizen participation and engagement; and ways to incorporate civic input into decision-making processes. Additionally, the Federal Government could encourage and facilitate resource and knowledge coordination between local governments to reduce the costs associated with developing and implementing similar online applications and services. The national strategy alone will have a negligible impact on local governments if they lack sufficient knowledge and resources to develop the engagement practices needed to reach the Federal Government’s e-government goal.

Providing ubiquitous, reliable high-speed broadband through the NBN will enable digital economy development and new opportunities for online engagement with governments. But improved infrastructure will not routinely transfer into increased online engagement. While e-government is a gradual and on-going process (Senyucel and Stubbs 2006), documents like the National Digital Economy Strategy offer little actual assistance with development. Burns and McGrail (2012) note that it may take many decades to gain benefits from NBN investment, rather than the shorter time frame envisioned by the Federal Government, which suggests that the government has set unrealistic and unachievable goals. There appears to be an assumption that local and state bodies, which were identified as being vital to drive digital engagement, will know how to achieve the engagement goal set by the Federal Government.
Additional guidance and support are likely to be needed by authorities when developing and implementing online engagement mechanisms. A policy approach that coordinates knowledge and action through the various tiers of government will facilitate the greatest chance of successful, citizen-centric e-government ventures, if governments are to take the next step in transforming visions of engagement into action.

REFERENCES


Bowles, M; Wilson, P. 2012. ‘Appraising the importance of the National Broadband Network in Australia’s race to compete in the digital economy’. Australian Quarterly 83 (1): 11-19.


**ENDNOTES**

1. The term ‘customer’ is frequently used in this article even though ‘consumer’ is more prevalent in telecommunications and media policies. The reasoning for this is that, while the *National Digital Economy Strategy* does use the term consumer, the strategy’s e-government goal and initiatives specifically refer to customers. As will be highlighted in this article, the term customer has different implications for e-government development and the potential for online engagement.

2. Government use of the term ‘consumer’ in Australian policy documentation does not, however, always exclusively relate to consumption of goods and services but may also broadly concern citizen interests (see Australian Communications and Media Authority (ACMA) 2010). Conversely, economic matters can be considered as part of citizenship (see Miller 2007), with the term ‘citizen’ then encompassing public and consumer interests (see ACMA 2010).

3. Notably, the *NBN* is the largest infrastructure investment by a single nation intended to advance global competitiveness in the digital economy (Bowles and Wilson 2012).

4. Similar single access website developments were previously proposed as early as 1997 (see Burgess and Houghton 2006).
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