COMMERCE COMMISSION NEW ZEALAND

Project no. 13.07/12813

High speed broadband services demand side study

Issues paper 2 - e-Health and e-Education

Date: 24 January 2012

Introduction

1. The Commerce Commission (Commission) is carrying out a high speed broadband services demand side study (study) to identify and inform on any factors that may impede the uptake of high speed broadband services in New Zealand.[1]

2. This study is conducted under Section 9A of the Telecommunications Act 2001, which empowers the Commission to conduct inquiries, reviews and studies into any matter relating to the telecommunications industry or the long-term benefit of end-users of telecommunications services within New Zealand.[2]

3. Prior to *The Future with High Speed Broadband: Opportunities for New Zealand* conference, the Commission plans to release three issues papers – the first of these three papers, which was issued on 19 December 2011, is available at the link below:

   http://www.comcom.govt.nz/high-speed-broadband-services-demand-side-study/

Paper 2: e-Health and e-Education

4. This issues paper, the second in the series, presents reports written for the Commission by Mr Ernie Newman on demand for high speed broadband services from:

   a. Primary and Secondary Schools; and
   b. the Health Sector.

5. The Commission retained the services of Mr Newman in May 2011 to conduct an investigation of the demand for high speed broadband services from primary and secondary schools, and from the health sector. The Commission anticipates that Mr Newsman's findings, presented in the two attached reports, will provide a valuable basis for public discussion of these issues.

Next steps

6. After the release of the three issues papers, the Commission will hold a conference (*The Future with High Speed Broadband: Opportunities for New Zealand*) on 20 and 21 February 2012.

7. The Conference will be followed by the publication of the study draft and final reports by the end of May 2012.

8. You are encouraged to comment on the issues papers either directly to the Commission (telco@comcom.govt.nz) or using any of the media that the Commission has made available, including LinkedIn, Twitter (@FutureBroadband) and Facebook. We also encourage you to participate in the conference and engage in the formal consultation on the report.

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1 A copy of the terms of reference for the study is at http://www.comcom.govt.nz/high-speed-broadband-services-demand-side-study/.

2 Telecommunications Act 2001, subpart 2, section 9A.

9. Table 1 below details the timeline for the high speed broadband services demand side study project:

Date	Activity
19 Dec 2011	Publication of Technical Issues Paper
24 Jan 2012	Publication of e-Learning/e-Health Issues Paper
7 Feb 2012	Publication of Willingness to pay, content and applications Issues Paper
20-21 Feb 2012	The Future with High Speed Broadband: Opportunities for New Zealand Conference
9 April 2012	Publication of the Study Draft Report
4 May 2012	Due date for Submissions on the Draft Report
28 May 2012	Publication of the Study Final Report

COMMERCE COMMISSION

HIGH SPEED BROADBAND SERVICES

DEMAND SIDE STUDY

DEMAND FROM THE HEALTH SECTOR

ISSUES PAPER

Written by Ernie Newman, Ernie Newman Consulting Ltd
December 2011

While many people have been consulted in the drafting of this paper, responsibility for the views expressed rests with none of them individually nor with the Commission, but with the author alone.

DEMAND FROM E-HEALTH

Contents

1 Executive Summary

This issues paper is designed to aid the understanding of stakeholders about the nature and volume of demand for fast broadband that will originate from the health sector.

It has been compiled primarily from a series of interviews with a cross section of leading experts including health sector IT and strategy leaders, as well as clinicians who are well versed in IT developments within the sector. It has also been informed by attendance at the Scottish Health Informatics Conference in Edinburgh in September 2011, discussions with experts from England, Scotland and Denmark, participation in the 2010 "Enable My Health" public workshop series, my own role as inaugural Chair of the National Health IT Board's Consumer Panel, and some Web research.

It reaches the following conclusions:

- Health systems globally are groaning under the weight of aging populations, societal expectations of longer lives and better health care, and the desire to give citizens the benefits that new health technologies can deliver.
- Information and Communication Technologies (ICT) is being seen globally as the key to delivering the new models of health care that are desperately needed.
- Health stands alone as one of the few sectors yet to maximise the transformation the Internet can deliver. While other sectors have adopted the efficiencies of the Internet era, health is still at the beginning of its run. There are understandable reasons for this, but the sector globally needs to be galvanised to modernise its service delivery.
- There are pockets of excellence in many countries, but nowhere has the full transformative potential been anywhere near fully realised. The sector has a frustrating tendency to implement local "pilot" programmes. Everyone is enthused by these programmes as they demonstrate great potential, but then they peter out. Often such a pilot is almost as expensive to implement as a full-blown national rollout, yet due to lack of scale does not deliver the anticipated financial benefits. None of this diminishes the opinion of experts that ICT, in the widest sense, has nowhere near reached its potential as an enabler of better health service delivery.
- New Zealand is at least up with the international play. We have some dedicated, forward-looking clinicians, and a pool of successful software vendors who specialise in health. New Zealand Trade and Enterprise claims in a recent video that our health IT sector is world-class - second only to that of Denmark. The success of the National Health IT Board in its objective of on-line Shared Care Records for every New Zealander by 2014 will be the single biggest determinant of how we utilise the Internet in modernising health service delivery.
- Demand will come to the Ultra-Fast broadband network from the health sector. However, it will not be instantaneous. An initial burst will appear in 2014 when people will be able to go on-line and view their personal health records. However, the main impact on demand for

bandwidth will come as people become accustomed to more self-management of their health and wellness, using an ever-increasing pool of on-line video and multimedia content in support.

- In the early stages of UFB the growth in bandwidth demand will come from DHBs, GP practices, pharmacies and related health services. Consumer demand will pick up later.

2 Purpose of This Paper

This paper is intended to set out in lay terms the specific nature of how the New Zealand health sector is expected to utilise Ultra-Fast Broadband, and to identify some issues to be addressed. It is addressed to a variety of stakeholders – telecommunications service providers, clinicians, health service administrators, policy makers, and consumer leaders. It is a contribution to the national debate about the use of communications technology to achieve positive change and efficiency in the health sector.

3 Acknowledgement

Much of the content of this paper has been derived from interviews with a range of acknowledged experts in the future role of ICT in the health sector. A list of these people is attached as an appendix. Their assistance is greatly appreciated.

4 The structure of the health sector

The health sector in New Zealand comprises a complex mix of professions and entities which presents unique challenges.

Primary care is led by general practitioners. Most work in small clusters, sharing premises, covering for one another and collaborating professionally. Others are part of the emerging network of Integrated Family Health Centres. Primary care is also provided by numerous other health professions working independently, most of who, like general practitioners, are SMEs. General practitioners are funded partly by government through a capitation payment based on the number of patients on their books, and partly by fees contributed by patients themselves.

The government's involvement in primary care is led by Primary Health Organisations (PHOs), which are funded by the 20 District Health Boards to support the provision of essential primary health care services through general practices. PHOs have been the main vehicles through which the government's Primary Health Care Strategy has been implemented. Each PHO provides services either directly or through its provider members. The role of the PHO is to improve and maintain the health of the entire enrolled PHO population, as well as providing services in the community to restore people's health when they are unwell. The aim is to ensure GP services are better linked with other primary health services (such as allied health services) to ensure a seamless continuum of care, in particular to better manage long term conditions.

Secondary care, conversely, is dominated by public funding of the twenty-one DHBs, supplemented by a significant number of private hospitals. The DHBs enjoy a very high level of autonomy which, while ensuring a high degree of responsiveness to local needs and circumstances, is a real challenge for those looking to implement nation-wide services and initiatives such as an integrated IT structure.

5 Strategic challenges for health

Globally the provision and maintenance of high quality health services is proving to be a massive challenge for governments everywhere. Medical technology is advancing at an unprecedented rate. As cures are found for more and more diseases, it is becoming technologically possible to keep people alive significantly longer than earlier generations if the cost is not a barrier. Citizens know this, yet still have an expectation that governments will find ways to fund the prolonging of their lives.

Medical technology is one reason for the pronounced aging of the population. The "baby boom" is another. Babies born in New Zealand this decade may well expect to live to 100. Yet the aging includes the health workforce itself – research in the central North Island showed the average age of General Practitioners to be 57 years, and a similar level for nurses. Recruitment and retention is an issue with both professions. So as the citizens get older and require more health care and medical technology becomes available to provide this, the workforce to provide the service is shrinking.

Notwithstanding the advances in technology, in certain respects the population is becoming less healthy with trends such as substance abuse, sedentary lifestyles, fast foods and obesity adding to pressure on health services.

One obvious need is to move downward the tiers at which people receive their care and treatment. Hospitals need to shift more people down the pyramid to primary care through a GP. Primary services need to embrace more efficient business models, moving to devolve as much treatment as possible to be delivered in the community by families and care givers, rather than engaging medical professionals in face to face visits unnecessarily where community carers can do the job. Doctors need to delegate down to nurses, or to new forms of health professional whose roles have yet to be defined. The use of telephone, Internet and email as alternatives to some face to face consultations also offers considerable promise, with leading edge examples here and overseas proving highly successful both in terms of patient outcomes and sector efficiencies.

It is self-evident that communications technology has a role to play in a solution. ICT can enable the creation of new service delivery models for health just as it has in other economic and social spheres. However, it is clearly not yet utilized in health as effectively as in most other sectors. Not only is efficiency compromised, but also safety. The lack of communication vertically and laterally creates clinical risks. Patients tend to assume that the clinicians they deal with are sharing information to the maximum extent appropriate, but this is clearly not happening.

Such changes in clinical practice and communications will require fundamental shifts in the funding models. Both in the subsidies provided by governments, and the fees paid by each patient, there needs to be a broad focus on payment for outcomes. The narrow status quo rewards clinicians based on the amount of time they spend face-to-face, one-on-one with a patient. It does not recognize nor provide for e-health consultations or the delegation of some parts of the role to a professional other than a doctor, or some form of care-giver. Where clinical functions can be delegated to a nurse, or when an overseas practitioner becomes involved in an on-line consultation, diagnosis or second opinion, that needs to be factored into the funding model. A patient's care team may in future include people they have never met and never will, yet who need to be compensated.

Moreover, we are seeing a significant increase in people taking interest and ownership of the management of their own health and wellness. Spurred by the widespread availability of health information on the Internet – albeit accompanied by challenges in relation to information quality – people are getting far more involved than earlier generations who were more inclined to act without question on the instructions of their doctor. As the population ages, the boundary between health care and lifestyle management is blurring – people are moving from being interested in their health only when they are ill, to a preventive maintenance mode. This trend can make a huge improvement in peoples' quality of life and reduce demands on the health service, but needs to be supported and managed. There is a need to find ways of filtering or authenticating information on the Internet to sort the valuable data from the dross.

This trend towards self-management of health also invites a fundamental change in the way the sector interfaces with people. The old system tended to exclude the patient and family from

involvement in their own care. This has been a wasted opportunity. For example, the recent trend by many hospitals to actively encourage 24/7 hospital visiting by an immediate family member has significant benefits – when the doctor does his rounds there is now often a family member present who can explain how the patient has been over the past 24 hours. Patients are not necessarily experts in the conditions from which they suffer, but they are experts in how they feel. Open sharing of information with the patient, and the creation of on-line networks among those facing similar health challenges, can be enormously empowering to the patient while reducing the pressure on the health professionals and enhancing patient safety.

Rural health services are a special challenge. New Zealand has a dispersed population. It includes many people working in agriculture and tourism, as well as a number of regions with low incomes and a high proportion of Maori, such as the East Coast and Northland. However, these rural areas are served by a relatively small pool of specialists. Traditionally these specialists have been scattered around the country so that most specialist services are available everywhere – the specialist has gone to where the patients are. In the future the imperative for higher productivity from clinicians may make this impossible. Technological solutions are available to mitigate the issues around distance, including video and tele-monitoring. These will need to be deployed much more widely than at present.

Indeed Maori stand to benefit particularly well from health services delivered over fast broadband. The availability of personal shared care records with better-informed self-management will lend itself to the traditional way in which Whanau are involved in managing the health of their communities, especially older members. Rural regions with high Maori populations will benefit from Telehealth. Long term conditions in which Maori are over-represented, such as diabetes, will be assisted greatly by the enablement of managing long term conditions through shared care teams.

While technology and funding can offer many of the solutions, human factors need to be addressed also. There will be a need to break down barriers which have prevented nurses from assuming some of the roles traditionally filled by doctors, something that has been slowed by doctors' concern about encroachment on what they see as their intuitive role. New roles will need to be created that don't now exist – for example, the Community Health Aides that have been created in Alaska. Nurse specialists in hospitals will need to be enabled to work more closely with primary care nurses who have the ability to become the real champions for each patient's wellness.

IT can play a major role in enabling more efficient devolution of accountabilities by making the requisite information available instantly and completely. The challenge will be to gain professional acceptance of this and persuade all parties that such devolution is safe, both clinically and in terms of information security.

6 IT in Health

The fragmented character of health services has led to the sector developing a diverse range of IT systems.

As independent private sector businesses, primary care providers are obviously free to source their software and IT services from a wide range of providers. Likewise, historically DHBs have been free to manage their IT independently of each other in response to their perceived local needs. More recently and under the strong leadership of the IT Health Board there has been a concerted move amongst the DHBs towards a regional approach, which is clearing the way for systems which, though not necessarily identical, are capable of interoperability.

New Zealand is fortunate to have a number of entrepreneurial local health software developers, several of which are well-established on international markets. Such companies often see it as an essential component of global credibility that they have a solid sales base in their own country. Thus, the competition for local software initiatives is often intense, and sometimes in direct conflict to the "NZ Inc." approach which could deliver coherent national solutions and interfaces to New Zealand health providers and citizens. It is important to maintain a competitive and contestable market for health IT services as well as ensuring full interoperability. The two are not mutually exclusive and with good management we can have the best of all worlds.

Despite all that complexity and fragmentation, considerable progress is being made in weaving these disjointed systems into a national health IT ecosystem, with the IT Health Board leading the way. National and regional projects are in progress across numerous fields with the common aims of unleashing the power of communications technology for better and more efficient health outcomes, and opening the way for new health service delivery models.

A highly significant end goal of all this work is the introduction of Shared Care Records, a form of personal electronic health record for every New Zealander. Scheduled for introduction in 2014, this programme will potentially enable the creation and maintenance of a single record covering every interaction an individual has with the health system throughout life, though in reality the record may be less comprehensive for a range of reasons. The benefits will include:

- Ensuring that complete, accurate basic personal health information is available in a timely manner to every clinician the individual encounters in their lifelong health journey, resulting in more efficient communications and safer health services
- Enabling people to view their own health record, including their clinical records and test results, on-line. In turn, people can manage their own health and wellness with full information, respond to any errors or misconstructions that might get into the records inadvertently, and use their few minutes with the doctor more effectively based on high quality information.
- Facilitating innovative new business models for the delivery of health services by enabling the exchange of information among clinicians

Any one of these three benefits would be sufficient to justify the investment in Shared Care Records. Collectively, they represent a huge advance that would give New Zealand a degree of international leadership in this field. There are a number of issues to be resolved, including the highly sensitive nature of some health information and the need for robust and transparent privacy and access constraints. However, these are well understood and there is an expectation that they can be resolved to satisfy the community as the programme progresses, as they have in a handful of other countries where progress is being made.

Such records, over a lifetime, may become large, especially for people who have experienced chronic conditions. If a patient is under comprehensive care, their record may be accessed on a regular basis by a considerable number of people – GPs, hospital clinicians, specialists, physiotherapists and others as well as the patient themselves and possibly a nominated member of their family or whanau. It may be that a clinician or nurse in a different time zone is nominated as a member of the patient's care team so that a patient can make contact by email in the event of a minor issue after hours. Records will include X-rays, MRI scans, optical field-of-vision tests, and other high-density data. People with an interest in self-management of wellness are likely to look at them and add data regularly. They will be using the material on the Shared Care Record to check spellings and other data, to research an ailment or health issue on the Internet – often accessing information in video or multimedia form.

There are likely to be subsidiary applications developed for specific conditions or wellness challenges which are not a formal part of the Shared Care Record, but draw data from it and present options to the patient in specific ways. With appropriate standards of scrutiny and verification by a trusted source, such applications can become an effective tool for people who want to move from leaving the management of their health entirely in the hands of their doctor, to playing a role themselves.

Not everyone will have a desire to access their Shared Care Record with any great regularity. However, there will be a significant number who seize upon it as a highly effective tool to manage their illnesses and maintain their well-being, or interact with their care team.

Advance care planning" is being discussed as a safe repository for people to store instructions and wishes about their end-of-life care should they become unable to articulate their wishes at some future time.

Storing the Shared Care Records of an entire country will be a significant task. Such data inherently has a much longer lifespan than financial or transactional data applicable in most other fields. Economics and safety considerations will dictate a need to move it away from the individual GP practices and hospital repositories where the components are stored at present, to regional or national repositories. This will open up demands on the telecommunications system to provide for the data to be accessible on-line, day by day, whenever it is legitimately required.

7 Examples of Emerging Health IT Projects and Usages

7.1 Aged Care

One of the many challenges posed by the aging population is how to sustain older citizens to live independently in the community for as long as possible, before becoming dependent on rest homes or other forms of support. Often a key factor in a family's decision to place parents or relatives is a worry that the older relative will have a fall or a medical mishap and be unable to call for help. Forgetfulness, leading to failure to take medicines or perform important household chores, is another common fear.

Technologies have evolved to deal with many of these concerns. "Smart Homes" can be configured to the individual's needs using personalized combinations of sensors, camera, speakers, security devices, robots, timers, alarms, intercoms, medicine dispensing devices, and medical equipment. Routine visits to doctors can be reduced or eliminated using Telehealth systems as shown below. Vital signs can be monitored on-line either periodically or continuously – pulse, blood pressure, ECG, glucose level, weight, and more, while fall detection sensors guard against any accident supported by a panic button. Relatives and caregivers can be greatly reassured in the knowledge that their elderly relatives are under electronic guard 24/7 – potentially more effective than being in a specialized facility such as a rest home. The next generation of such systems is likely to offer surveillance outside the home as well as within.

Quality of life, and ongoing connection with families, can be maintained using big screen television sets connected over a fast broadband connection – granny's virtual attendance at the grandchild's birthday party is here and now. Such activity should complement face to face contact rather than replace it, but together the two can assist in reducing any sense of isolation.

The global "InteRAI" project, which New Zealand is poised to join, will develop these services still further. InteRAI is a network of researchers dedicated to improving health care for persons who are elderly, frail, or disabled. Its goal is to promote evidence-based clinical practice and policy decisions through the collection of data about the characteristics and outcomes of persons served across a variety of health and social services settings. InteRAI also works in the fields of physical activities promotion, activities of daily living, home environment optimization and physical restraints. This work will continue adding to the menu of options available to support older people in safe, happy, independent living. New Zealand's adoption of InteRAI may not precisely replicate the global model, but will be focused more on assessing the needs of the individual within their environment.

7.2 Ambulance Services

The extension of cellular networks in rural New Zealand will open several opportunities to improve the efficiency of ambulance services and their interface with hospitals.

Currently ambulance services here are not regarded as a full partner within the health service, but rather as a means of transport to get people to hospital in emergencies. The ability of ambulance

crews to make clinical judgments, often with minimal information about a patient's medical history, is limited. With home call-outs at night especially, crews often have two options – take the patient to hospital, or leave them at home to go to their GP in the morning. Incomplete information often forces them to take the safe option of taking them to hospital, usually incurring the cost of an admission to an Emergency Department which can exceed $4,000. So if the on-line availability of patient records could fill an information void and give crews the confidence to leave patients in the community more often, the savings could be substantial.

Similarly ambulance services will benefit in emergency situations such as accidents. Cameras can be quickly set up by the roadside to give hospital emergency departments real time visibility of the situation and patient condition, with the added benefit of increasing the safety of ambulance crews where violence or drunken behavior are involved. Devices can be fitted in ambulances to monitor patients' vital signs en route to the hospital, and a camera in the ambulance can be monitored by hospital clinicians so that they are prepared for the patient the moment they arrive. This will make a major contribution in improving the readiness of hospitals once the patient arrives during the "golden hour" when life-saving treatments are most likely to be successful.

In New Zealand's circumstances, where ambulances are frequently manned by a single volunteer in rural areas, this can be a huge advantage.

7.3 Chronic (Long Term) Conditions Management

The aging population combined with the increasing ability to cure many common illnesses means that a greater proportion of people are suffering from chronic conditions such as diabetes, heart disease and respiratory problems. As much as 70% of New Zealand's health expenditure is applied to long term conditions such as cardiovascular disorder, cancer, diabetes, chronic pain, arthritis and depression. The life expectancy of sufferers is increasing, but at a heavy cost to the health budget - the percentage being spent on chronic illnesses in most countries is rising markedly.

The management of chronic or long term conditions is being given priority in the work of the National Health IT Board. One of its flagship projects has been working with the northern region District Health Boards in implementing a pilot project which establishes a Shared Care Plan to

"My Diabetes, My Way," is a Web-based service which has been running in Scotland since December 2010. The percentage of diabetes sufferers in Scotland rose from 2% in 2002, to 4.6% in 2010, more than half being in the 45-65 age group. This meant that diabetes was drawing more than 10% of Scotland's national health budget, and "self-management" was identified as a key strategic response. The site enables patients and their carers to go on-line for information about their own case, and the management of diabetes in general. So far there are only a few hundred signed up, with a target of 5000 by 2013. Patients are enthusiastic – 99% use it to check their personal diabetes control, 95% to check and annotate their medical records, 94% to improve their knowledge, 94% to generally assist meeting their health goals, and 83% to receive reminders about their medications.

enable new ways of treating sufferers of such conditions. The pilot involves selected patients, clinicians, pharmacies and hospital specialty services. The initial focus has been on cardio vascular conditions, arthritis and diabetes. The project went live in August 2011 and will run for several months before being evaluated independently. There has been some excellent early reaction from doctors, nurses and patients involved.

7.4 Maternity

Maternity services lend themselves very well to the concept of shared care with the teamwork among the doctor, midwife, nurses, and occasionally the specialist. A pilot project based in Canterbury is developing an on-line Shared Care Record for maternity services.

7.5 Medications Management

Accuracy in medications management is of paramount importance to health services. The first thing a clinician needs to know of any patient is what medications they are on. Often patients are not able to answer the question well – medical terminology is often lengthy, written in Latin, and user-unfriendly. Patients will often answer questions by describing the colour of the pill, or shape of the box. Older folk with a range of medical conditions can often be on as many as 20 or more medications concurrently.

The handling of medications from pharmacy through to patient is a complex area. One of the projects being rolled out in New Zealand is e-prescribing. This means that each time a clinician writes a prescription, the written copy given to the patient is supplemented by an electronic copy which is sent to a central repository. The written prescription carries a bar code. When the patient presents the written prescription to the pharmacy of their choice the system matches it to the electronic record and automatically enters details in the pharmacy records, saving time and greatly reducing the potential for errors in dispensing. Feedback to the prescribing clinician will also add a dimension – for the first time the clinician will know whether or not the patient has had the prescription filled. This process will drive some pharmacies to upgrade their Internet speeds to increase efficiency. New Zealand is following just a handful of other countries in introducing this facility – a very practical and obvious usage of ICT that in most settings would have become mainstream a decade ago, but in the unique field of medicine remains a challenge. Estonia for example, introduced an equivalent service recently and learned for the first time that 20% of prescriptions go unfilled.

Shared Care Records will eventually add another dimension. Sometimes a patient will collect their prescription, but fail to complete the course or not take it at all. Reasons might include a reaction such as nausea, a sense that the medication has done its job, forgetting to collect a repeat dose, or unease gained from some external source about side effects. This can be very important information, but patients may be reluctant to tell their doctor this face to face. However, in the unthreatening environment of their home they may be quite willing to annotate their own Shared Care Record with the reason they stopped, providing the doctor with this information next time he sees them and logs onto their record.

7.6 On-Line Health Information

As in every other aspect of life, the Internet is teeming with information about health and illness, with advice to patients how to self-manage them. As with every other topic the challenge for the individual is to distinguish between the majority which is authoritative, and the minority which may mislead and even harm them. In health, the stakes are especially high.

There is an obvious need and opportunity for reputable sources such as government agencies and health NGOs to run various forms of health portal where consumers can go safe in the knowledge that the information they are accessing has some form of reliable authentication. Examples of such portals are appearing here and around the world, often promoted and maintained by condition-specific patient support groups.

As people become more confident using the Internet as a source of self-management of their health and wellness, there is a likelihood that we will go on-line before going to the doctor – for example, to see whether our symptoms are the normal "winter flu" which can be resolved with rest or over-the-counter medicine, or something more that requires an appointment. This is one of many small uses of the Internet that will collectively take a lot of pressure off our scarce primary and secondary care resources.

Today's medium of choice for the communication of complex information is increasingly video. It is likely that over time, sound or written words without pictures will fall out of favour and become yesterday's communication form. The ability to go on-line to manage illness and wellness through video content, in parallel with monitoring our own Shared Care Plans, may become a significant driver of uptake for Ultra-Fast Broadband.

7.7 Primary Care Reform

Reform of primary care services will be an important aspect of the necessary devolution of health care from secondary care, to primary care, to the community. Not only is the population aging, but so are the doctors. A key objective should be to have people think a little more about whether they can deal with their issue some other way before engaging a General Practitioner.

In New Zealand some ground-breaking work has been done in the Waikato. As a part of the government's "Better, Sooner, More Convenient" programme for primary care reform, the four District Health Boards comprising the Midlands Region (Gisborne, Lakes, Taranaki and Waikato) have established an Integrated Family Health Network with a regional focus on improving patient journeys. Their Integrated Family Health Centres (IFHC) comprises of teams of inter-disciplinary professionals working collectively.

The difference between an IFHC and the traditional GP practice becomes apparent immediately the patient phones for an appointment. Instead of the traditional receptionist, the call is answered by a fully trained professional in an environment resembling a call centre. The patient is asked questions about the reason the appointment is required, and a degree of triage applied over the phone.

Sometimes the outcome is that an appointment is made in the traditional manner. Other times, the patient may be advised to use an over-the-counter medication, or a prescription may be sent to them by email, or they may be told to go and get a blood test or x-ray before coming into the doctor. Such outcomes result in a smoother journey through the system for the patient, and the more efficient use of scarce GP time.

Over time and with more Ultra-Fast Broadband it is easy to see how such a triage might be improved over video in the patient's own home, perhaps with their big screen television connected to their computer. The resolution and reliability of the technology has developed to the point that diagnosis and management of many conditions across a video channel is absolutely feasible and safe. As more people have high quality broadband on tap, the more general use of this technology will become very attractive. Even now, here in New Zealand, there is a record of specialist disciplines such as dermatology using video as an alternative to costly patient and clinician travel.

IFHCs may well provide a viable alternative to some of the small regional hospitals that impose a disproportionate cost on many non-metropolitan District Health Boards. With the ability to access top quality specialists 24/7, including after-hours video consultation when the specialist is at home, they can arguably offer a service superior to a resource-strapped small hospital which currently has no way to readily link into such high quality support.

7.8 Radiography

Medical imaging is a very bandwidth-intensive component of the potential demand for Ultra-Fast Broadband in health. Radiography will, over time, become a component of each individual's Shared Care Record. Now and then people and their clinicians will want to refer back to them on-line. Such images may comprise not only fractures or joint issues, but material as diverse as CAT scans, optical field-of-vision tests, or even a scan of themselves pre-birth.

In earlier generations the custom was for radiographers or doctors to hand the X-rays to patients themselves for "safe" keeping. Now it is standard for the storage to occur within the health system, but the maximum value will become available only when interested parties including the patient can go on-line to access these.

While the number of access sessions to view medical images may not be huge, the demand on bandwidth and the resulting impact on health outcomes are both potentially substantial.

7.9 Remote Monitoring

Remote monitoring, or telemetrically-supported supervised self-monitoring, of patients in their own home can offer not only a significant saving in scarce health resources, but a major improvement in the quality of life for those faced with various health challenges.

The potential for remote monitoring of elderly people to keep them safely in their own homes has already been canvassed under 7.3 above. The potential for remote monitoring also overlaps into other sections of this report. Remote monitoring has widespread potential for people who need a degree of observation rather than intense care. It can involve having recording devices in the home, or simply providing an electronic survey for the patient to complete and file at pre-determined intervals.

Public awareness and acceptance of remote monitoring is soaring. The London Business School has recently estimated that 350,000 Britons are now on remote health monitoring of some kind, with a potential market of 1.4 million. Per capita, this potential translates to 95,000 New Zealanders who could have their key measures monitored remotely, saving time and travel for their clinicians and themselves.

Patient reaction to a Scottish survey on remote monitoring:

"I've never felt so well looked after in my life. I think it's a godsend like." (Patient aged 58)

"I don't worry about him the same as I used tae. It's all taken care of before it can get tae that level. That machine can tell Alec he's ill even before he kens it hisself" (Spouse of patient aged 75)

"There's some times you phone them up for an appointment ye cannae get one. . . So I feel if I've got that (Telehealth device) I've got a chance of a doctor anyway." (Patient aged 75)

While in many respects remote monitoring is in its infancy, there is a growing body of well-informed opinion globally that it deserves far more attention, quickly, as a means to improve health outcomes. Clinicians who practice it speak glowingly of the simplicity of going on-line and viewing all their patients' current readings together on a screen, determining efficiently which need some form of intervention. Patients speak of the freedom of knowing that each morning their important readings are automatically sent off to their medical team, sometimes with minimal or no intervention from themselves. At times the first a patient knows a reading has even been sent is when a nurse calls them and suggests a change in their dosage or exercise programme, or a visit.

Remote monitoring is not limited to physical health. In some parts of the world it is being used effectively for tele-psychiatry, allowing a mental health practitioner to engage in daily conversations with more patients, involving far less travelling time and dislocation than if the consultations were in person. Specialist applications such as speech therapy are being conducted the same way.

Remote monitoring is seen globally and in New Zealand, as being poised to move from the domain of a bunch of enthusiasts, to a standard component of the health armoury. There are plenty of challenges ahead. These include defining appropriate algorithms for deciding when intervention is required across a variety of scenarios, working out the most predictive signs, what new physiological measures might be introduced, and how to modernise the health funding model to compensate clinicians for consultation that is not face-to-face.

Generating a base of evidence around the cost-effectiveness of remote monitoring is also problematic, as with many forms of Telehealth – a problem that is recognised in all jurisdictions. Part of the problem may lie in the fact that so many of the successful applications are still pilots – incurring most or all of the costs of a full scale deployment, but with insufficient critical mass to

capture and measure the cost savings and beneficial health outcomes. Clinicians, understandably, demand a base of clinical evidence that any new system is solid and robust, as well as needing assurances that it reduces workload, meets medico-legal requirements, and minimises "false positive" readings. Herein lies one of the frustrations – pilot programmes in remote monitoring have often initially increased clinician workloads due to increased telephone contact, decreased their earnings due to absence of face-to-face contact, and increased cost by requiring medication to treat conditions which without remote monitoring may have been undiagnosed.

Despite all that, there is a wide and rapidly-expanding body of well-qualified opinion globally that remote monitoring is coming of age. In New Zealand's case geographic, economic and social imperatives – including the special benefits to Maori health - will certainly drive a major increase in uptake in coming years, assisted by the recent formation of the NZ Telehealth Forum.

Remote monitoring is likely to be a significant driver of broadband uptake, but this will be indirect. The monitoring itself is mostly low bandwidth and capable of transmission with low speed lines. However, in time the emergence of more remotely-monitored patients is likely to encourage those people to monitor their own health on-line more frequently, using video information sources, video consultations, or multimedia content with high bandwidth requirements.

7.10 Remote Surgery

Much has been made of the success of New Zealand's world-leading surgical bus operated by Mobile Surgical Services Ltd. The service is a manifestation of the potential for remote surgery – where an operation is supervised or performed on a patient, using video, by a team comprising a local doctor and a specialist in another city or country.

Remote surgery has a role where it is not practicable to physically get an appropriate surgeon to the same place as the patient because of urgency or cost, or where remote supervision is a more efficient use of scarce clinical resources.

Ultra-Fast Broadband will remove an obstacle for services of this kind. Currently such services rely on having a telecommunications service provider establish a special link via satellite each time they arrive at a provincial or rural site. With fast broadband they will simply be able to plug the bus into a standard broadband connection on the hospital wall.

Remote surgery has no national boundaries. New Zealand patients will over time be able to draw on the support of international specialists when required to supervise or perform operations, while at the same time our own specialists will be able to offer services remotely to other countries. Both these opportunities could assist in making New Zealand a more attractive place for an internationally-mobile pool of highly-qualified specialists to practice, with the added inducement of earning income through wealthier patients in other countries without leaving home.

As with many health applications, the aggregate bandwidth requirement from Ultra-Fast Broadband will not be great. UFB will do more for health, than health will do for UFB. However from a national perspective the economic and social benefit will potentially be substantial.

7.11 Telehealth

Much debate is conducted on the definition of Telehealth, with little real purpose. For the purpose of this paper Telehealth is taken to mean any delivery of a health service which has a significant dependency on telecommunications and Internet services. Such a definition embraces some other applications dealt with earlier in this paper, such as remote monitoring and aged care.

There is significant potential for the use of video consultations to replace physical visits by specialists with a saving of considerable time and cost. Every day, numerous specialists commute to and from our smaller hospitals to see patients there. A typical return journey by car between say, Christchurch and Greymouth or Hamilton and Taumarunui, may be 4-5 hours. This downtime comes at an opportunity cost of several patient consultations.

Video consultations between hospitals or other health premises are becoming an efficient alternative to these regular visits. Modern tele-presence can be as good as being in the same room. Even in demanding specialties such as dermatology video is in occasional use, though for follow-up monitoring rather than diagnosis. It can be supplemented by a trained nurse alongside the patient to feel the skin or describe anything the specialist needs examined more closely. With increasing numbers of homes having big screen, high definition television sets, and high quality cameras available for the price of a tank of petrol, the attraction of video consultations can only increase.

Video has applications also for out-of-hours work. The life of a health practitioner often involves a commitment to being on call 24/7 in cases of accident or other medical emergency. The potential to conduct an examination on-line from home, rather than have to dress and travel to the hospital or surgery, can make life far more civilised for clinicians while improving their job satisfaction and the quality of patient care.

The potential value is not confined to accidents and serious emergencies There is potential for a patient who experiences a medical issue at night to phone their GP or specialist at home and establish a video link – if the resulting conversation ends with reassurance that the problem can safely wait until the morning, this becomes a substantial saving to the ambulance service and emergency department.

Globally, there are many thousands of examples of Telehealth projects which have been piloted, and trumpeted as successes by patients, clinicians and administrators. Yet there are only a few which have achieved real scale. Experts attribute this to “pilot-itis’ – the propensity of the health sector to initiate small scale pilots which succeed, but fail to find a way of growing them to the scale required to demonstrate real economic benefits. It may be too, that pilots have more attraction politically as a form of expenditure, offering “ribbon cutting” opportunities that become less appealing when a mass deployment is considered.

One thing world experts appear to agree on is the need for clinical support on a local level for Telehealth to succeed. It is too easy for the standard objections to be proffered, objections such as, “The technology is too unreliable or expensive,” “Telehealth may reduce my income,” “What about medico-legal liability?” or, “Where is the clinical evidence that it can’t harm the patient?” Local champions who see the big picture are indispensable to success, and they must include respected, credible clinical leaders.

It is imperative that we make progress. There needs to be a vision of what Telehealth can achieve, reassurances that the reward structure will be adjusted quickly to ensure fair compensation, and recognition that a change management process is needed alongside a technology one. Perhaps there should be a ban on any new pilot unless it is accompanied by a migration plan to a full-scale national rollout if it proves successful.

The recent launch of the New Zealand Telehealth Forum, with the financial support of the National Health IT Board, is a very positive sign. Hopefully this group can make rapid progress in promoting Telehealth as a mainstream practice of the immediate future, dealing with objections, and working to build on successful work already completed here and overseas.

Telehealth has the potential to become a significant driver for the uptake of Ultra-Fast Broadband. Not only specialists but GPs will have an incentive to deploy fast connectivity in their homes for emergency out of hours use, while the availability of video consultation will become a similar incentive to patients. There are many issues still to be resolved, but New Zealand is on track to make real progress.

The Whole System Demonstrator Programme, a comprehensive, long-awaited study on the capability of Telehealth and Telecare established by Britain’s Department of Health, is shedding some light on the potential system-wide efficiency gains. Billed as the world’s largest-ever study of the potential of such services, the headline results released in December 2011 are highly-encouraging. These early indications show that if used correctly Telehealth can deliver a 15% reduction in A&E visits, a 20% reduction in emergency admissions, a 14% reduction in elective admissions, a 14% reduction in bed days and an 8% reduction in tariff costs. More strikingly they also demonstrate a 45% reduction in mortality rates. It is estimated that 3 million Britons with long term conditions could benefit from Telehealth.

8 Questions to Ponder

1 How can we add impetus to the slow process of introducing on-line Shared Care Records for every New Zealander?

2 Is the complex mixture of Boards, companies and individual practitioners within the health system slowing our progress? Are there ways we can streamline the system?

3 Is enough attention being given to the changes required in the roles of health personnel that will be a key component in the evolution of Shared Care Records? What more needs doing?

4 How can we use UFB and rural broadband to enable a step change in the health status of poorer people in more isolated communities?

5 How can we maintain and advance New Zealand's position as a leading-edge country in health software, as a by-product of increasing the use of ICT as an enabler of better health for New Zealanders?

9 Conclusion

The use of ICT as an enabler of better, more affordable health outcomes is well understood in government, and we are fortunate that a comprehensive action plan is well-advanced. The challenges are considerable but there is an effective group of highly-credible clinicians at the forefront, supported by IT specialists in central government and throughout the sector with consumer input.

The outcome will be a significant dependency on telecommunications, including broadband connectivity, for the management of our illnesses and maintenance of our wellness.

More self-management will be an integral part of this process. Given far more information about their own status in an easily-accessible form, people will become more curious about their health and wellness, and more inclined to use the internet as a source of information and guidance. This will drive traffic to Ultra-Fast Broadband.

Telecommunications offers many solutions to the challenge of caring for an aging population so that they can have safer, better quality living and more sociability in the familiar surroundings of their own homes. While much of the functionality to support this is low bandwidth, other components will add to the attraction of high speed broadband. Video will be key to this.

In totality, Ultra-Fast Broadband will enable a new generation of health services. The challenge now is for New Zealand to take full advantage of these, while also building on our position as a significant global player in the field of health software. The opportunities are substantial.

APPENDIX

List of Interviewees

Discussions with many people, insights gained from numerous presentations, and much reading have provided the raw material for this issues paper. Special thanks is recorded to the following who gave time for individual interviews:

Professor Des Gorman, Health Workforce NZ

Dr Peter Gow, Middlemore Hospital

Dr Stuart Gowland, Mobile Surgical Services Ltd

Matt Hector-Taylor, HSA Global Services Ltd

Dougal McKechnie, Health IT Cluster

Dr Murray Milner, National Health IT Board

Graeme Osborne, National Health IT Board

Dr Harry Rea, Middlemore Hospital

Tony Foulkes, Taranaki District Health Board

Malcolm Pollock, National Institute for Health Innovation

COMMERCE COMMISSION

HIGH SPEED BROADBAND SERVICES

DEMAND SIDE STUDY

DEMAND FROM PRIMARY AND SECONDARY SCHOOLS

ISSUES PAPER

Written by Ernie Newman, Ernie Newman Consulting Ltd
December 2011

While many people have been consulted in the drafting of this paper, responsibility for the views expressed rests with none of them individually nor with the Commission, but with the author alone.

DEMAND FROM PRIMARY AND SECONDARY SCHOOLS

Contents

1 Executive Summary

This discussion paper is designed to aid the understanding of stakeholders about the nature and volume of demand for fast broadband that will originate from primary and secondary schools.

It has been compiled primarily from a series of interviews with a cross section of leading experts – mostly professional educators, with a small number of software vendors. It has also been informed by some Web research, attendance at the Association for Learning and Technology Conference at the University of Leeds in September 2011, discussions with international experts, and many years of participation in specialist conferences about the use of ICT in New Zealand classrooms.

It reaches the following conclusions:

- Already there is very significant pent-up demand emerging for connectivity in schools because of the practice of students taking their own digital device to school, and wanting to have it on-line all day. This practice will increase rapidly now that state schools are starting to join private schools in requiring students to bring such a device, and/or helping them to source one.
- Alongside the above trend, the use of multimedia as a core educational tool continues to burgeon.
- Just as people in business have found the boundary between work and leisure has become blurred over recent years, so too have modern students blurred the boundary between study and leisure. That means that study has become an activity spread across the full 24/7 time period. In turn it means the students expect connectivity at home and other places they go that is at least as good as they get at school. It follows that better school connectivity will drive residential demand also.
- New Zealand teachers are generally becoming as well qualified as those in comparable countries for the era of e-learning. A great deal has been done over the past decade to up skill them, and most have been willing to leave their comfort zones and embrace it as learners. The same is not being said about the teacher training institutions, which are seen as behind the times and missing the opportunity to position themselves as thought leaders in this field.
- School networks need to be reconsidered in the light of a trend toward cloud computing. Much of the infrastructure of yesterday will still be required to enable multimedia work, but servers will be less in demand and there will be greatly increased demand for Wi-Fi connectivity throughout the school with significant numbers of students on-line simultaneously including a great deal of video content.
- There are 760,000 students in New Zealand's primary and secondary schools. The emerging expectation that a high proportion will be on-line at once, including use of bandwidth-hungry video, at school during the day and at home after that, means there is enormous potential demand for fast broadband. The speed of uptake and amount of demand will depend on how well the telecommunications industry enables, markets and prices the services.

2 Purpose of This Paper

This Issues Paper is predominantly the result of talks with a range of thought-leaders and visionaries across the education sector. It sets out in lay terms the specific nature of the ways schools are likely to use high speed broadband, and identifies some of the issues to be addressed. It is intended to inform all the stakeholders – teachers, parents, administrators and ICT vendors – thereby helping align and develop their thinking and to be a catalyst in dealing with some of the issues that might otherwise stand in the way of a well-coordinated national roll-out and uptake.

The Paper is intended to be a contribution to an on-going dialogue, and not the end point. If it provokes debate, that will be a useful contribution.

3 Introduction

It is widely accepted among policy-makers, education professionals and the wider public that education stands out as having the greatest potential among the sectors in which high speed broadband will bring about fundamental change. The education of tomorrow's New Zealanders will be substantially better as a result, leading to a significant economic advantage for future generations. Students will be taught a more individually-customised curriculum, in a way that suits their own learning style, and have more fun in the process. This is a very exciting prospect for New Zealand.

> *"Because teachers are who they are, they should be leading the thinking globally around these topics and opportunities as it impacts on the development of our national and global citizens." - Interviewee*

The government's Ultra-Fast Broadband (UFB) and Rural Broadband Initiative (RBI) have assured us of widespread high speed connectivity, within just a handful of years, across practically all schools and most residences. Our schools have done well in equipping themselves with networks adequate for the early years of e-learning, while our teachers deserve great praise for the positive way most have re-trained themselves to educate the "digital natives" generation amid many other professional pressures. As a country, we are well-placed.

Internationally there are high expectations of connected schools. The OECD has published the "6 Scenarios" for schooling up to 2020, segmented into status quo, re-schooling, and de-schooling. ICT is a central part of this work. The Scenarios approach the question of how education might occur overall in a society, unconstrained by the notion of the individual school. One of the potential drivers put forward for such radical change is the threat of a major crisis of teacher shortages, triggered by a rapidly aging profession, low teacher morale, and buoyant opportunities in more attractive graduate jobs. ICT features heavily in some of the suggested responses. Many of the observations in the OECD Scenarios resonate strongly with the realities in New Zealand.

The end point of e-learning is a reward well worth striving for. The potential is for New Zealand's primary and secondary schools to provide students with an education that is as good as, or better than in any other developed country. One where students are taught using the communication tools of their own generation rather than those of a past one. One where students can progress at their own pace regardless of the speed at which they learn, or whether their schools are low or high

decile. The potential exists for schools to transform themselves so as to turn out the higher-educated students needed in the New Zealand we aspire to be in the 21st century.

However, to take advantage of this vast opportunity requires several key groups to understand and be in alignment with the goals and pathways. Education professionals, policy setters, school administrators, parents, ICT vendors, teacher training institutions, and students themselves need a common sense of the steps we all need to take.

4 Acknowledgements

Much of the content of this paper has been derived from interviews with a range of acknowledged experts in the future role of ICT in New Zealand schools. Other aspects of the content have been drawn from attendance at the annual conference of the Association for Learning and Technology at the University of Leeds in September 2011, and associated interviews with several British contacts. The names of these people are listed in Appendix A. A number of their observations have been recorded in this paper, but as the interviews were conducted one-on-one I have not generally attributed them to a specific individual.

5 The Changing Student

As any parent or grandparent knows, communications technologies have made students of the 21st century very different to their immediate predecessors. Their behaviours, choices for discretionary leisure time, and methods of learning are radically changed.

Today, 96% of New Zealand students have access to a computer, and 92% to the Internet. Both figures are 2-3% higher than the OECD average.

Today's primary and secondary students watch less television than children in the recent past. When they do watch, they expect to be able to tailor their viewing. In the digital environment they take for granted being able to chop out the advertisements, record and play back, splice clips together, and pick out only the parts they want to see, and they want to do the same with other forms of entertainment. They expect to view at a time that suits their schedule – not that of a programme director in Wellington. When they watch YouTube and other on-line video sources they expect it to be interactive – they want to comment, express approval or otherwise, and add their own written, audio or video responses. Interactivity is no longer an optional add-on, but an expectation.

The richness of the Internet as a source of information and means of learning, and the inclination of students to use it at any time, means that increasingly learning has become a 24/7 activity. The boundary between learning and play has become blurred, just as adults' boundaries between work and leisure has blurred over time. Learning takes place anytime and anywhere – at school, home, the school bus, or friends' homes. Access to information is ubiquitous and instant.

For students, that ready access is game-changing. It empowers them immensely. It enables them to learn when they feel inclined to learn, in a style and at a pace that suits them. They can organise their lives accordingly. Study, social and family time become far more flexible. Arguably the term "homework" is now redundant – if the school network can be accessed then schoolwork of any kind can be done anywhere and anytime, inside or outside school hours.

> *"ICT is to teaching what penicillin was to medicine. Once the experimentation was complete, it was incumbent on the doctors to build it into their practices straight away – their obligation as a professional." - Interviewee*

All this has changed the nature of students. They have become much more individual, and concerned with the values of individualism, than their predecessors. They are more inclined to take risks. Yet with individualism there has been recognition that nobody is an island – society has become infinitely more complex, so to survive and prosper requires the collective skills of the group.

And yet, with some conspicuous exceptions, primary and secondary schools still operate much as they did generations ago. Classes start around 9am and end around 3 or 3.30 pm. Years are divided into terms, and days into study periods, based on a 1950s model. Students are lined up doing English, maths and other subjects at the same age, same speed and all at once, irrespective of their ability or their style and pace of learning. Schools deliver a production-line programme in a world of individualism.

That way of thinking condemns slow learners to fail more comprehensively, and makes fast learners slow down to ensure they succeed less. Students become disengaged because the learning systems

they encounter at school have failed to keep pace with the communications technology that pervades their real world. At home and in the outside world they live in a technology-rich world, and are then expected to drop back a generation when they walk in the school door.

6 Learning Technologies

Technology, well used, can change all of that. It can make school and home immediately transferrable. Many students perform a lot better in a digital environment because they can learn to manage their own learning programmes and speed of progress. There is some evidence that the students who respond poorly to traditional teaching practices are the students who benefit most from technology.

Applications for collaboration and efficiency abound. Google Apps for Education is one typical example. It supports learning, tracking of progress and assessment. It streamlines the efficient administration of the teaching and learning process in the same way as on-line banking has transformed the way we deal with financial institutions.

Electronic voting tools that are used imaginatively, offer benefits in the classroom. Traditionally the show of hands has been a standard tool used by teachers to maintain student attention and interest, and generate feedback to determine how well the message is getting through. Voting tools can instantly record which student has got each answer right or wrong, assisting with on-going assessment processes and enabling them to be grouped instantly according to the level of comprehension. Electronic voting is popular with adult conference-goers because of its immediacy, an attribute that should translate into the classroom and make learning a more enjoyable experience. It can also enable the efficient taking of a roll call at the beginning and end of a session.

Routinely recording lectures is becoming commonplace at tertiary level, and seems likely to grow into the secondary system over time. Lectures may not be the most popular form of teaching, or the most effective, but they are recognised as an essential feature. The Netherlands is a leader in this practice. It is an inexpensive way to enable students to go back over a lecture they did not fully assimilate, or one they missed – often from home. Students report they appreciate that opportunity as it enables them to fast forward the parts they understand, and replay the others. Recorded lectures are often used in preparing for exams. There is research indicating that it improves the pass rate, and that students often watch the same lecture multiple times. Students have also reported back that recording can improve a poor lecture as they can skip over the unsatisfactory parts.

Digital story telling is a technique with considerable value in classrooms. It is described on Wikipedia as “the new practice of ordinary people who use digital tools to tell their 'story' - digital stories often present in compelling and emotionally engaging formats - they are usually less than 8 minutes long and can be interactive.” Such stories can be made by primary students from a young age, teaching them communication and creative skills as well as the subject matter about which they are writing. Many schools use digital story telling extensively, but its utility is greatly increased when there is ample bandwidth to allow the output to be accessed from home, or produced jointly with other students in different cities or countries. If the school has a simple digital camera, digital stories and

movies can be made at a very low cost – sometimes zero. Specialist software such as Windows Photo Story is commonly used.

Digital Story Telling has special potential to engage Maori and Pacifica students. The tradition in those cultures of oral history and storytelling lends itself perfectly to this 21st century adaptation, with the potential not only to engage the students far better than in more standard forms of teaching and learning, but also to make a step change in the preservation of the culture for future generations.

One element of learning activity is about access to information – Internet and text book content, interlaced with teachers' knowledge and understanding. But there is another element which is about creating. It involves taking other people's ideas and building, sharing and developing them. Earlier generations did this by rote-learning, then re-writing using their own words what others had written to prove their level of comprehension. In that era "sharing" involved handing in an exercise book for the teacher to mark.

Today the process is far broader. Students are often on-line checking and expanding what the teacher is saying even while the lecture is in progress. A vast range of ICT tools are available for collaboration, which will drive a great deal of demand for high speed broadband.

> *"It's not just about taking advantage of technology to do the same things better. It's about the changes that the Internet has brought to society and the needs of today's students. It's crucial that we educate kids for the needs of tomorrow's citizens, not yesterday's." - Interviewee*

In earlier days of Internet-supported education, most of the content was in written form. Today content is becoming multimedia-based – podcasts, animation, and video-based repositories of knowledge. It goes without saying that such content is vastly more engaging and effective to students, especially younger ones, than endless written text. It is also far more dynamic – today's Internet-based learning resources can be constantly updated and improved, unlike the encyclopaedia or text book of yesteryear.

7 Digital Devices at School

The journey from each New Zealand school having a computer lab and one or two PCs in each classroom, to the ultimate of every child having a device at school which is connected all day, has moved ahead considerably in the past 12 months. The arrival of the iPad and to a lesser extent the smart phone has been the driver.

A decade ago, students with a computer at home were occasionally prohibited by their school from using these for study purposes. The rationale was that such use would give them an unfair advantage over those without such a facility.

The intervening period has seen enormous progress. Schools have moved from a computer here and there, to a computer lab and multiple computers per classroom. As fast as schools could be wired up, it seemed, the demand for connectivity increased.

But it is the explosion in the number of students bringing digital devices to school that has proven the tipping point for bandwidth demand. It began a several years ago when well-resourced private schools started encouraging, or requiring, every student to bring a laptop. At that stage laptops were around $3000 or more – a significant investment. It should be noted though, that a few early adopters of this practice pulled back after deciding the concept was ahead of its time.

> *"The iPad is not the future of education; it's the present of education. If we consign the iPad to the realms of the future, then we are implicitly saying that it's not for right here, right now, today. We're saying that we can postpone the task of seriously engaging with the educational and social impact of ubiquity of Internet-connected computing. I ask you to consider other industries that put off dealing with such challenges. How is that approach working out for record companies? For newspapers? For booksellers? The hour is already late. We have allowed a 16-year gap to develop between society and schools in terms of our children's access to computers." - Fraser Spiers, Head of ICT, Cedars School of Excellence, Greenock, Scotland*

Today wireless notebooks, iPads and tablets are fast becoming the norm. Thousands of students, especially from higher-decile communities but across the socio-economic spectrum, own their own devices. They routinely bring them to school. Students are beginning to see it as almost a birth right that the school will not only allow them to use the device to aid their education, but provide the connectivity for them to do so. In response, many leading-edge schools have introduced a policy of BYOD – bring your own device – on a voluntary basis and an increasing number are starting to actively encourage it or even make it a requirement. More schools would follow were connectivity not a barrier.

Opinions vary as to the extent this is already happening, and there do not appear to be any recent statistics. However, an educated guess is that more than half of our primary and secondary students already have access to a portable device that they bring to school sometimes, or could bring, subject to connectivity, reasonable pricing and school policies.

And why should affordable connectivity at school not be their expectation? For the price of a coffee one can go on-line free at commercial premises such as Starbucks and McDonalds. Practically all offices ensure connectivity for their staff. Local government can provision free connectivity in numerous public areas including the Wellington waterfront. Is provision of connectivity not, then, a reasonable expectation for a citizen of tomorrow to have of their place of learning?

More and more teachers are embracing the use of devices during lessons. Certainly there is the potential for backchat, but that has always existed - only the medium has changed. A few teachers are concerned that the on-line student is a threat to their power base. Yet the positives far outweigh the negatives, with the ability for more advanced students to be on-line gathering information faster than the teacher can deliver, and the ability for slower students to revise. Thinking teachers encourage students to be on-line accessing information during lessons, not punish them for it. This changes the pedagogy, allowing each student to set their own pace for learning whilst still under the leadership and guidance of a skilled classroom teacher.

The iPad has been pivotal in this context. It is seen as having a "Star Trek" quality – a little like the first flip phones. It has introduced the concept of the computer coming to us, rather than us having to go to the computer. It is the start of a new paradigm of devices – new, cheaper devices of a similar nature will come charging along behind it. When the A3 iPad emerges, that will be a true game changer for primary and secondary schools.

Importantly the iPad and its derivatives have very limited processing power – they are designed for the age of cloud computing where data and software are held at a remote site. They depend totally on connectivity with suitable bandwidth.

Already there are many examples of schools equipping their students with devices, not only the most affluent. One example is the decile 1 Point England School in Auckland's eastern suburbs. Here, the children of a very underprivileged community of predominantly Maori and Pacifica citizens have the use of a netbook 24/7 throughout their tenure. The master lease of the devices is funded by a philanthropic source, and paid off by parents at $10-$15 a month in a three year purchase agreement. This ensures that the students all have similar devices and that ownership and responsibility for the device lies with the student and their family, avoiding the trap some schools in other countries have encountered when "giving" digital devices to impoverished children.

Currently iPads retail at around $795. A very acceptable netbook can be purchased in bulk for $300-$400. These prices are in real terms a far cry from the early days when a laptop retailed at more than $3000.

Increasingly, schools are including a digital device on their stationary list at the start of the year. Orewa College is one that has recently introduced this policy for year 9. The school's explanation to parents is compelling – the school is providing the fibre connectivity and the Wi-Fi network across the school campus, so it is not unreasonable to ask parents to fund the remaining link in the chain –

"My understanding is schools don't deny access to those who can't afford it. But the reality is that iPads have become the tool of convenience – they're often better in terms of the applications that one can use, and certainly students are becoming increasingly familiar with them. Their portability means they are a desirable thing to have in the school environment."
- Pat Walsh, Secondary Principals' Association, on Radio NZ National

the device. Orewa College names the iPad as its device of choice, but will accept laptops. Certainly there has been an initial adverse reaction from some of the wider community, but this is clearly dissipating as more parents attend briefing sessions and hear the professional staff explain the benefits. Most of the resistance is related to the timing – there is very little doubt that a device for every child is the end point, but some debate about the kind of device and the right time to start.

For schools to require parents to invest in their children's education is nothing new. In earlier generations substantial investment by parents was required or encouraged in text books, and even full sets of encyclopaedias in the home. Encyclopaedias now exist on-line, available free as a by-product of the investment in a digital device, while many experts are predicting the disappearance of the traditional text book within a decade. Parental investment in a device is being offset by savings elsewhere.

The governance model in our schools means that the decision about what type of device the students use is highly decentralised. Teachers, and Boards of Trustees will have the final say about what to recommend or accept, having regard to both the technological and pedagogical readiness of the school. There will be a number of considerations. For example, primary schools are more likely to prefer notepads or iPads because of portability and flexibility – it is now common to see these in use by pre-schoolers. Secondary schools, however, may prefer the added functionality of a laptop with access to a rigid keyboard, as well as software such as Word and Excel.

So while it is foreseeable that most students will have a digital device at school in the near future, it should be remembered that some will have more than one connected concurrently. Just as it is common now for homes to have multiple devices connected to a home network – sometimes more than there are people living in the house – so too will it be for schools.

"Bring Your Own Device" does not render redundant the hardware already in schools. This will still be required for multimedia and other sophisticated applications as stated elsewhere in this report. BYOD performs the complementary function of keeping the students connected throughout the school day.

Finally, the concept of every school student having a device with on-line access at school is a great educational leveller. In terms of equity of opportunity, it is hard to imagine anything that would give such a helping hand, in relative terms, to the less advantaged.

The value of every student having a device at school is recognised well beyond New Zealand. Uruguay has recently become the first country in the world where the government provides every student with a laptop. The initiative known as Plan Ceibal began in 2007 under the personal direction of the Uruguay president, and just three years later had achieved its objective with 450,000 laptops in place. It has enhanced connectivity not only within the schools, but through the wider school communities including students' homes. (See details in Appendix B)

Therefore, it can be assumed that in a very short space of time, numerous schools will have most or all of their students bringing a device to school, expecting connectivity while they are there, and using it both during and between lessons – often for high-bandwidth content such a YouTube. That concept is challenging, not only for the school but also for the UFB. The notion that many of New

Zealand's 760,000 primary and secondary students across the spectrum may be on-line simultaneously, downloading rich content including streaming video from school by day or home by night is an exciting and challenging prospect for the UFB suppliers.

8 The Role of Multimedia

The potential for multimedia applications across the Internet to become the foundation of learning is almost unlimited. This has been recognised since the importance of the Internet to education became understood in the 1990s, with lack of bandwidth and infrastructure being seen as the two obstacles. With these obstacles now about to be removed, the opportunity will be vast. This will be especially significant for our future as a serious player in creative and other "weightless" industries.

Scotland's GLOW network is seen by many people in education as an exemplar of national school content networks. However, even this is highly bandwidth-dependent. Users in Edinburgh rue the fact that most schools get only about 8Mbps, and if 30 or 35 YouTube videos are open concurrently – a very common requirement in today's larger schools – the network crashes.

This pent-up demand for multimedia access is one of the key differences between schools and businesses. Many business people fail to understand why schools crave so much bandwidth. The answer is in the capacity of an unlimited range of multimedia applications to introduce a completely new model of education at primary and secondary level. Multimedia enables a range of learning styles and speeds, allowing both faster and slower learners to reach their maximum potential in interesting, engaging, rewarding ways. Even now, every school requires significantly more bandwidth per capita than the typical business, and the gap can only increase.

Multimedia applications for schools are constantly becoming available. They are being driven by both global and New Zealand developers as well as by schools themselves.

Augmented reality – the overlaying of digital content across a real object or activity - is one application with unlimited potential as a foundation educational tool. Wikipedia describes it as "a term for a live direct or indirect view of a physical, real-world environment whose elements are *augmented* by computer-generated sensory input such as sound, video, graphics or GPS data." An early example is the ever-expanding functionality of Google Earth – an educational tool of almost unprecedented power. New examples are emerging daily - Google Art Gallery is one, enabling viewers to examine the contents of the world's great art galleries even to the point of zooming right in on the brush strokes. These are teaching tools that even a few years ago could barely have been imagined. Experts in learning media predict that in 5-10 years augmented reality will be a very prolific education tool, with widespread application. Its power and compelling interest will certainly have students wanting to go on-line and demonstrate it to parents, relatives and friends outside school.

Yet sadly, bandwidth today is a huge constraint. As one local educational leader lamented when interviewed for this study – "Open Google Earth in many schools and the entire school network grinds to a halt."

One visionary interviewed for this Report reflected on a recent project on global climate change. Schools from around the world participated over a 24 hour period, each coming on-line as the project arrived in their time zone. Students were required to gather data in real time based on questions that arose during the project. One example was a question about how climate change was impacting indigenous communities – this had New Zealand students scrambling to assess what was going on in low-lying Pacific islands, looking at changing patterns of population within New Zealand, and examining migration trends.

Touch technology has huge implications. Students will use big screens to collaborate in teams, constructing knowledge and understanding.

Modern multimedia applications are becoming almost unlimited in scope. Emerging technologies will continue to add to both the compelling need for connectivity and the number of connection points. One example is electronic wallpaper or the "living wall" which effectively separates the device from the screen and turns almost any surface into a giant throw-away screen - potentially this can transform the classroom into a completely different environment as a vehicle to teach and learn.

Simulation offers another application of multimedia. Conducting marginal chemistry experiments on-line until the chemistry lab is virtually blown up is an activity far more enticing than doing the same experiment in real life under strict cautionary supervision.

Diverse on-line multimedia applications have enormous potential to teach students the ever-increasing amount of knowledge required to be a modern citizen, in interesting and enticing ways. It will be an ever-increasing driver of demand for fast Internet, especially at school but also at home and other places that students frequent.

9 Social Networking

Social networking is a pervasive driver of the social world in which the 21st century student lives. Schools can neither ignore it nor regard it as an irrelevancy – they must embrace it and use it as another weapon in the electronic armoury that supports modern day education.

Teachers generally recognise the potential of social networking. Many would like to use it more, but feel constrained by lack of connectivity. High speed broadband will remove this constraint.

Many schools already use social networking as a key element of their teaching and communication with students. Many have extensive blogs, written by students, updated hour by hour. Many more encourage their students to use social networking sites such as Facebook to collaborate in homework and school activities.

This network of student communication enables parents and care givers to take an active part in their children's education, monitoring it on-line and proffering comments. Children get vastly more feedback as a result, from parents, relatives, friends, and teachers. Potentially the children in the lower-decile areas have the most to gain from this process, which can help to engage their parents in school activities also.

10 Video

Video is becoming ubiquitous. Arguably the world is moving towards a state in which audio communication without pictures will be as out-dated as watching a black and white movie.

Young people are leading that change. Schools are in the midst of it. They cannot slow it down – and why would they, given the power of the picture as a teaching and learning aid?

An obvious and easy example is the making of video content by school classes. Numerous schools post video content on the Web every school day. A YouTube search on "school New Zealand" leads to more than 50,000 video clips, mostly posted by school classes, while many thousands more can be found among the Web sites and blogs of hundreds of leading schools as diverse in style and decile as Point England, Kristen, Tawa Intermediate and Whakarongo. Moving pictures have become the 21st century communication form of choice.

Interactive video, including multicasting and VoIP, has limitless use in classrooms. Already it is in daily use in many schools for calling in international experts, remote teaching of specialist subjects, and virtual access to sites with access limitations such as factories, plus teaching techniques of film production and similar creativity.

Language teaching offers a considerable growing potential for video, due to the ability to communicate body language and settings in a way that sound alone cannot. Students can observe and communicate with native speakers in other cultures, face to face with high definition, not only in a classroom but as part of their daily lives with their families. The same facility can be offered in reverse with, for example, an overseas language student participating virtually in the dinner table conversation of an ordinary New Zealand family. The shortage of Te Reo teachers in the South Island is another example of a problem that can be redressed on-line.

11 Implications for Residential Connectivity

Learning in the 21st century has ceased being confined to a school day of 9am to 3pm. Learning is becoming an on-going, blended activity that takes place throughout the waking hours. It happens at school, at home, in study centres, in school buses, at friends' homes and numerous other places.

It follows that as fast connectivity becomes more widely available in schools, students will need equivalent access at home. Parents will come under pressure to provide it, perhaps at the expense of some other item of discretionary expenditure such as pay TV. This increase in demand and need for high bandwidth may halt or reverse the slow trend for homes to exist solely on mobile phones and forego a fixed line. Failing that, children in such homes may be forced to go somewhere else to study such as a friend's home, library, or study centre.

Internet service providers in New Zealand have discovered that upgrading a school's connectivity can lead quickly to greater demand for better broadband plans from surrounding homes.

In turn, the added connectivity at home driven by the needs of children's schooling will result in more parents using it for personal and work applications, building further on the demand. Their

visibility of the material the children are accessing over their school network may provide a greater stimulus to adult education, while also enabling monitoring of their children's work. Potentially over time, this may do away with the traditional 6-monthly, 5 minute parent-teacher interview in favour of reporting and contact in a timely way, on-line, as and when needed.

Once most or all students have ultra-fast access at home, schools will be able to set bandwidth-hungry assignments which require students to research video and other content in evenings. There will rarely be a night when a student does not go on-line to do something. That trend alone has a major impact on the demand for residential bandwidth through the Ultra-Fast Broadband and Rural Broadband Initiative.

The trend to blended learning affects not only the places from which students go on-line, but also the time of day. Whether desirable or not, many students claim to stay on-line frequently until well after midnight. An example of such changing patterns is the education site Te Kete Ipurangi www.tki.org.nz where the workload is increasing exponentially overall but especially during school lunch breaks and early evening. Student maths site Mathletics reports its heaviest demand to be not in school hours, but between 5pm and 6pm.

Some experts predict that schools will need to re-structure the school day. Instead of the customary break into a series of periods with a five minute gap between, the gaps will need to lengthen to perhaps 20 minutes so that students can go on-line to access what they need from the Internet.

The aftermath of the Christchurch earthquakes is providing a useful illustration of what can be done. Schools are being operated in double shifts, with many students finishing the school day at 1pm to free up their premises for a second shift. Many of these students go on to study centres where they continue learning, but the situation puts extreme pressure on many students and especially those who are studying for important exams. It is notable that the Web site "Studyit" designed to assist students preparing for NCEA exams, suddenly has four Christchurch schools among its top fifteen users.

In summary, an important driver of demand for fast Internet will be residential customers motivated to upgrade by the need for their students to have speeds at home matching those at school. It is difficult to quantify the extent of this demand, but the most likely household candidates will be those where there is currently insufficient bandwidth to run video in a satisfactory way, or where multiple users compete for bandwidth at busy times of day.

12 Implications for School Infrastructure

Over the years a huge effort has gone into providing schools with computers and in-school networks. A 2009 survey showed that nearly all schools had some form of network, with computers in most classrooms – averaging about one computer for every four primary or three secondary students. Decentralised decision making has led to school networks varying considerably in structure, cost, financial model and adequacy. In many cases the network management has been the responsibility of a teacher or other individual who is at the outer end of their technical capability and/or time availability.

The next stage of demand will be more sophisticated, and any systems failure will become much more disruptive. The typical school of tomorrow will need Wi-Fi networks for student connectivity all day, wired infrastructure for multi-media applications in each classroom, video production suites, cameras, editing equipment, video conferencing facilities, and staff trained and capable to run each of these elements. The infrastructure needed will be much more diverse and sophisticated than today's typical medium-sized businesses.

Already many schools are groaning under the burden of keeping their networks going, often under the guidance of a staff member who was recruited for an entirely different purpose. Some networks are almost at the point of collapse. Even those who contract out their network management to specialist vendors sometimes find the technicians on offer are at the limits of their capability. This situation is unsustainable in the context of the present requirements, let alone future ones.

Looking ahead, the question is what role the school network will play in an environment where government-funded fibre connectivity with unlimited bandwidth is available.

There is a popular view that schools will all move to Cloud computing, where software and data are held at a secure remote location instead of on school servers. Cloud computing has the advantage that servicing and support can be consolidated at the remote location, with a common help desk and service centre filling the needs of hundreds of schools. Each school would still require local resource to deal with its wireless system and local issues, but this would be much more limited and could be achieved in some cases on a part time basis or by a commercial contractor. The first examples of schools using the cloud are emerging, and experts predict in 3 to years most or all New Zealand schools will be using a cloud environment.

Effectively the time is approaching quickly for all schools to decide whether they will be a "hardware school" investing heavily in servers and related infrastructure, or a "Web school" investing mostly in Internet access. Neither answer will remove their medium-term need to provide both wireless infrastructure for on-going use by students and teachers, and wired connectivity and infrastructure for multimedia. However, if they select the "Web school" route the current battery of servers will disappear, along with the on-site servicing needs that accompany it.

A very important benefit of cloud computing is security. After the earthquakes, Christchurch schools that had their data stored or backed up off site proved to be far quicker to get up and running than those schools reliant on a bank of servers within the school.

13 School Bandwidth Requirements

Just how much bandwidth each school will require as these developments mature, and how that will change over time subsequently, has yet to be determined. In the UK, experience over recent years has been that the school bandwidth demand doubles every 18 months, yet the UK is arguably behind New Zealand in implementation. In Scotland, users of the "GLOW" network bemoan that major school networks crash when as few as 30 YouTube clips are running concurrently.

Some sector leaders here in New Zealand believe the current bandwidth being provisioned within the UFB will be too little even before it is rolled out. International experience is that in schools

demand will expand over time to meet supply, but it is unrealistic to expect that demand will reach its full potential from the very outset. Several leaders interviewed for this report expressed concern that the UFB bandwidth settings are insufficiently ambitious.

At the heart of the "how much" debate is the philosophical argument about metering. Once fibre is installed, the marginal cost of additional bandwidth as a proportion of the total cost is relatively minor. Yet unfortunately, the telecommunications sector has a practice of treating any increase in bandwidth as a major income-generation opportunity. This is yesterday's perspective – as Internet luminary David Isenberg wrote in the 1990s, we need to move from managing bandwidth scarcity to creating bandwidth abundance.

There is a clear need for a debate about how much bandwidth schools will need per capita over what timeframe, so that any adjustment to the UFB provisions can be addressed early on. Schools, more than any other users, should be ahead of the game and not trailing behind. "Project PROBE" several years ago demonstrated how the demand can escalate even while the building is in progress, and it is important to learn from that experience.

In the early stages the bandwidth requirements will be a function of several parameters. These will include the number of students and teachers, the school's policy on BYOD, the students' requirement for connectivity during school time, teaching practices, and the desire for multimedia uses. It should be possible to develop a simple formula to calculate the current requirements and future trajectory, based on the experiences of other schools and input from the teachers.

14 Schools as Broadband Vendors

Several people interviewed during the writing of this study raised the idea that schools could play a useful role as conduits to encourage and facilitate the connecting of their wider school communities to the UFB and RBI. Effectively the local school could become the centre of a broad-based digital community.

Already an example exists in east Auckland where Point England and several neighbouring schools have constructed a wireless network around their community enabling students to log onto their school network from home. This innovative approach has caused others to reflect on whether schools could take a useful leadership role in bulk-buying connectivity and making it available for their entire school community, or simply selling on commission. This has the potential to increase uptake of UFB in the early stages. Such an arrangement might, for example, provide for bandwidth between the home and school network to be free, and all other traffic be at a commercial rate.

The "school as a vendor" concept could have special merit in communities which were densely populated and less affluent, encouraging uptake by segments of the population who, due to financial constraints or age, are least likely to sign up without some encouragement.

There would be obstacles to overcome. Legal constraints inhibit schools from entering commercial deals at present, and those connected to the KAREN network might need to consider the acceptable usage policies if they were carrying non-school traffic. None of these factors should be insurmountable.

15 Funding

Clearly while the transition to a fully on-line school promises a better-educated population leading to massive economic and social benefits, it comes initially at a very high cost to schools and parents. Therefore, it is crucial to recognise the extent of cost savings elsewhere in the community.

The Internet, over a relatively short timeframe, is likely to replace many of the expensive text books that parents are required to purchase or borrow. In Korea for example, education leaders have announced that all text books will be gone by 2015. Similarly Google is effectively replacing the traditional dictionary, thesaurus and encyclopaedia. Collectively these cost savings over time will go a long way to offset the cost to parents of providing an iPad with a 3 year lifespan.

School libraries will be impacted by reduced use of printed text books. They are likely to focus more on recreational reading material. If so, the question has to be asked why school libraries and public libraries still need to be separate – a significant cost-saving to the community could arise.

"South Korea Ministry of Education, Science, and Technology announced that the country is planning on making a transition to digital textbooks using tablet PCs. ALL textbooks for ALL grades and ALL classes will be converted to digital format. Tablet PCs (model not specified) will be used to run these textbooks via cloud storage system. They also added that school buildings will get Wi-Fi, which is essential if they are incorporating cloud storage. During the transition process, both digital and paper textbooks will be used.

"There are some prerequisite systems before this can come true. First of all, if they want to incorporate cloud system, ridiculous amount of bandwidth and humungous server must be prepared. I'm sure they can get it ready. Although surprisingly un-universal in the software field, South Korea hosts one of the world's finest high-speed Internets. Especially in the capital, Seoul, state-of-the-art internet speed and Wi-Fi availability runs through the city. It won't be very difficult to install necessary hardware."
http://technorati.com/technology/article/south-korea-to-convert-to-digital/#ixzz1StQm9g7w

The practice of students bringing devices to school should reduce the pressure on schools to provide more and more personal computers. There will still be a requirement to do so for shared use, but this will be confined to multimedia and other complex uses, and for students who for whatever reason are unable to bring their own devices.

As schools make the inevitable transition to more use of cloud computing with centralised service centres and help desks, economies of scale should impact positively on school budgets. In addition the greater consolidation of buying power will make the sector a much more enticing target for ICT service vendors, reducing the cost of sales. Some of the savings will be passed through to schools.

Daunting though the costs may seem at first glance – to the government, schools and parents – these figures need to be seen in a much broader perspective. There may be value in some cost modelling being carried out to ascertain the extent of new costs and savings, with a view to seeing how the impact of the two can be realigned or offset against each other to the best effect. This can be done effectively only when we have a well-articulated vision of what New Zealand schools will look like in a decade with full broadband-enablement.

16 Teacher Education and Professional Development

Teachers have made tremendous ground in re-training themselves for the ICT era, supported by government and a range of external agencies. Interviewees were fulsome in their praise. One interviewee described New Zealand teachers as "leading edge in getting to grips with the technology."

Despite being a relatively aging profession, there is little evidence that the age of teachers has any bearing on their ICT-readiness. The character of the school at which they teach and the leadership provided are far more important factors. Overall, the readiness of the teaching fraternity does not appear to be a constraint on ICT usage.

However, there is a big one-off time commitment for teachers to make the change. It takes a lot more effort for a teacher to redesign a lesson around digital content, than to haul out their notes from last year and repeat it. This is especially true where the school environment for ICT is less supportive.

It is really important to get the "digital natives" running New Zealand's classrooms. This means that principals need to step up and embrace the transition to e-learning as a key performance indicator. Maybe the ICT-preparedness of the school, technologically and culturally, should form a defined part of ERO reports.

> *"Once upon a time what would have happened is that you have had a facilitator come along. They would have sat down beside you and talked you through the step and you would have written notes and played around and then probably forgotten it all or given up. Now there are lots and lots of different sites available which basically have got video, you work through, you can stop, you can pause, you can rewind if you don't quite understand, you can do it at your own pace, you can still talk to a knowledgeable person from your staff but you can actually sit there and teach yourself. And if you have that drive and ambition and you want to do this stuff then there are resources out there." - Interviewee*

One area that arose repeatedly as a serious concern in the interviews was the perception that our colleges of education are many years behind the times in teaching the teachers. As one participant expressed it – "the way universities are teaching is essentially the same as 80 years ago, but the young people in front of the teacher are from a different paradigm." Others noted the very low key nature of the training institutions – they rarely speak at professional events, nor take an intellectual lead in the sector. Allegedly today's graduates know the pedagogy, but have little concept of modern e-learning practices. There is doubt whether the training institutions themselves are using the technology.

If that is a fair reflection, it is alarming. Student teachers of today will still be teaching in 2050, yet allegedly they are being taught using 1950s practices. Action is needed to better align "teachers of teachers" with modern classroom realities.

17 Remote Teaching

E-learning and UFB will offer a major boost to the viability of schools with relatively small rolls, which struggle to make up viable numbers in some age groups or to offer a satisfactory range of subjects. Over time this may impact on school business models, especially in remote areas, by enabling the concept of "one school, many sites" where teachers take classes comprising several sites connected by video links and smart boards. Such a development would have a stimulating effect on not only the schools concerned, but on their entire communities.

Newfoundland in Canada offers a good case study. Remote fishing areas faced the problem of many small schools with low numbers. In conjunction with broadband they introduced C-Teachers, E-Teachers and M-Teachers. A C-Teacher is a traditional classroom teacher - physically present in a classroom and available for learning support. An E-Teacher is the Expert or Electronically-Enabled teacher, who generally teaches a specialist subject, providing tutorials and lectures on-line. The M-Teacher is the Moderator, Mediator, and Manager - someone who has a special engagement, whose expertise is actually in understanding the process of learning and thinking, and who can moderate and manage that process. Newfoundland has enshrined all that in law. It creates a lateral career path so they don't all have to aspire to become a principal.

Notwithstanding the OECD Six Scenarios (refer Section 3) there will always be an institution called "school" because there is a social and economic function as well as an educational one. Society expects children to be safely in school at certain times of the day. Yet schools can operate in many different ways. For example, if a school in a small community wants to offer a course in Russian, this can be done on-line, by multi-cell video conference, with native speakers at hand, and not necessarily during core school hours. Likewise the potential to make Maori language teaching available universally – world-wide as well as across New Zealand – becomes far more real with the e-school.

The opportunity to avoid smaller, remote schools closing, or to build new country schools as a result of the renewed viability of small schools, presents significant opportunities for regional development and a reversal of "urban drift." Underprivileged Maori-dominant communities such as Northland and the East Coast stand to benefit disproportionately, There is potential for further study in this aspect to explore ways these changes might be harnessed to build stability into schools that are threatened by falling numbers, and reduce costs to the education system overall.

18 National Leadership

Self-governing schools to the extent that New Zealand has embraced are unusual by world standards. In terms of the move to connected schools, the model has had both advantages and disadvantages.

The positive aspect has been to foster innovation during the early years of ICT. Schools have been free to experiment with a wide variety of ICT-based models in teaching practice, teacher training, connectivity and infrastructure. Schools have attempted, with a fair degree of success, to trade off the tensions and meet the specific needs of their disparate communities. There have been successes and failures, but the net outcome is that New Zealand now has a very broad understanding of what has worked and what has not.

The negative aspect has been to leave individual schools somewhat isolated at a time of these fundamental changes that affect every element of school management and practice. The financial demands in particular, have been challenging. Yet without this requirement for self-sufficiency it is arguable that innovative solutions such as the sponsorship at Point England might never have arisen.

People interviewed for this Study were complimentary about some of the leadership initiatives taken by the Ministry of Education in the early days of ICT. In particular the Laptops for Teachers programme, some of the early leadership in professional development for teachers, and the Microsoft licenses for all schools are seen as being high quality policy moves that hit the mark and accelerated progress. The new Network for Learning or "N4L" announced late in 2011 also seems likely to get a warm reception from educational leaders.

However, a common theme from the interviewees was that in recent years the Ministry's role seems to have declined. The uncertainties are now reducing and the way ahead seems clearer than it has in the past. As a result, there appears to be a general desire for the Ministry to provide a greater level of strategic leadership. As one interviewee put it "the Ministry seems to be running a different agenda to the schools and the schools are racing way ahead."

At the time of writing, several key questions about future government policy are awaiting resolution. Hopefully these will be clarified in the coming months.

By consolidating the demand for infrastructure, devices and services, nationally or regionally, the Ministry could make the sector more attractive to vendors and less costly to service. What vendor wants to provide services to an impoverished school with poor quality, underperforming infrastructure and a one-off architecture and business model?

In addition the Ministry could provide very good value by proffering advice and/or direction on issues such as the future shape of school networks and infrastructure, business models, funding options and technical training.

Perhaps the most glaring gap is of a national strategic blueprint for ICT in schools. There needs to be a clear determination that New Zealand is not going to waste this amazing leap in technology just to use it to do the same old things. Leadership is needed to inspire and encourage teachers to commit to professional development, showcasing leading performers as a "carrot" for the laggards. Leadership is also needed to educate parents about what the new technology means to them, and communicate the role of the on-line school in improving educational outcomes for the New Zealanders of the future. That kind of encouragement will ensure that the UFB reaches its maximum potential quickly, changing the relative standing in the world, first of New Zealand's education system, and then of our economy.

Finland and Australia are examples of countries which appear to have a national direction for the technology-enabled school that is much more widely understood than in New Zealand. There is a lot we could learn from both countries.

19 Questions to Ponder

1 Does the education sector as a whole share a common vision of what primary and secondary schools will be like once broadband availability ceases to be a constraint? If not does this matter? And whose role is it to develop such a vision – the government, teachers, schools themselves, or someone else?

2 Are we making best use of the visionaries and luminaries in the sector? Is there a forum where they can congregate, and make useful formal input? If not, should one by established, and whose role is this?

3 Should there be a national resource centre and focal point for the evolution of ICT in schools? If so, where should it reside – a government agency, a university, the Correspondence School, a private research institution, or somewhere else? Who should take the initiative to make this happen?

4 What specific steps should be taken to fast-track the levelling impact of ICT to make a step-change in educational outcomes for underprivileged and isolated Maori and Pacifica communities?

5 Is the amount of bandwidth provided for in the UFB adequate for the medium term future? How can this be determined? If not, who should act to deal with the issue?

6 What is needed to make the introduction of Ultra-Fast Broadband into our schools, to make a step change in the quality of primary and secondary schooling to the economic and social benefit of future generations?

7 Can New Zealand become a global centre of excellence in creating on-line teaching resources for schools across the English-speaking world? How? What are the first steps?

20 Conclusion

New Zealand is neither a world leader nor a laggard in the introduction of ICT to schools. However, our actions over the next five years will determine whether we use ultra-fast broadband to improve our relative position in education, and thus our economic position, or allow other countries to overtake.

Although there are actions the government can and probably should take to stimulate demand, the best outcome would be for uptake to be driven by a strong competitive retail market within the ultra-fast broadband network. There are opportunities for novel marketing strategies which bring together the connectivity, devices, services and skills required for New Zealand to utilise this investment to the maximum extent.

The one factor that seems unlikely to be a constraint is latent demand. This does not mean at any price – neither schools nor their students have unlimited resources. But with innovative bundling and marketing, it should be very easy for a competitive retail industry to deliver competitive and highly attractive offers to schools, their students and school communities.

This Report has been designed to assist the telecommunications industry understand the character of the demand from primary and secondary schools over the coming years, so that they can provide appropriate services and market bundles. Hopefully it will make a useful contribution.

APPENDIX A

List of Interviewees

Discussions with many people, insights gained form numerous conference presentations and much reading has provided the raw material for this report. However, a number of experts in New Zealand took time out to be interviewed specifically for the purpose. Appreciation is expressed to them, as follows:

Howard Baldwin, Ministry of Education

Matt Boswick and Kurt Rogers, Alcatel Lucent

Yvonne Blanche, Mathletics

Shelley Bremner, Thornton School

Russell Burt and Dorothy Burt, Point England School

David Copeland and Jill Wilson, CWA New Media

Dr John Langley, Cognition Education

Margaret McLeod, Ministry of Education

Stuart Middleton, Manukau Institute of Technology

Carol Moffatt, CORE Education

Charles Newton, Education Consultant

Kate Shevland, Orewa College

Derek Wenmoth, CORE Education

Laurence Zwimpfer, 2020 Communications Trust

APPENDIX B

Uruguay – a Case Study

Uruguay may seem an unlikely country to boast of having a world first, every primary and secondary school student with a government-provided laptop to take to school. Yet this has not only been achieved, but completed within 3 years on a sustainable basis.

Reaction to this insight at the recent Association for Learning and Technology in Leeds was almost universally "if Uruguay can do it, why not the UK or USA?" I say "why not New Zealand?"

Uruguay is a small country with a population of 3.5 million (NZ has 4.2 million.) Its per capita GDP is US$10,000 (NZ is about US$30,000). Like us, it is a significant agricultural producer.

The initiative, known as "Plan Ceibal" started in 2007 under the personal leadership of the country's President. It was established to promote social and digital inclusion for more and better access to education and culture for the whole of Uruguayan society, but with special focus on children. Among many other goals was the intent that every child and teacher has a laptop with wireless connection both inside and outside the classroom. It has embraced connectivity both to schools and their wider environments. Support was gained from two US-based charities focused on "one laptop per child."

Public reaction at the time was sceptical – people thought that it was unachievable. Yet three years later the Plan had delivered 450,000 laptops covering the country's entire primary and secondary school population. Practically all schools are on-line. Indeed, there are a number of schools that have high quality Internet access but do not have electricity. A programme to upgrade all schools to fibre is starting this year.

Plan Ceibal has three pillars – equality, learning and technology. The challenges were the same as those faced everywhere as education has moved into the digital age, with the initial fear by teachers of the changes being the hardest barrier to overcome. However, teachers came to recognise that the relationship with students doesn't change just because in many instances the students know more than the teacher.

The government has assessed the life span of a laptop as 4 years, and has budgeted for replacement over that cycle. The total cost of ownership over 4 years is US$400.

The impacts have been seen in many areas. Social equality has been improved and student self-esteem enhanced. There has been a significant increase in Internet use at home, with parents becoming more involved and up skilling themselves. Children are watching considerably less television. The average time the students use the laptops at school is 4-5 hours out of the 20 hour school week. Ubiquitous access has allowed teachers to utilise the wide range of learning tools available globally including Wikis, and social media.

The government is now looking to provide a secure, nationwide Wi-Fi network. This will lead to on-line vocational training, new applications in agriculture.

An important side-effect has been that the school has become the centre of each community in a way that did not happen previously. Adult education has increased markedly with the school as the focal point.

Important advice from the project is to make sure the implementation is governed by education professionals including teachers, and not by software vendors. The technology should be made to fit the pedagogy and teaching practice, not the other way around. The outcome should be an easier life for the teacher, not a more difficult one.