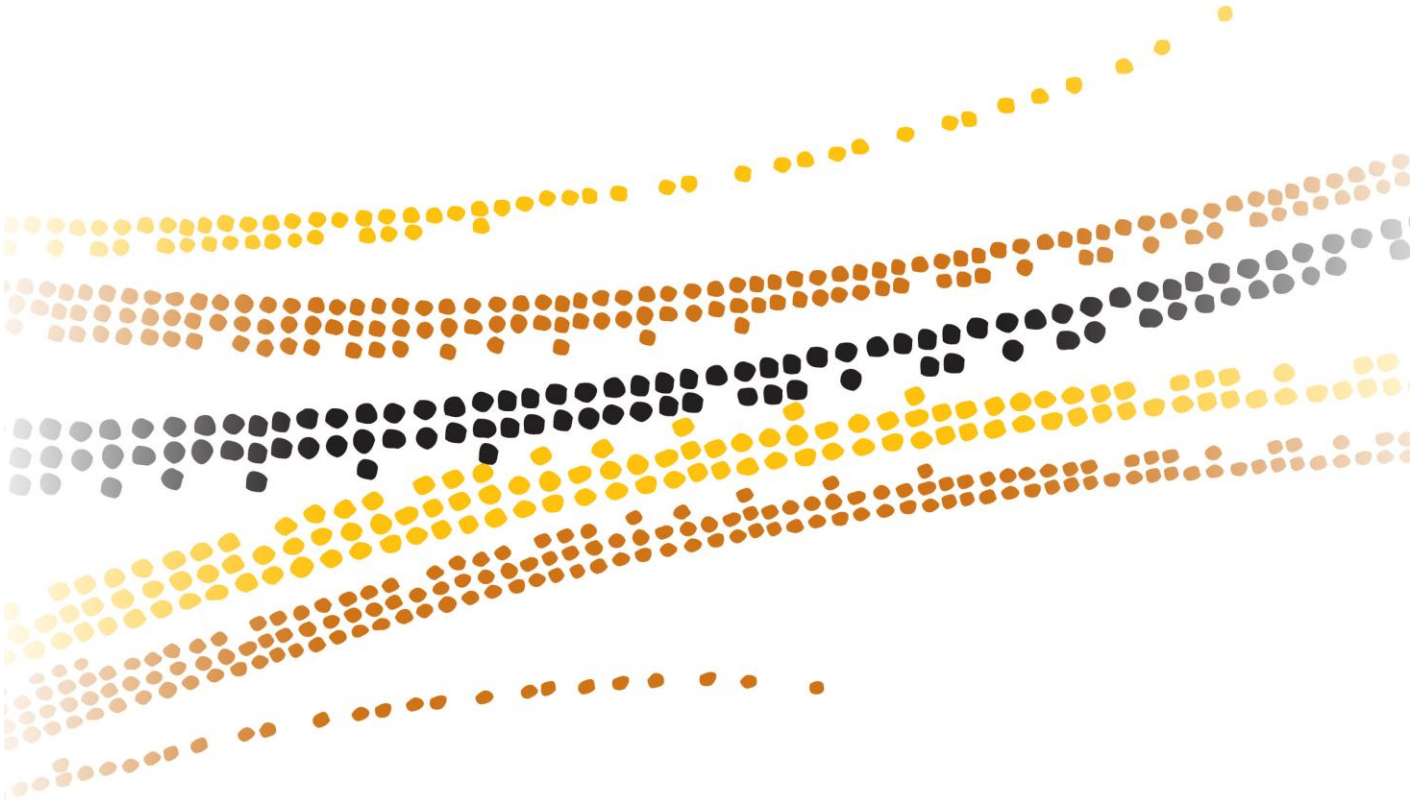
Centre for Appropriate Technology

Home Internet for Remote Indigenous Communities

Technical Progress Report

Author: Andrew Crouch

June 2012



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The Centre for Appropriate Technology (CAT) is the national Indigenous science and technology organisation. CAT's vision is Happy and Safe communities of Indigenous peoples and its purpose is to secure sustainable livelihoods through appropriate technology. CAT is currently funded from a variety of sources including the Commonwealth and State and Territory governments and private sources.

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1. Introduction

The Home Internet Project is a joint project between the Centre for Appropriate Technology (CAT), the Centre of Excellence for Creative Industries through the Swinburne University Institute for Social Research, and the Central Land Council.

The project is focussed on three central Australian outstation communities: Kwale Kwale (40km west of Alice Springs), Mungalawurru (80km northwest of Tennant Creek) and Imangara (200km southeast of Tennant Creek).

The three year project is structured in three phases:

- A baseline study (this phase was completed in 2011, and the associated report[1] can be found at http://www.icat.org.au/media/media/accan%20final%20report.pdf).
- An implementation phase that includes the provision of computing and Internet access facilities in community homes, and ongoing training and technical support for the residents. A total of 20 computers and associated satellite services connecting all computers to the Internet have been installed in the three communities, 4 computers in Kwale Kwale, 5 in Mungalawurru, and 11 in Imangara.
- A longitudinal research phase monitoring the ongoing use of the facilities

CAT is the lead organisation for the implementation phase, and is an active partner in the baseline and longitudinal research phases.

The Home Internet Project was conceived with dual and complementary goals, on one hand to provide tangible benefits to the communities and residents in which the project was planned to take place, and on the other to use that platform to research the constraints to realising those benefits, in the hope of providing some insights into the path forward for similar activities in other communities and homes. The project partners were conscious when embarking on the project that the current paradigm for the provision of community ICT services in remote communities continued to be one of Government funded support for the 'Community Computing Centre' or 'Internet Café' model, although the mainstream had well and truly moved on from this model towards ubiquitous home computing.

This report summarises our experience with the technical aspects of the project through the planning and implementation phases, and the first 12 months of operation. While the project is relatively small in scale, its characteristics are indicative of the issues that are likely to arise during most implementations. Nevertheless, our experience can only be

[1] Rennie, E, Crouch, A, Wright, A & Thomas, J 2011, *Home Internet for Remote Indigenous Communities*, Australian Communications Consumer Action Network, Sydney.

used as a guide to forming a template for a larger scale (either in terms of community size or number of communities) rollout program.

The report begins by discussing the project objectives in greater detail. It then situates the project within its remote central Australian environmental, technical, human and governmental contexts, and summarises the general requirements that were identified for the implementation project. The body of the report goes on to describe the implementation process in some detail, and our subsequent experience over the first 12 months after commissioning of the facilities, up to the end of June 2012.

2. Project technical objectives

The objectives for the Home Internet Project as a whole are to:

- Identify the cost, technical and social barriers that are contributing to the low use of computers in Indigenous remote Australia
- Improve digital literacy generally in the target communities
- Support livelihood, enterprise and employment initiatives either of individual community members or at community level
- Provide continuity of access to computing and the Internet for post-school aged teenagers to help maintain the skills and knowledge they have gained at school
- Demonstrate good practice models for other communities
- Better inform government policy in regard to the social and learning benefits of funding and promoting home computing and Internet access, compared with the current policy approach of funding shared community facilities

The explicit and implicit technical objectives contained within these broad objectives are to:

- Identify the cost and technical barriers that are contributing to the low use of computers.
- Provide continuity of access to the computing and Internet facilities in the communities for the duration of the project, including technical support and maintenance
- Train residents in the use of applications
- Provide a platform for ongoing research into the use of the computing and Internet access facilities (the longitudinal research phase of the project)

This report is intended in part to identify the barriers, but also to record the experience so far in planning, implementing and maintaining the facilities and assisting in residents' use of them through training, as measures of our success in meeting the broader objectives for the project as a whole.

3. The operating context (geographic and physical environment, existing ICT infrastructure, human factors, policy & regulation)

Key features of the operating context for the project are discussed below.

3.1. The geographic environment

The community in relation to its regional town

The distances between central Australian remote communities and their regional support towns (such as Alice Springs or Tennant Creek) are very large in comparison with most other Australian contexts. While the project communities are 40km (Kwale Kwale), 80km (Mungalawurru) and 200km (Imangara) from their respective centres, even larger distances are the norm. These distances make a major contribution to the cost to residents of travelling to town to shop, access services and for social visits. In a similar way, they define the cost of obtaining commercial support for ICT products and services such as computers, televisions, phones and the range of associated subscription services. Community or station stores at nearer locations (Murray Downs Station adjacent to Imangara, or Ali Curung 30 km away) whose main function is food and clothing supply, offer only a basic level of service, typically sales only, for a limited range of high volume consumer goods.

The regional towns offer services in proportion to their size; Alice Springs (population 27,589 in 2011) has multiple retail outlets for general consumer ICT goods and services such as Harvey Norman, Dick Smith, Target, Kmart, Tandy and specialist stores such as a Telstra shop, and a half dozen shopfront commercial radio communications and office computer networking businesses. Tennant Creek (population 3000) on the other hand has only one shopfront computer business, and sales of domestic ICT goods are made through generalist consumer stores.

Within the community

At a local (community) scale, distances vary from typical suburban scales (houses 30 metres apart) up to a kilometre or more in the larger communities or in exceptional cases for outstations such as Kwale Kwale. Adoption of distribution technologies such as WiFi must take these distances into account, particularly where the intervening terrain or vegetation cover limits line of sight path choices between buildings.

3.2. The physical environment

The desert environment presents a number of challenges to the operation of ICT equipment.

Dust

Most remote communities lack continuous vegetation cover in the proximity of the houses and community buildings, and buildings are not particularly well sealed against airborne dust and grit. Dust storms in these dry areas are quite common. Consequently, dust ingress can be a threat to the operation of computing equipment, particularly printers with exposed paper feed mechanisms.

Heat

Summer ambient temperatures can be high, up to 45 degrees Celsius, and domestic buildings are typically not air conditioned.

Weather

Weather events involving localised heavy rainfall and flooding are relatively common in central Australia, and can occur at any time of year. The impact on the mostly unsurfaced road surfaces and their associated infrastructure often make access to and from communities unpredictable. Road closures commonly prevail for several days and can extend to several weeks in extreme circumstances. Heavy rain and cloud cover can also affect continuity of satellite services or cause errors which have the effect of making services 'run slow'.

Insects and vermin

Termites and ants are prevalent in some areas. These can infest buildings without causing structural damage, selectively entering fixed electrical and electronic installations such as power distribution boards causing interruption to power supplies. Mice may also cause damage by invading exposed equipment and materials such as printers and paper stocks.

Bushfires

Bushfires can be a threat not only to people and buildings, but also to infrastructure and access.

3.3. Electrical supply

Communities rely on a range of different sources for powering ICT and other household electrical equipment.

The project communities use the following types of electrical supply, which are representative of the diversity of power arrangements for remote communities in general in the Northern Territory.

- Connection to the Alice Springs electrical grid.

  Most of the Kwale Kwale houses are connected to the Alice Springs (Power and Water Corporation) electrical grid. These houses are equipped with token-based electricity meters. Bus ticket-sized pre-paid plug in tokens available from town retail outlets are used to provide a metered amount of electricity, typically for a value of $10-30$.

- Solar photo voltaic (pv) systems

  All houses and buildings at Mungalawurru are equipped with a shared un-tariffed reticulated *Bushlight*[2] supplied and maintained solar pv system. Each building has a custom designed smart energy meter, which is programmed to provide continuous feed to an essential circuit (lights and fridge) and a daily quota to a discretionary circuit which includes other general load items such as the computer. A standby diesel generator provides supplementary power for welding and other occasional high loads.

  One of the outlying houses at Kwale Kwale is not grid-connected, and has its own solar photo voltaic (pv) system supplemented by a generator.

- Diesel generator

  All buildings at Imangara are connected to a high capacity diesel generator which is shared with the community school and Murray Downs Station. The generator is maintained by the NT Power & Water Corporation. Some community buildings have conventional post-paid meters, while all houses in the community have the pre-paid type.

All project households are dependent on continuity of power supply for their shared satellite Internet connections, computers and printers. Because the satellite equipment is

[2] *Bushlight* is the trade name for a range of solar photovoltaic electrical energy systems developed, installed and maintained by the Centre for Appropriate Technology to meet the energy needs of remote outstation communities. See http://www.bushlight.org.au/

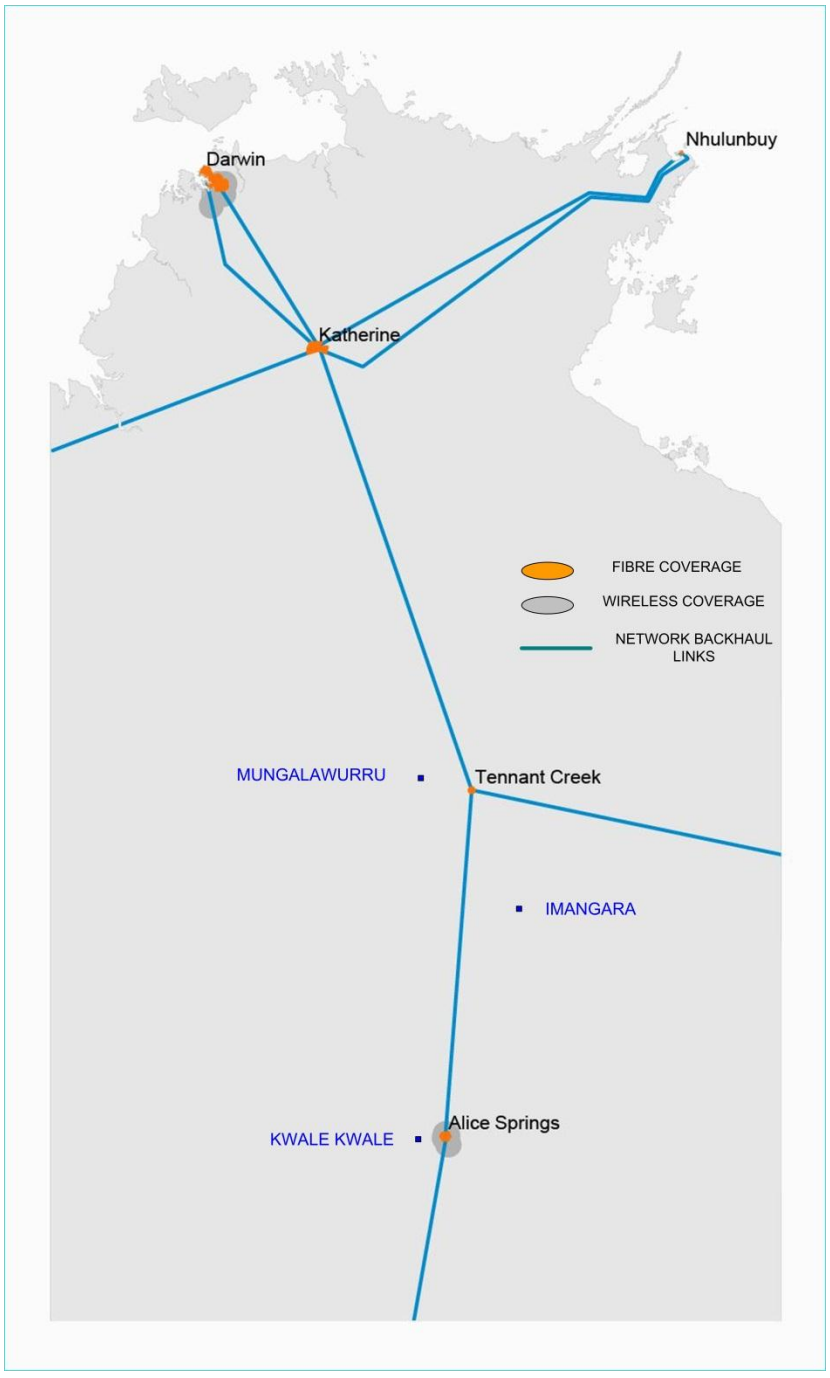
centralised, the cost of electricity for it, although relatively small, is borne by the relevant householder.

3.4. Availability of Internet services (pre- and post– NBN)

Relatively few central Australian communities are served by terrestrial Internet services. None of the project communities has mobile phone coverage, or access to ADSL services. Furthermore, it is unlikely that any of the three will have a terrestrial service option under the National Broadband Network (NBN) – see Figure 1 – Projected NBN service coverage for the Northern Territory overlaid with the project locations.

The remaining Internet connection options are satellite based services, including the current NBN Interim Satellite Service (further described in Section 3.6) and in the future the full NBN satellite service.

Figure 1 – Projected NBN service coverage for the Northern Territory overlaid with Home Internet Project locations



Source: [NBN Co - National Broadband Network - Australia | Coverage maps]

3.5. Human factors and their impact

Human factors can have a significant influence on the operation of any ICT project, and the ones listed below in particular tend to have a more pronounced influence in Indigenous remote communities.

Mobility

Remote community residents move regularly to and from other locations for a great variety of reasons. These include the need to obtain provisions, to access services such as health and education services, and to make social visits. Also, because most such communities (including two of the three project communities) are connected to major roads by long stretches of unsurfaced secondary roads that are vulnerable to rain damage, people must ensure their continued access to shops and other services by moving to town for several days when heavy rain threatens or occurs. Thus it is common for all the members of a household to be away from home overnight or for longer periods.

People may also move house relatively often within the community. The external movements of regular residents can be a factor in this, as are visits from relatives or friends, and the economy of pooling together into a single house to limit heating costs in winter. Community ceremonial business, particularly around the end of the calendar year, can involve mass movement of residents and reduce peoples' interest in engaging in other activities for a number of weeks at a time.

Additionally, people may vacate a particular house (and community) for a period of time following the death of an extended family member. While they may return to the community they usually do not return to that house, but instead occupy a different house.

FINDING

1. **Residents' mobility both to and from the community and within it dictate that ICT configurations need to be as flexible and portable as possible to cope with these variations.**

They also make project management more complex, as residents and custodians may not be present as often or predictably as might suit the project schedule.

Community structure

People are usually aware of project events in general terms, but may perceive them to be of limited interest or relevance to themselves, and the shared authority structures at community level mean that the unit of 'household' rather than 'community' is often a more applicable scale for managing project business. This can affect the feasibility of arrangements for sharing costs between households such as payments for electricity use, and the actual shared use of the computers themselves.

Some community locations and buildings are gender-specific, such as Women's Centres and Single Men's Quarters, although these usages can change over time.

Further examination of human factors

Detailed examination of the impact of human factors on the take up and ongoing use of ICT is beyond the scope of this report, but will be addressed further within the longitudinal research phase of the project.

3.6. Government policy and legislation

A number of government policies have the potential to influence community and household level ICT projects.

Subsidies

The Commonwealth Government offers a subsidised service through the NBN operating company NBNCo for Internet connection in locations that are not served by a 'metro-comparable' Internet service. This Interim Satellite Service (ISS)[3] supersedes Australian Broadband Guarantee (ABG) subsidised services, and has been operational since 1 July 2011. ISS is currently available only to customers who are unable to access a 'metro-comparable' broadband Internet service, as defined by the following key characteristics:

- Access to the Internet at a peak Data Speed of at least 512/128 kbps and 3GB per month usage allowance (with no restrictions within these limits on downloads or uploads or time spent online);

- A price to the End User over three years of no more than $2500 (including GST) including equipment, installation, connection, account establishment, travel costs and ongoing provision of the service; and

- The service provider offering the broadband service can install the service within a reasonable period of time.

ISS is designed to offer a step-change in performance when compared to typical ABG residential satellite services. It provides up to 6 Megabits per second download and 1 Megabits per second upload speeds. ISS will ultimately be superseded by the higher speed full NBN satellite service which is scheduled to begin operation in 2015.

Legislated controls on computer use

[3] Further details are available at NBN Co - National Broadband Network - Australia | NBN Co Interim Satellite Service

The *Northern Territory National Emergency Response Act 2007* (Cth) (the NTER Act), includes a number of requirements related to the control of computers in prescribed areas where these are defined as 'publicly funded', with the aim of preventing the use of such computers to access offensive material. These controls include the requirement to install and maintain a content filter, keep a record of users and access times, and to conduct audits on each computer at six monthly intervals. This Act ceases to have effect on 18 August 2012, but the Commonwealth Government has indicated its intention to replace these computer control measures with a non-legislative measure such that all Commonwealth funding agreements will require funded organizations to take steps to minimize inappropriate use of publicly funded computers.

4. General technical requirements for the implementation project

The starting point for the project was an initial set of discussions with the members of the 20 or so households in total over the three communities. These discussions began as community level discussions, and were followed by further discussions at household level during the baseline phase of the project. Following are the general implementation requirements for the project, based on CAT experience and these discussions with residents. As far as possible, the intent was that the facilities and services selected for the project should be typical of what a household operating independently might choose.

Internet access

As a practical matter, it was considered that the operating cost of individual satellite Internet connections for all households would exceed the available project budget, as well as being difficult to coordinate and manage within the project context. The Internet access requirement was therefore based on the assumption that sharing of each service between multiple households was necessary. A ratio of around 5 households per service was adopted, therefore requiring 4 services in total. This was a practical choice, dictated partly by project funding considerations and partly to provide an approximately equal service levels (speeds and quotas) for all households.

Speed and quota – A combination of speed and data quota that would permit residents to make effective use of a range of common applications (including video) was needed.

For ease of management purposes (both for project management by CAT during the project, and for the residents' benefit after the project), the following features were desirable:

- a simple billing structure for the Internet access account
- shaped services (whereby the bandwidth is restricted once the quota is reached but with no additional charges and billing)

Computer types

The issue of 'desktop or laptop?' was addressed with the residents during the baseline study. It was pointed out that the desktop option might be more sustainable, in that the hardware is less likely to be moved around, dropped and broken, and that the keyboard could be replaced more readily if damaged. On the other hand, it was also pointed out that the laptop offered portability within the house and its surroundings while retaining Internet connectivity, if residents wished to have that option. Residents volunteered that they preferred the larger desktop display and larger and more widely spaced keys for new users.

It was made clear that each household could choose whichever of the two options it preferred. In practice, most households chose the desktop option (see Section 6).

Computing applications

During the baseline study, residents also discussed the computer applications they already had some experience with, and the ones they would like to use. The list of applications included the following:

- Web access for personal business such as shopping, banking and paying bills, finding out information and general web 'surfing'
- Storing, looking at and printing photos
- Email
- Playing computer games
- Downloading and playing music and movies
- Numeracy and literacy applications (e.g. school programs)
- Writing stories

Printing

Colour printing was required, particularly for photo and image printing.

Furniture

In most cases, the existing household furniture did not include a spare table on which the computer and printer could be placed, although seats were readily available. Therefore it was a project requirement to provide a suitable table. This table needed to be compact, given the lack of available unused space in some rooms.

A number of residents asked at an early stage of the discussions whether a cover could be provided to permit the equipment to be secured when they were away from home, or to allow it to be stowed at times when they did not want young kids to use it. The cover therefore needed to be lockable, and large enough to enclose the computer itself and the printer. The table/cover combination was also needed to help protect the equipment from dust, food and mice.

Physical security

Given the number of young children living in or visiting many houses, central equipment such as satellite modems and local area network equipment also needed to be reasonably physically secure.

Training

Residents' existing computer literacy varied greatly. Those who had experienced some exposure at school were generally confident in using such techniques as web browsing, online banking and shopping, and photo printing, but not necessarily a broad range of

applications. Others, particularly those aged over 30, typically had no or very limited skills in any of these areas. Consequently, training in a group setting might not be appropriate - a considerable amount of one-on-one tutoring could be required. Residents did not indicate a consistent preference for the type of training they preferred – some preferred a one-on-one arrangement, others learning together with a single friend, and some in a family or wider group.

5. Technical project management

Selecting (local) suppliers & establishing relationships with them

The implementation project placed some technical demands on the supply and installation of the equipment. These included equipment recommendations appropriate to the physical environment, and the ability to configure a robust WiFi network over each community – including the installation of appropriately dimensioned directional antennas and wireless access points on most houses to cover the distances between them and the satellite access points. The logistics involved in delivering these solutions dictated in turn that the suppliers be as locally based as possible to contain project costs.

Another ingredient for a successful implementation project was that potential suppliers would have some familiarity with the bush environment i.e. that they would have had some experience in installing and supporting ICT equipment in remote communities.

From a project management perspective, the project scope was relatively small; selecting and managing more than one supplier to service the three small similar communities would be unwieldy and create unnecessary work. It was therefore proposed that the commercial relationship be limited to a single supplier of equipment and services. The provision of satellite Internet services was separately managed however, since provision, installation and support of such services is typically a specialist area in its own right.

Clarifying the requirements

A challenge at community level was to confirm the list of participant households, and to make provision for sharing computers in community buildings where the residents preferred that option instead of placing the equipment in their own homes. As noted above, certain decision making tends to be taken on a household level, and reaching consensus on shared arrangements becomes more difficult as community size increases.

Conducting communications from outside the community with individual householders was not workable with a single public or private phone as the only means of direct communication with each of the three communities, and finding residents at home at the time of a particular visit was by no means guaranteed.

FINDING

2. **Face to face discussion and communication is the preferred means of maintaining project management dialog with residents on a project of this type. Communication with one or a few individuals in the community by phone or other means should not be relied on to convey important information to or from all of the residents.**

Another factor affecting the deployment of the facilities was the limited availability of space in some houses and community buildings and the often complex usage and ownership arrangements for such buildings. All interested parties needed to be consulted on these matters, and on any subsequent changes that might be brought about by changes in the residency and usage of individual houses. At Imangara for example, the only potentially available community building was the Women's Centre, and a number of residents had pointed to this as the logical space to house some of the computers for shared use. Part of this building is dedicated for use as an occasional health clinic and the remainder, which was the only suitable space for computers, contains a large kitchen for the preparation of meals for older residents and school children. Building use on the kitchen side is managed by the Barkly Shire Council Nutrition Program. Ownership of this building (and all the Imangara houses) is vested in the NT Government Department of Housing, Local Government and Regional Services (DHLGRS) Remote Housing Unit, although at the time the implementation was taking place, the ownership position was unclear.

The choice of community buildings versus homes to house the combined satellite service infrastructure (dish and modem) and WiFi distribution point, had to take into account a number of factors:

- The technical suitability of the site as a nucleus for the WiFi connected homes in its cluster. Clear line of sight for wireless signals was necessary between the roof of the satellite service / WiFi distribution building, and each of the houses it needed to communicate with
- The availability of reliable 240 volt electrical power, and agreement about who would pay for the electricity to operate the satellite service, and how that cost could be met or shared.
- Eligibility for the government-subsidised satellite services (Refer Section 6) depended on the applicant for the service being an individual resident. Where the satellite service was potentially to be located in a community building owned by a third party rather than that resident, this meant that agreement needed to be reached between the building owner and the subsidy scheme operator (the Commonwealth Government Department of Broadband, Communications and the Digital Economy, or DBCDE) that this was an appropriate and bona fide arrangement.

The options were discussed with residents and other stakeholders before decisions were reached and a senior resident nominated in each case as the applicant. In practice, the solutions varied between communities. At Kwale Kwale, the tall community shed was chosen as the location for the satellite service primarily for technical reasons, because it offered the only practical location with line of sight to the houses for WiFi distribution. It also had its own electricity meter, which meant that sharing the electricity cost would be easier to arrange. Two computers were also placed there as that suited the needs of the residents of the adjacent houses. At Mungalawurru, the Bushlight shed was chosen as the location for the satellite service because electricity for it was unmetered and therefore implicitly shared equally across the community, it was physically secure, and it was also suitably central from a WiFi distribution viewpoint. At Imangara, two satellite services

were required because of the larger number of households, and these needed to be located in buildings spaced apart to ensure line of sight WiFi distribution for all the houses. In the initial discussions with the community members, the houses of senior residents Gilbert Corbett and Linda Dobbs were agreed upon as the satellite service locations. However, after the applications were made, Gilbert and his family decided to relocate to Tennant Creek for personal reasons, which precluded his house from being used. The second choice for the satellite service was the Women's Centre building described above. This building was technically suitable, and the person who was Centre manager at that time agreed to be the applicant. Agreement was ultimately reached between Barkly Shire Council and DBCDE to allow the installation at this site to proceed, although it was subsequently established that DHLGRS are the actual owners.

Keeping residents informed

While the previous point highlights the challenges in obtaining and confirming project information, it was equally important to ensure a flow of information in the other direction. To this end, community meetings supplemented with house visits were held relatively frequently. Visits and meetings were used to raise awareness prior to the baseline study, and again later to announce the receipt of funding to allow the project to proceed.

During and after implementation, similar opportunities were taken to inform residents of progress and to answer their questions.

Impact of community business

Community events can have a major impact on the project. A tragic car accident resulting in the deaths of Imangara residents late in 2011, with the ensuing sorry business and funeral arrangements, meant the postponement of support and research visits for 3 months.

On site preparation

Three categories of preparatory work needed to be carried out on site prior to the main installation work.

The networking supplier first needed to conduct a survey visit to the site, primarily to establish the physical layout for antenna siting purposes, and to examine the wall and roofing structures to determine how to carry out cable penetrations. The surveys typically required about a day per community, and in one case had to be repeated by senior contractor staff at their cost when the first set of information was found to be incomplete.

The second category involved the provision of additional power outlets in some instances, mainly to cater for the networking equipment. This work could only be carried

out by a licensed electrician, usually a sub-contractor to the networking supplier. Because the volume of electrical work onsite was relatively small, the majority of the cost incurred was in travel time. For our project, the locations of computers and printers in the houses themselves were constrained to use existing power outlets, which were reasonably well distributed. However, this may not be typical for remote homes and could become a substantial cost item.

The third category was the installation and commissioning of the satellite Internet equipment. Because this activity was planned independently of the computer and local network installation, it needed to be ordered and scheduled sufficiently in advance of the latter to ensure that the satellite service was guaranteed to be operational when the computers were ready to be installed.

Transfer of ownership

One aim of the project was that at some point the residents would make a decision to take formal ownership of the computer, although they would also be free to choose later not to continue their involvement in the project. The project partners judged that this decision should be made by the families individually when they became sufficiently familiar with the computer, probably after a few months. If and when they decided to take ownership, they would sign an agreement to that effect, and from that point the choice of whether to retain or dispose of the computer and printer would be theirs. The agreement also includes a description of the commitment that the owner is making to take care of the equipment, and that the project team is making to provide ongoing support and training for the duration of the project.

The actual timing of the transfer has also depended in practice on the residents who were nominated as custodians (either by themselves or by other residents) being present consistently in the community over a period of several months, and continuing to be associated over that time with managing the computer. The transfer of ownership or any delay in it occurring has not changed residents' access to the computer or their ability to obtain training or support in any way. In those cases where the custodianship has changed hands or the resident has not continued to be associated with a particular computer, transfer has not yet taken place. To date, the transfer agreement has been signed for 2 of the 4 computers at Kwale Kwale, 4 of the 5 computers at Mungalawurru, and 5 of the 11 computers at Imangara.

6. Technology, equipment and service selection

Internet connection

Satellite Internet service subsidies were available through the Department of Broadband Communications and the Digital Economy's (DBCDE's) Australian Broadband Guarantee (ABG) program[4]. While the download quotas under the ABG plans were typically less than ideal for our shared service configurations, the cost saving was attractive, and performance was comparable to unsubsidised services. Another advantage to ABG customers was that contractual safeguards[5] had been established by the Government as the program funder to ensure that providers met their installation schedule commitments in remote areas, which would be more difficult to enforce in a normal individual contract.

The ABG program offered several choices of Internet Service Provider (ISP). A number of these retail ISPs utilise the same wholesale satellite provider service (the IPStar satellite), but all offered minor variations in plans involving price, peak/off peak quotas and overall monthly quotas. With most plan features being comparable with those of other ISPs, the ABG plans offered by Skymesh included a slightly greater off-peak period and quota for price which was attractive, and consequently this ISP was chosen for all three sites. The plan speed and quota chosen was nominal (i.e. up to) 4Mbps/2Mbps download/upload speed with a 17GB per month (5GB peak/12GB off-peak) quota. The plan was 'shaped' to ensure that once the monthly quota was used up there would be slow speed residual access to the Internet, but no additional charges would accrue.

CAT acted as facilitator with the ABG Government staff, Skymesh and its installation contractors, for the families who were the actual applicants for the services. Skymesh uses a tiered provisioning arrangement, contracting the coordinating role to SkyBridge in Melbourne, who in turn contract the actual installation work to regional firms. For the project communities this was Orion TV Systems, a small Mt Isa based company.

FINDING

3. **The ABG application process described here and its NBN successor involve several steps and choices that are not straightforward for a customer unfamiliar either with broadband services or dealing with a tiered service delivery sequence. The process is further complicated by the limited communications options (usually a single payphone) available for contact to and from a customer in a remote community. For these reasons, the process would need considerable streamlining to obviate the need for external facilitation**.

[4] The ABG program has since been superseded by the NBNCo Interim Satellite Service (ISS). The ISS subsidy and eligibility conditions are substantially the same as those applying under ABG, although the speed performance & quota / price ratio has improved – see Section 3.6.

[5] Safeguards contracted through back to back commercial agreements between each ABG provider and the Commonwealth Government

Local area networking

As discussed earlier, distances between community houses and other buildings were significant in some cases. These distances dictated that a radio solution to interconnecting the local network would be preferable over cable. The latter would require not only repeater hardware but also trenching, the direct cost of which would be prohibitive and in other communities might also incur additional costs for sacred site clearances. Amongst the radio options, standard WiFi technology using Access Points configured with omni-directional antennas is restricted in range to a radius of about 50 metres with line-of-sight visibility, and considerably less if there are obstructions in the signal path. Thus this approach would not be suitable for household connection considering the distances involved. An alternative is to use directional antennas to create point to point radio paths. While a few of these point to point paths require elevated antennas to clear terrain or vegetation obstructions, the majority could be implemented using antennas on short roof- or eave-mounted posts.

The local area WiFi configuration ultimately adopted was therefore a network of point to multipoint links utilising the 5.8GHz WiFi band and radiating from the building with the satellite connection towards the individual houses. Power for each WiFi Access Point transceiver was provided through a Power over Ethernet (PoE) injector connected directly to a 240v outlet (without the need for a plug pack adapter). One satellite connection was provided at Kwale Kwale, one at Mungalawurru, and two at Imangara to service the larger number of households there. In some cases, the point-to-multipoint 'circle' was subdivided into discrete angular sectors each with its own central Access Point transceiver and antenna, to ensure sufficient signal strength over each radio link. The detailed design for this configuration was carried out by the supplier following the site survey.

Connection of additional computing devices

Of growing relevance to computing in remote communities, as elsewhere, is the increasing availability and use by residents of WiFi capable portable computing devices such as smart mobile phones, netbooks or tablet computers.

The configuration described above caters for the Internet connection of the project's household computers, but not for connecting any additional WiFi capable computing devices. In two of the communities (Kwale Kwale and Imangara), an additional standard 2.4GHz WiFi Access Point with omni-directional antenna was provided to cater in a limited way for such devices - in one case for the laptop computer that was provided to one of the households.

While not a primary target for this project, these Access Points can provide for other computers, with the following constraints:

- As noted above, standard WiFi Access Points have limited range. A single such Access Point means that a user has to move their device close to the Access Point to connect to it. Each of the three communities is spread over a much wider area than can be effectively covered by a single Access Point, and this would be typical of most remote communities. Coverage could be increased by introducing more such Access Points, but at the cost of additional equipment.
- Usage controls such as Internet quotas and content filtering can be implemented where needed either individually in the computing device or centrally in the common path to the Internet.

  The individual option using control software in the computing device depends on compatibility of the device's operating system with the control software application, and also a management regime for the device users to enable such applications to be installed – this case by case approach may be overly complex to administer for additional devices and may not even be achievable for some devices, such as mobile devices.

  The central option requires additional hardware and/or software, which can be located on- or off-site, with appropriate configuration of the computing devices themselves.

  Neither of these approaches was deemed appropriate for the specific purpose of managing additional devices for this project, but one or the other would need to be considered if connecting a significant number of additional devices is envisaged in any future implementation. Usage control would require a degree of ongoing oversight, requiring some ICT competence and also authority over the use of the facilities - either at household or community level. Particular aspects to be considered include:
    - Whether responsibility for managing content filtering is deemed by the community to be an individual household responsibility or one for the whole community to address together
    - Any content filtering and monitoring requirements that might be imposed externally
    - Monitoring and controlling the impact of usage by additional devices on the Internet quota available to the core group of users

- Where usage controls are not implemented, a 'blunt instrument' but simple approach to managing additional computers is to allow or disallow access to the standard WiFi Access Point through password control. This approach was adopted for the Home Internet Project, and the password managed by senior community members.

Special arrangements

In one isolated case, a Kwale Kwale householder had installed his own computer and Internet service before the project evolved. His solution utilised a mobile data (NextG) service on the extreme fringe (40km) of the Alice Springs reception area. He had installed his NextG USB 'stick' modem on a pole above the house, connected to the computer with a 6 metre long lead-in cable. This configuration only gave him intermittent connection, and the project subsequently supplied a high gain directional tuned frequency (Yagi) roof mounted antenna which enabled continuous operation.

Server or not??

A technical option for the shared local network was to provide a server to support the local network. Facilities that this could provide include the ability to cache Internet data and reduce the volume of satellite download data, and to provide a centralised content filter and other network management tools. Nevertheless, such a configuration would be onerous to support, would be a further single point of failure, and most importantly, did not represent the type of solution that a householder or even a small community would choose unless, improbably, a community member was capable of and interested in providing the more complex ongoing technical backup that such a solution would entail. Furthermore, conformity with a joint network management structure might not suit the various households in the community, each of which is autonomous except perhaps in needing to meet the requirements of the NTER Act described above.

Consequently, the local network was designed to be server-less, using a (Windows) workgroup structure.

Computer hardware & accessories

In the event, almost all households (the exception being a single laptop at Imangara) chose the desktop computer option.

UPS

Uninterruptable Power Supplies (UPS) were selected for the household computers. These serve to provide protection against power surges in areas more prone to lightning (the two northern tropical locations), and also to provide some minutes of battery backup to cover interruptions to the power supply.

Printers

Printing requirements introduced a number of conflicting considerations. The broad choice was between inkjet and laser/LED technologies. Table 1 summarises the considerations involved.

Table 1 – Characteristics of laser and ink jet printers

Feature	Personal laser/LED printer Characteristics	Inkjet printer Characteristics
Typical purchase price (single function printer)	$400	$100
Power consumption	Low at idle but High when fusing the image	Low at idle and when printing
Heat generation	High (fusing)	Low
Print quality	High	High
Throughput speed	High	Low
Physical characteristics	Large, heavy, robust	Compact, lightweight, low durability
Colour printing	Yes (colour model)	Yes
Aggregate cost per printed colour sheet (excluding capital cost of printer)	Approx 20-40 cents	Approx 20-40 cents

Laser printer technology is inherently less prone to high ambient temperatures than the lower entry cost ink jet technology, since it is designed to cope with the heat generated when the ink is fused or baked onto the paper by a high power, high temperature heating element. Unfortunately however, this function would also cause heat build-up inside the cover which could potentially damage the computer itself. High power consumption is also undesirable in the remote community context. Other factors affecting printer choice are equipment cost and size, both being higher for colour laser printers.

Consequently, we opted for inkjet printers. The ink jet printers chosen for Kwale Kwale were of a more expensive gel type (comparable in price with a personal laser printer). The supplier suggested that these might be less prone to ink dry-out than conventional ink jet printers, although our experience to date has not shown any difference between the two types in this regard.

User applications

The computers were equipped with a licensed Microsoft Office software suite (Windows 7 plus Office Home and Business), which included the Internet Explorer browser and Outlook email client. Several freeware user applications, including Google, Google Earth, Skype, Adobe Flash Player, Adobe Reader and some offline games were also installed.

Support applications

Support applications were also installed on each computer. These included:

- Anti-virus protection (*AVG Free*[6])
- Content filter (*Integard Home*[7])

  The Integard content filter is a stand-alone 'family friendly' filter selected from the NTER approved list, and is representative of the style of filter that a householder would choose. While other options such as a proxy addressed remotely located filter could be implemented, such solutions are more applicable to an institutional configuration such as a school network or community library.

  The Integard content filter offers some additional features, including the ability to distribute the satellite quota for each service evenly across the connected individual computers. All five computers share the overall ISP-managed quota (17GB per month or about 500MB per day), and that quota is subdivided locally using the individual computer content filters to about 100MB per computer per day, to regulate to a degree the amount that each computer takes out of the pool.

Furniture

As discussed above, the typical requirement was for a combined table and cover to house the computer and printer. In a small number of cases (2) the householder required only a table, as they did not normally have kids living in the house, and locking the external doors provided them with adequate security for their needs.

In keeping with the need for compactness, the table top dimensions were limited to 1200mm x 790mm. While more work space around the computer would always be desirable from a user viewpoint, this had to be weighed against the material, production and transport costs, the space available inside the house, and the practicality of installing it.

The table and cover design was prototyped at CAT, and with minor changes was adopted for each of the community houses. Figure 2 shows the design of the table/cover assembly.

[6] AVG Free Antivirus Download
[7] Internet content filter and chat monitor software, Integard

Figure 2 – Computer table and cover assembly

Materials included 35 x 35 x 2 mm square steel tubing for the table frames, 18 mm MDF for the table tops, and 17mm structural ply for the covers. Vents to dissipate heat build-up and cable entry holes in the cover were covered with mesh, so that with the front cover closed, mice could not enter the equipment space.

The tables and covers were fabricated, painted (primer coats) and pre-assembled at the CAT workshops, with some welding of table frames contracted locally in Alice Springs. Depending on the number of tables/covers required at each community, these were either disassembled and delivered in flat pack form, or delivered in assembled form as a single large truckload. The delivery work was carried out by CAT.

Once at the community, help was provided by residents to unload, re-assemble and place the tables inside the houses. In most cases, the residents opted to place the table in the main living room at the front of the house, which is the most spacious room. This room varies in size with the house design, and ranges from about 6 x 4 metres up to about 8 x 5 metres. The majority of the bigger living rooms are sparsely furnished, or not at all, and comfortably accommodate the table and a chair. Some of the smaller ones are tight for space. A minority of residents decided to place the table in a bedroom, where space depended on whether the bedroom was occupied or was a spare room. In one or two cases, the door opening (even the external main door) was less than 800mm, making it

necessary to temporarily remove the door or the computer cover to get the furniture through.

7. Implementation, including sourcing and installation

Scheduling

The procurement sequence and timing for the prime computer and networking equipment implementation for each community is presented in Table 2. In parallel with this program, the application process for each satellite service was initiated at least 3 months prior to the service being needed, to allow the satellite ISP's ordering and logistic processes adequate time. The aim was then to hold over the scheduled satellite installation date until about a fortnight before the networking and computer equipment was due to be installed, to minimise the period where access charges would accrue for dormant services. In practice, the ISP installer's modus operandi was to conduct a sweeping round of multiple installations across the Northern Territory and northern South Australia over a three week period once every few months, so the actual dates were adjusted for best fit with this program.

Table 2 – Procurement sequence and indicative schedule

Request for quotation	week 1
Quotations received	week 3
Order placed for site surveys	week 6
Site surveys	Week 8
Revised final quotation received	week 14
Order placed for equipment	week 15
Equipment in store at supplier	week 17
Equipment configuration	week 18
Transport to site & installation	week 19

The site survey visit, which was costed into the contract, was valuable in giving the contractor an insight into the physical configuration, construction and condition of the buildings which they might otherwise not appreciate from plans and photographs, ultimately saving installation delays later. Site survey visits should be built into any future tender/contract arrangements for similar ICT projects.

Some overlap of the individual programs between multiple communities was an advantage, in reducing the number of individual visits. However, it was found useful to stagger the final installation/commissioning activities to allow sufficient bedding down and initial introductory training for residents in each community immediately after commissioning.

FINDING

4. **A nominal four month implementation timescale for communities of this size seems realistic, although certain activities where large external organisations are involved (such as satellite Internet service procurement through government schemes) may require longer lead times to mesh with their schedules and processes.**

At Kwale Kwale, the supplier had difficulties in sourcing some of the networking equipment, a situation which took them 8 weeks to resolve. Furthermore, when configuration of the computers themselves was begun, it came to light that the supplier had obtained the wrong computer type. This in turn took a further 4 weeks to correct. Consequently, the implementation was delayed by about 3 months overall. On a relatively small scale project like this, there is limited scope for preventing such delays from occurring. In this instance, we contracted another supplier for the subsequent implementations at Mungalawurru and Imangara.

FINDING

5. **Experience with this project highlights the importance of engaging an experienced supplier partner, who has alternative and reliable sources of equipment and can quickly activate them.**

Satellite service installation

Installation of the satellite Internet facilities entailed a brief visit by CAT in conjunction with the Skymesh installation contractors. The work (involving a team of two contractor staff) was completed in about 2 hours in each location. When tested against a broadband mirror test location immediately after installation, the links provided download / upload speeds of 2.9-3.7Mbps / 270-500Kbps respectively. These speeds were close to the maximum download speed for the service, but considerably less than the maximum upload speed.

Figure 3 – Part of Mungalawurru *Bushlight* shelter showing satellite antenna, with central WiFi antennas in the foreground

Pre-configuration of computers off-site to minimise the time spent downloading on-site

Once the equipment had been sourced and delivered to the Alice Springs-based supplier, it was set up in their premises to mimic the community's logical layout. Email, Skype, Windows and content filter accounts were pre-configured and various freeware downloads were carried out by CAT at the supplier's premises to obviate the need to attempt this over the satellite link at the community.

FINDING

6. **Pre-configuring the equipment at an urban location minimises the amount of time required to set up the computers in the individual houses on site, partly because these repetitive tasks can be carried out more efficiently on a single bench top, and also because a higher speed terrestrial Internet connection is available to carry out the download tasks.**

While it would theoretically be possible to make the individual/personalised software configuration work for each computer a supplier task, this would likely require more time in formal documentation than it would save in execution. Also, the task is more or less equivalent to what experienced users would do if they were personalising a new PC for themselves at home for the first time, so it is not normally regarded by suppliers as a supplier task, and would likely be priced accordingly.

Location within the home or other buildings

During the last few weeks before installation, uncertainties arose with regard to some residents' participation in the project. A degree of uncertainty like this in the planning arrangements is to some extent inevitable, given people's mobility, the limited means of communications between the project manager and all the residents (due to the distance and limited number of phones), and the residents' limited understanding of the complexity of the arrangements.

FINDING

7. **It is preferable in a remote community project of this type to make the configuration arrangements and timing as flexible as possible to cope with changes as they occur, and to allow for more face-to-face discussions and site visits than would normally be considered sufficient.**

Installation

For installation, the key work tasks required at each house were:

- the installation of a pole mounted antenna and wireless access point;
- installing lead-in conduit and cabling to the computer location with roof, ceiling, and wall penetrations and cable termination as required
- mounting of the power injector for the wireless access point near the computer
- testing of the WiFi link to the satellite service location
- unloading, unpacking, .installation and testing of the computer and printer and removal of packaging waste

The task sequence is illustrated in Figure 4. The WiFi networking and computer related tasks could be carried out in parallel depending on the number of persons doing the work.

Figure 4 – Installation tasks (per house)

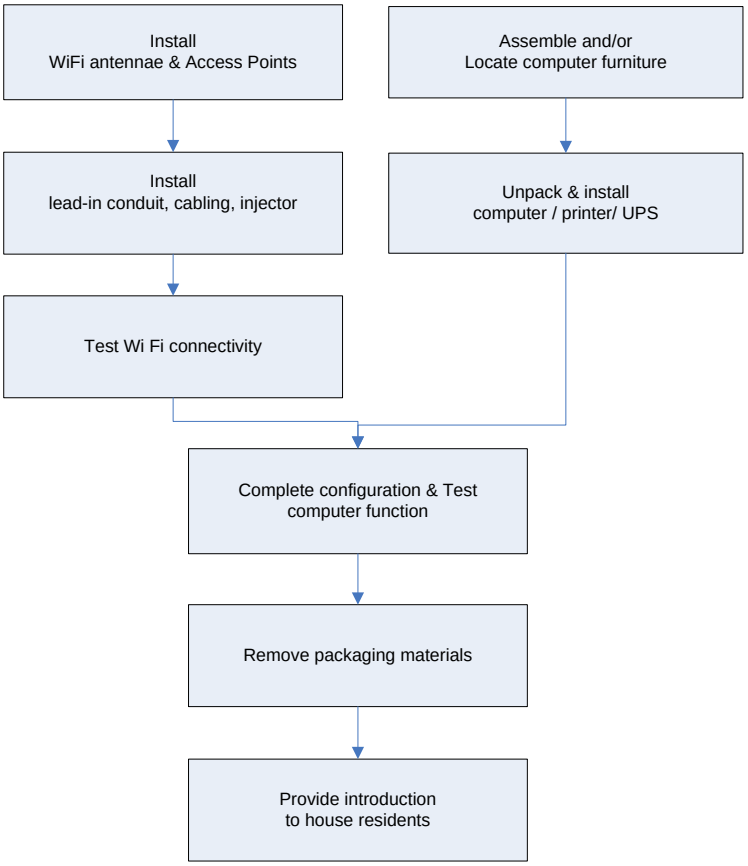


Figure 5 illustrates the volume of packaging material typically remaining after each computer package was unpacked and assembled. This waste, which included significant volumes of plastics such as polystyrene, was removed from site.

Figure 5 – Packaging waste (per house)

A total of 20 computers were installed, comprising 4 at Kwale Kwale, 5 at Mungalawurru and 11 at Imangara.

The actual volume of work on site (excluding training time which was contributed by CAT project staff) is shown in Table 3. The number of work hours per building at Kwale Kwale was greater because:

- two of the buildings required elevated antennas
- one of the buildings housed all of the central equipment and two of the four computers.

Table 3 – Volume of contractor work on site

Community	Total onsite work hours	Number of buildings	Average work hours per building
Kwale Kwale	30	3	10
Mungalawurru	40	6	7
Imangara	60	10	6

Antenna mounting

For the majority of buildings, it was possible to mount the WiFi (local network) antennas on a short vertical pole (typically 500-1500 mm long) either on the roof or eave of the building. However, at Kwale Kwale the hilly and scrub-covered terrain between the houses necessitated the provision of elevated antennas, to provide clear line of sight for the wireless signals. Fortunately, it was possible to mount relatively short and light weight antenna posts onto existing tall structures in each case to reduce the time and cost to mount the antenna. Additional mast stays were not required. Figure 4 shows examples of the antenna mounting arrangements.

Figure 4 – Antenna mounting variations

8. Training and technical support

The time CAT staff spent at each of the visits over the first 9-12 months of operation following implementation of the facilities was shared between providing technical support of the facilities and training of residents in their use of the computer, Internet and various applications. Virtually all of these interactions occurred face to face, and it is difficult at this stage of the project to visualise a subset of these that could be successfully carried out using remote methods of support. With rare exceptions and despite some encouragement, residents have not made much use of the facilities themselves to ask for advice on how to carry out a function or solve a problem, and for those few occasions where this has happened, the explanation or solution has almost always required a presence on site.

FINDING

8. **Support planning and resourcing for a project of this type should assume that most support will require a visit to site, at least for the first year after implementation.**

Average hours spent by CAT staff on training and technical support for the first 9 months after (i.e. not including) the implementation and installation period amounted to about 10 hours per week over the three communities (including travel time) or 7.5 hours per week (excluding travel time).

Training

In most cases, the training has been in the form of a one-on-one and step-by-step tutoring session with a resident who has asked for assistance in learning to use a particular application. Examples of this include accessing the resident's bank account, searching for and browsing websites of particular personal interest, setting up personal email accounts, making Skype calls inside and outside the community, reading and writing emails and managing email accounts, facilitating external email and Skype contacts, accessing music sites, configuring games, accessing You Tube, printing photos and letters, setting up account passwords, explaining Internet quotas, explaining card payment options for online purchase applications, explaining audit requirements, using educational applications, managing online passwords, and downloading applications.

The majority of requests of this nature have come from residents with limited previous computing experience. Younger residents with computing experience from school or elsewhere have been largely self-sufficient with application use, and have only asked for quite specific assistance with problems or more complex tasks within applications, which fall more into the category of technical or application support than the training described above.

The one-on-one tutoring / mentoring method of training appears to be the most practical given the diversity of requests and the range of skill levels amongst the residents, at least for the cohort aged teenage and above where we have had the most experience. The volume of requests arising from residents has continued at a fairly constant level amongst those residents who have maintained an interest in using the computer. Interest amongst a few of the older residents declined once they had some initial exposure and realized that the learning task was perhaps more difficult than they had imagined, or that the perceived benefit to them was not worth the learning effort.

FINDING

9. **Training of residents tends to fall into two categories:**
   - **One-on-one tutoring for residents who have no experience in using particular applications**
   - **Specific assistance with problems or more complex tasks within applications, for younger residents with computing experience from school or elsewhere**

   Over the course of the first year after implementation, the one-on-one tutoring / mentoring method of training has been found to be practical for the cohort aged teenage and above given the diversity of requests and the range of skill levels amongst the residents, and is also favoured by most of these residents over group training.

Technical support

Technical support has been required for a variety of matters, as listed in this section below. Only a few instances have been what might be described as 'show-stoppers' i.e. problems that prevent the resident from using the computer entirely. Where that has occurred due to a fault with the computer processor and in one case the Internet connection (all at Mungalawurru), there has sometimes been another computer available that they could use until repairs were effected. Some other problems such as printer problems with paper feed pickup could be resolved without the need for tools or spare parts or software skills, usually involving cleaning of the working surfaces. Generally, residents were disinclined to attempt to fix these minor mechanical issues themselves, so the problem waited until the next support visit.

In most cases, the resident concerned did not contact CAT about a computer problem prior to us visiting. This meant that:

- in some cases resolution had to wait until a second visit if replacement parts or consumables such as ink cartridges were not carried in sufficient quantity/variety to make good the equipment on the spot

and

- a larger stock of parts and consumables had to be carried.

Liaising with service providers

Account and billing management for the four satellite Internet services was required on occasion. The payment method chosen was a direct debit from a CAT account (as CAT is the funding recipient for this phase of the project), with normal internal approval processes for supplier account set-up and monthly payment.

Tools and materials for support

In most instances, support required only basic mechanical tools (screwdrivers, cordless drill, pliers), a voltmeter for testing the presence of mains voltage at power outlets, and some cleaning materials. A stock of printer cartridges, printer paper, spare printer(s), USB headsets, mice and mouse pads was also required and carried. Spare power tokens also proved useful.

Status reporting

The content filter was configured in all cases to send an email spontaneously to a support email address once on each day that the computer was connected to the Internet. For unexplained technical reasons this function only began to operate at about the end of November 2011. Nevertheless from that time onward these emails gave a useful indication of the degree of activity of each computer (and thus in their prolonged absence whether there might be some kind of problem with that connection), though not the content nor the actual extent of time connected over each day.

9. Experience with the equipment and services

It should be borne in mind that these notes describe the experience over a relatively short period of time (12 months) since the facilities were first placed in service.

Satellite service

The satellite Internet services have remained continuously in operation with few interruptions. Almost all of the interruptions occurred in the first few months at one community, while the residents were coming to terms with the need to keep the pre-paid meter fed continuously in the part of the shed that supplied the modem with power. A satellite modem at Imangara also required powering off and on again on one occasion to restart the link; fortunately this occurred during a support visit.

Actual speed performance at the computer was quite variable, ranging from close to the rated maximum speed at installation time (early morning) to much lower at other times. Each link is nominally designed for a maximum of 4Mbps down / 2Mbps up. Table 5 provides examples of measured speeds. All of these measurements were recorded using the same Internet speed test tool[8] and mirror location. Some measurements were taken before the residents' computers were commissioned, while others were taken afterwards. In the latter cases the test computer may have been competing with other computers for bandwidth; those results do not necessarily reflect the aggregate link speed, but give a reasonable indication of the speed available to each user.

While these low upload speeds may not be a major impediment for applications that rely mainly on download performance, two way real time applications such as video Skype may be affected. Desktop application software suppliers such as Microsoft recommend that 500Kbps should be allocated per video stream[9]. If this criterion were applied, few of the times at which the Table 5 speeds were sampled would have been suitable for videoconferencing.

[8] Ozbroadband speed test: www.oz**speedtest**.com

[9] *Technology Whitepaper - Preparing your network infrastructure for UC collaboration and video deployment* Buckley, D and Anscombe T, Gen-I Australia May 2012

Table 5 – Examples of measured Internet speeds

Location	Date	Time of day	Download speed recorded (Mbps)	Upload speed recorded (Mbps)	Pre/ post commissioning
Kwale Kwale	21/1/2011	0730	3.7	0.3	Pre
Kwale Kwale	5/04/2011	1500	0.3	0.1	Pre
Kwale Kwale	6/04/2011	0920	0.1	0.1	Pre
Kwale Kwale	11/04/2011	1530	0.4	0.1	Post
Kwale Kwale	14/04/2011	1300	0.2	0.2	Post
Kwale Kwale	23/05/2011	1500	0.2	0.2	Post
Mungalawurru	5/06/2011	0720	2.9	0.5	Pre
Mungalawurru	22/06/2011	1235	2.6	0.1	Pre
Imangara	2/08/2011	1500	3.7	0.5	Pre
Imangara	3/08/2011	1750	0.2	0.2	Post
Imangara	4/08/2011	1100	0.8	0.1	Post
Imangara	19/10/2011	1730	0.5	Not recorded	Post
Mungalawurru	1/02/2012	1145	0.8	0.3	Post

FINDING

10. Because of the often quite low Internet speeds (particularly in the upload direction), our view is that the service plan used on the project, while being typical of the higher speed offerings available under ABG, is not well suited to a multi-user situation.

Computers

Of the 20 computers initially installed by early August 2011, failures of other factors meant that on average, 17 computers and Internet connections were fully operational for the 9 months through to end April 2012.

Damage, failures and losses are described in detail in this section under *Repairs or replacements.* In addition, two computers at Kwale Kwale and one at Imangara were taken out of service for about 4 months and 2 months respectively at the residents' request.

Performance of applications

Skype was usable for (non-video) phone calls over the satellite link at some times, while at others speech was corrupted or one way only. Skype performance within the community (i.e. between the local computers) was satisfactory but this mode was only used occasionally as a novelty. For people who were learning to use computers this was not a reliable tool. Other applications such as Google Earth performed acceptably, but given their large consumption of download data, it was easy for a computer to consume its 100MB daily quota in half an hour.

FINDING

11. The performance of applications that are dependent on a reasonable Internet speed or quota for their effective function is variable.

Software options – how flexible (lock down or not)?

The option of 'locking down' the computers so that the configuration or applications could not be changed was not in keeping with the nature of the project, especially considering that after a familiarisation period the aim would be to transfer ownership to the household. The computers were therefore left 'unlocked', except for functions that would require administrator intervention under default Windows rules.

Software settings: updates and upgrades, firewalls

Some default settings were modified to improve the operation of computers in this limited Internet speed environment. These included:

- Turning off Windows updates, which can consume a large proportion of the daily download quota on every computer and also monopolise download speed/capacity at the time of turn on
- Disabling the content filter firewall (which was redundant as it duplicated the Windows firewall function). This function if left enabled was shown to cause timeout errors in the Outlook email application.

An exception to this regime was anti-virus definition updates, which we perceived to be too important to disable despite their often large size.

Maintaining passwords

Residents have had difficulty remembering or retaining records of passwords for email and Skype. This has not been a serious problem given that the applications do not normally demand a password at each activation. However as the desire for privacy increases it will become an issue.

FINDING

12. Passwords that are required by some applications for logon or other purposes are a complicating factor. Where possible and agreed by the residents, initially configuring applications to avoid the need for password entry is preferable.

Printers

An instance of children tampering with (and thereby disabling) almost full printer ink cartridges occurred early at one community. On the printers concerned these are presented at the front of the machine to make access very easy, whereas this experience suggests that the printer design should conceal the cartridge covers from normal view.

Consumables

Most use of consumables related to printing. Printer cartridges were required reasonably frequently (about one full set at around $100 per six month period per computer), and residents were shown how they could replace these themselves after the first replacement occasion. Printer paper consumption was steady but relatively low compared to ink usage – amounting to about 1 ream per community every second or third monthly visit. This suggested that the bulk of printing use is for photos where the amount of ink used per sheet is fairly high.

As with many inkjet printers, the cost of a full set of cartridges is comparable with the initial cost of the printer itself.

FINDING

13. The dominant consumable cost is in the replenishment of printer ink cartridges.

Repairs or replacements

Repairs or replacements fell into two broad categories:

- Failure or loss of core equipment including the computer processor or printer and network equipment

  On two occasions, separate computers failed to start up at turn on for no apparent reason. The first time this occurred, the fault was repaired by the supplier under warranty by removing and cleaning the processor memory board internal to the computer. The second time, the same repair was undertaken in the field by CAT staff. In both these cases dust was not evident, so the fault may be symptomatic of a minor design problem.

  On one occasion, the only laptop was damaged by rough use by a child, and was irreparable.

  On one occasion, the computer and printer from one house were removed by a resident to another location, and have not yet been returned to the community. The onus was placed on that resident to return them, so these items have not been replaced.

  These and other events of this type are tabulated in Table 6.

Table 6 – Failures or losses of core equipment to 30/6/12

Item	Total	Qty reported lost / failed / damaged	Type	Time of incident (weeks after installation)
Computer	20	5	Damage Loss Failure Failure Damage	11 15 32 41 43
Printer	17	2	Failure Failure	21 29
UPS	20	1	Failure	41
Network power injector	20	1	Failure	32

  In addition to outright failures, there were additional instances of malfunction of printers. In theory the paper tray under the inkjet printers was protected by a lightly fixed cover to seal the paper feed area, but in practice this cover was

frequently left off by residents when paper was added. Over time dust and grit affected paper pickup, and this was compounded by the exposed blank paper (either inside the paper tray or stored loosely on a shelf) sometimes crinkling due to too much or too little humidity.

- Failure or loss of accessories including headsets, computer mice, keyboards, cover padlocks

  The design of these computer accessories is such that they are relatively fragile, being connected by low strength cables and manufactured of light duty materials.

  During the period to end March 2012 (9-12 months of operation), accessory failures or lost items were as follows:

Table 7 – Failures or losses of accessory equipment

Item	Total	Qty reported lost / failed / damaged
Headsets lost/ failed / damaged	20	9
Mice lost/ failed / damaged	20	2
Keyboards	19	0
Padlocks lost and / or hasp forced open	18	6

In some instances where the same accessory (typically a padlock) was damaged or lost by the residents of a given house more than once, it was suggested to the residents that they themselves should replace the item next time.

FINDING

14. **A practical approach to the replacement of accessory items is to suggest to the residents that in cases where loss or damage occurs repeatedly (say more than twice) they themselves should replace or pay for the replacement of the item the next time this occurs.**

Restoration

Where possible, computers were restored to working order by the next support visit. In some instances this was not possible if access to houses was not an option due to the residents being away or having vacated the house.

Issues with applications

- Operating systems

  On one occasion, a computer would not start correctly and repair was achieved by CAT staff running a 'quick software repair'.

- Email

  The Outlook email application was used as the primary email client on each computer. To simplify operation, a single email address was assigned to each computer and initially, emails were broadcast to all addresses at each community to increase the chance of the email being seen. Subsequently, a few users wishing to have a private address were encouraged to use Hotmail or another web based client. A few had their own addresses already.

  Occasionally, the Outlook application behaved erratically, with Outlook data files disappearing twice and Outlook failing to access the mail server at some other times. Possible causes are slowness of the Internet uplink causing a timeout, or blocking by the content filter firewall.

  Generally speaking, resident users have only used the basic send and receive email features to date.

FINDING

15. **Because the operation of the Microsoft Outlook email application is somewhat more complex than web based email, it may be better for projects like this to use web based mail such as Hotmail in the first instance until users are in need of more advanced email features.**

- Other issues

  A few other instances of application problems have occurred, usually as a result of a resident attempting to do something new, inadvertently making a mistake and not being able to track back to their familiar starting point. These included rotating the monitor display, deleting shortcuts, and corrupting application start address paths.

Quota adjustment

As people move between houses or to and from the community, it has occasionally been necessary to change the daily Internet quota of one of the computers. This is readily carried out as a support task on the content filter.

This change would also be needed if a household wished to obtain a higher quota allocation and was prepared to pay the additional cost. Such a change would also complicate the billing management arrangements, but it could be done with the available tools. The prospect has been raised by one relatively advanced household at Imangara, but so far they have not taken up the option.

Accounts and password protection

Each computer was initially set up with a single unpassworded user account and a password protected administrator account. Over time, a few people have wanted more privacy for their material and introduced their own accounts and passwords.

Physical care of the hardware

Residents in the project communities do not necessarily have an intuitive appreciation of the fragility of computing equipment and its vulnerability to dust, dirt and heavy handedness, particularly of printing equipment and thin cables. Keeping the computer workspace clean seems to be more an outcome of the general habits of an individual than something that has been learned in the past 9 or 12 months. An example of this is the use (or non-use) of the computer cover to protect the equipment while it is idle. When closed, the cover will keep out most dust, food and mice. From our observations, less than a quarter of residents close down the cover regularly after use. In at least two other cases, mice have made their way into the printer and either damaged it or destroyed the paper stock. The actual building environment (shared community building or residential house) also has some bearing on protection of the computer equipment. The Women's Centre at Imangara, which currently houses two of the computers, is generally only used when Centre staff are present, and the doors and windows are usually closed for air conditioning and food preparation hygiene purposes. This building does not appear to have a dust and dirt problem, while other shared spaces are similar to the houses in this regard.

FINDING

16. **The need for a clean operating environment for the computer and printer, and for careful handling of cables and accessories needs to be regularly reinforced by the project managers. Typical inkjet printers demand a clean environment and careful handling of the printer and paper by the operator. Some households achieve this, while in others the work space is also used for eating, smoking or storage and small children are able to access the computer and printer, which makes keeping it clean difficult. Education /awareness raising continues to be needed in those cases.**

Power

Increased computer usage may change patterns of household energy use – not only for the computer or printer directly, but also the associated energy used for lighting, or heating or cooling the room. While we have not measured this effect, it may need to be considered when setting energy budgets in communities relying on off-grid power sources with limited capacity such as solar power systems.

Content filtering

One incidental effect observed with the Integard content filter is that the daily filter quota limit only activates at the end of a current application session. This means that if a resident starts using the computer to download a movie or similar large file while there is quota remaining, the filter limit will only stop further download activity once the movie download is complete. Because heavy use like that would disadvantage other users if overused, it would be desirable if there were also the option to set the filter limit immediately the quota is reached. The filter designers were approached with this request, but have not responded to date.

Antenna lead-in terminations

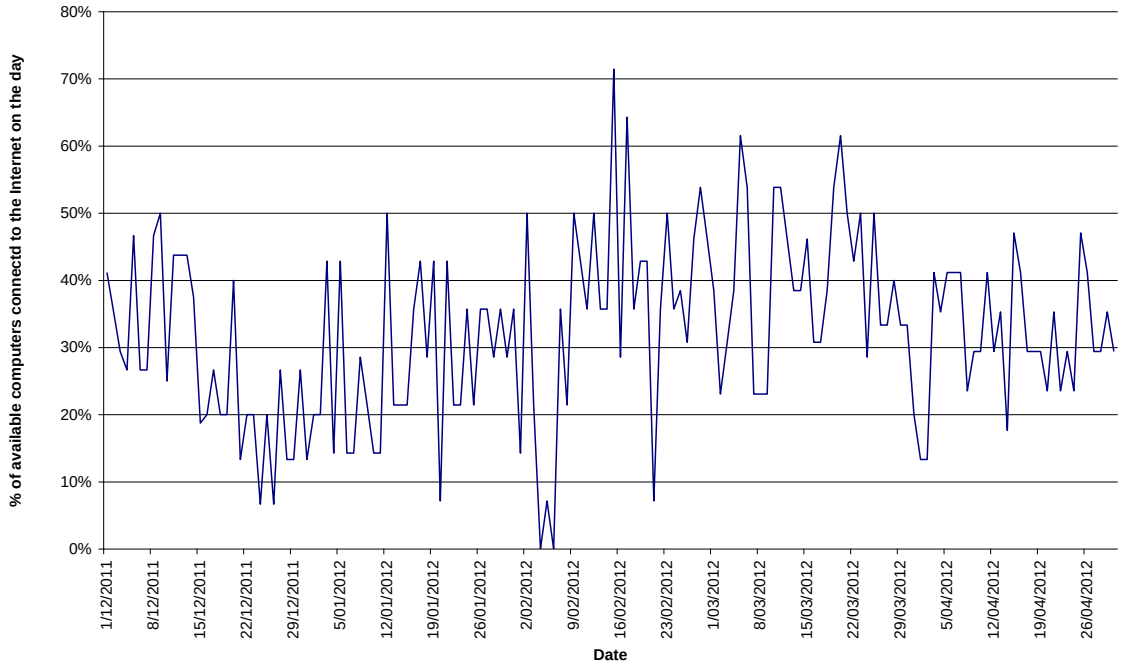
The antenna lead-in conduit, cable end connector and injector box bundle installed with each computer at Mungalawurru protruded about 100mm out from the wall into the room space near the computer table, making it somewhat exposed to damage. In one instance the cable connector may have been damaged when the table was moved against this bundle.

The installers were subsequently asked to modify the arrangement for the installations at Imangara, and instead utilised a short length of plastic cable duct mounted against the wall to house and protect both the cable end and injector box. This is a much improved arrangement.

10. Use of the services

The graph Figure 5 shows the percentage of available computers at all the communities combined that were connected to the Internet at least once each day during the period December 2011 to April 2012. The average over this period was 32%, or about 5 of the 15 available connections on any given day. These figures do not include any computers that may have been used purely for offline activity. As at the end of April 2012, 17 Internet connected computers were in service.

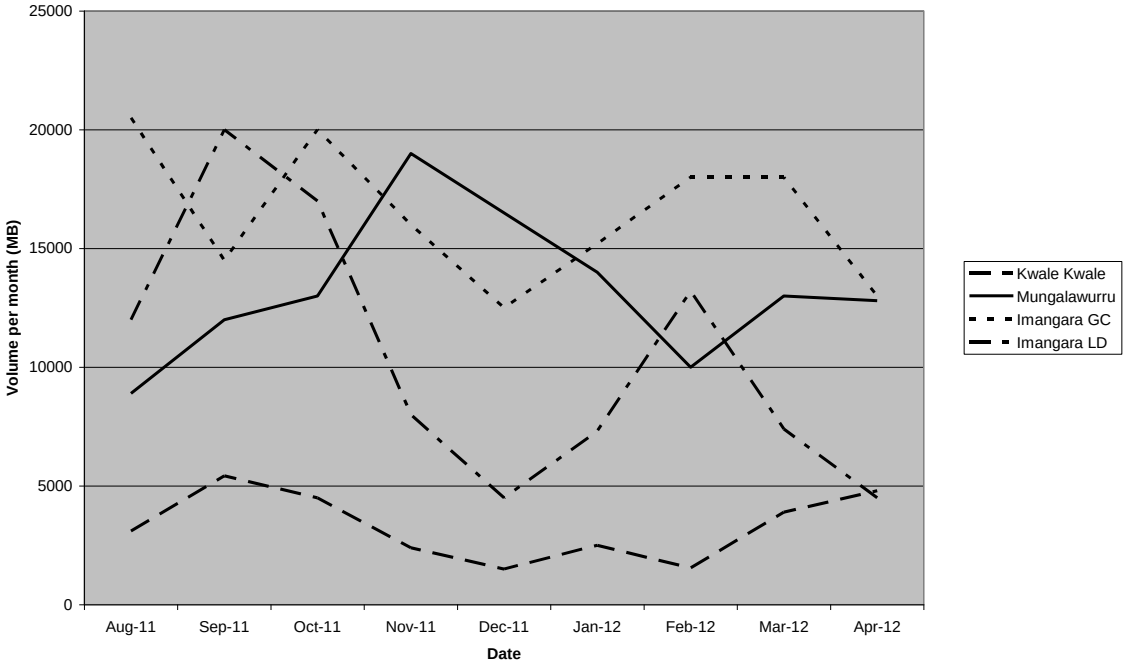
Figure 5 – Level of Internet use (all communities combined)



The next graph Figure 6 shows volume of use of the Internet per month by community and group. Group in this context refers to the group of computers associated with each satellite service. At Imangara, which has about twice as many occupied households as either Kwale Kwale or Mungalawurru, there are two groups of approximately equal numbers of computers. It should be noted that the Imangara LD group was particularly affected by the consequences of a serious accident in 2011, which resulted in several of the houses in this group being vacated and computers remaining idle from partway through November 2011. A partial explanation for the relatively low use at Kwale Kwale was that two of the four computers there were temporarily removed for safe keeping at the residents' request from the beginning of December 2011 through to mid-March 2012, while the main users were absent.

The total monthly quota in each case is 17GB (including both peak and off peak use); Internet use occasionally exceeded the quota everywhere except for Kwale Kwale.

Figure 6 – Internet volume of use by community/group



11. Cost, technical and other barriers to take-up

Cost barriers

The cost that would accrue directly to the residents to fully fund facilities themselves in the form provided by this project would likely result in them seeking cheaper alternatives or choosing not to have home Internet at all. Alternatives open to them in a remote community situation (assuming there is no mobile coverage) would include obtaining their own individual household satellite Internet connection, and possibly bypassing some features such as training and technical support for computing and printing. The cost of a satellite connection per household would be of the order of $40 per month on current pricing for the lowest speed and quota, compared to somewhat less for a higher capacity service shared between 5 households (say $25 per month per household), but the extra cost would be offset by avoiding the need for a local (WiFi) distribution network.

There are two aspects to whether a collective multi-household approach would work better than every household doing their own thing:

- From an initial planning perspective the collective approach, whilst being more expensive, is likely to offer the better chance for the members of all households to get a timely and comparable level of service, regardless of the abilities and level of motivation of the individual households.

- From a sustainability perspective once the services and facilities are in place, the households who see Internet and computing as a family priority are likely to find the resources to keep an individual service operational. For others, the outcome of such an approach would potentially be similar to that already experienced with satellite TV subscriptions, where people's ability to maintain payments fluctuate according to other demands and some services might be suspended for periods when those other demands are more pressing. A collective service is more likely to assist those who would otherwise struggle to allocate the funds, but at the cost of an external subsidy.

For cost and space reasons, it is unlikely in either a collective or individual approach self-funded by the residents that the computer could be guaranteed its own table, and less so a cover and room to itself, so it seems more likely that residents would choose a portable device (laptop or tablet). For similar reasons it seems likely that most would dispense with the need for a printer. Experience with our project so far suggests that laptop equipment would be more vulnerable to failure or loss, so the prognosis for a sustained long term facility is not good under these circumstances. This leads to the conclusion that some level of subsidy funding is desirable for the household equipment as well. These factors will be examined further in the longitudinal phase of the project.

FINDING

17. **Comparing a multi-household approach to Internet connection with one where every household does their own thing:**

    A collective multi-household approach to the provision of the Internet connections is likely to offer the better chance for the members of all households to get a timely, comparable and sustained level of service.

    Considering the costs to implement a facility of this type, it is unlikely that residents could afford the capital expenditure. It is also unlikely that residents could afford a sustainable solution to the provision and protection of the household computer equipment itself. A level of external subsidy funding is desirable to ensure sustainability for both Internet connection and household equipment.

Technical barriers

Organising a collective project of this kind is likely to be beyond the project management resources of outstation communities. The implementation scenario will typically require external resources - even the process of seeking subsidised satellite Internet services is administratively too complex in its present form to expect residents to undertake it successfully on a broad scale.

Once the facilities are established and bedded down however, the complexities reduce, and there is a greater opportunity for local involvement. Our experience so far with this project indicates that a moderate number of smaller problems demanding some technical expertise will continue to occur, and will need a program of regular support intervention coupled with one-on-one training of the individual users at community level. Monthly (or thereabouts) visits as undertaken so far seem to be a good starting point for this, with the possibility that the interval between visits could be extended over time as residents become more familiar with use of the facilities. Solving most of the problems would not be beyond the skills and experience of a person with broad user ICT experience. Such experience is unlikely to be available within most outstations at the present time, but might be found at some of the larger remote communities. The questions then are how to engage such people, and how to deploy them. A regional model where the ICT support person travels between communities on a regular schedule seems to be a logical approach to explore for supporting a number of communities in their ICT activities.

FINDING

18. **External resources will be required to:**
    - **project manage the implementation**
    - **provide a program of regular support coupled with one-on-one training of the individual users at community level**

Other barriers

While the cost and technical factors discussed in this section can constitute major barriers to ICT take-up, other socio-cultural issues play a role in the extent to which individuals adopt and use ICT, and how the ICT facilities are designed. One notable example which has emerged in our study is the impact of death of an individual or individuals. It was noted in section 3.5 that people may vacate a house (and community) for a period of time following the death of an extended family member and that upon their return, they do not generally return to the same house, but occupy a different dwelling. Accordingly, the need for ICT configurations to have a certain inherent flexibility and portability is more pronounced than might otherwise be the case. In our experience, not only did people vacate the community for a period of time and not re-occupy the house, but we were asked to take the individual's computer and remove all photographs and references to that individual (a form of electronic "smoking"), before returning and re-using it elsewhere in the community. The impact extended beyond the capacity to re-use that individual's computer to other users in the community. For example, at least one individual was reluctant to use Skype because the name of the individual appeared at the top of their contact list and so was visible each time they opened the application; they did not know how to remove that name from the contacts list. It was not until we removed the deceased person's name that the user felt comfortable opening up Skype.

Other socio-cultural issues identified in the report include:

- (Lack of) appreciation of the fragility of computing equipment and its vulnerability.
- People being disinclined to attempt to fix minor issues themselves
- The impact of assigned uses for buildings on ICT facility design and use
- The impact of mobility on ICT implementation and use

It is beyond the scope of this report to address these or other factors in greater detail, but they are being considered as part of the longitudinal research phase of the study.

12. Summary of Findings

1. Residents' mobility both to and from the community and within it dictate that ICT configurations need to be as flexible and portable as possible to cope with these variations (page 12).

2. Face to face discussion and communication is the preferred means of maintaining project management dialog with residents on a project of this type. Communication with one or a few individuals in the community by phone or other means should not be relied on to convey important information to or from all of the residents (page 18).

3. The ABG application process described here and its NBN successor involve several steps and choices that are not straightforward for a customer unfamiliar either with broadband services or dealing with a tiered service delivery sequence. The process is further complicated by the limited communications options (usually a single payphone) available for contact to and from a customer in a remote community. For these reasons, the process would need considerable streamlining to obviate the need for external facilitation (page 22).

4. A nominal four month implementation timescale for communities of this size seems realistic, although certain activities where large external organisations are involved (such as satellite Internet service procurement through government schemes) may require longer lead times to mesh with their schedules and processes (page 31).

5. Experience with this project highlights the importance of engaging an experienced supplier partner, who has alternative and reliable sources of equipment and can quickly activate them (page 31).

6. Pre-configuring the equipment at an urban location minimises the amount of time required to set up the computers in the individual houses on site, and also importantly makes a higher speed Internet connection available to carry out the download tasks (page 32).

7. It is preferable in a remote community project of this type to make the configuration arrangements and timing as flexible as possible to cope with changes as they occur, and to allow for more face-to-face discussions and site visits than would normally be considered sufficient (page 33).

8. Support planning and resourcing for a project of this type should assume that most support will require a visit to site, at least for the first year after implementation (page 37).

9. Training of residents tends to fall into two categories:

- One-on-one tutoring for residents who have no experience in using particular applications
- Specific assistance with problems or more complex tasks within applications, for younger residents with computing experience from school or elsewhere

Over the course of the first year after implementation, the one-on-one tutoring / mentoring method of training has been found to be practical for the cohort aged teenage and above given the diversity of requests and the range of skill levels amongst the residents, and is also favoured by most of these residents over group training.

(page 38).

10. Because of the often quite low Internet speeds (particularly in the upload direction), our view is that the service plan used on the project, while being typical of the higher speed offerings available under ABG, is not well suited to a multi-user situation (page 41).

11. The performance of applications that are dependent on a reasonable Internet speed or quota for their effective function is variable (page 42).

12. Passwords that are required by some applications for logon or other purposes are a complicating factor. Where possible and agreed by the residents, initially configuring applications to avoid the need for password entry is preferable (page 43).

13. The dominant consumable cost is in the replenishment of printer ink cartridges (page 43).

14. A practical approach to the replacement of accessory items is to suggest to the residents that in cases where loss or damage occurs repeatedly (say more than twice) they themselves should replace or pay for the replacement of the item the next time this occurs (page 45).

15. Because the operation of the Microsoft Outlook email application is somewhat more complex than web based email, it may be better for projects like this to use web based mail such as Hotmail in the first instance until users are in need of more advanced email features (page 46).

16. The need for a clean operating environment for the computer and printer, and for careful handling of cables and accessories needs to be regularly reinforced by the project managers. Typical inkjet printers demand a clean environment and careful handling of the printer and paper by the operator. Some households achieve this, while in others the work space is also used for eating, smoking or storage and small children are able to access the computer and printer, which makes keeping it

clean difficult. Education /awareness raising continues to be needed in those cases (page 47).

17. Comparing a multi-household approach to Internet connection with one where every household does their own thing:

    A collective multi-household approach to the provision of the Internet connections is likely to offer the better chance for the members of all households to get a timely, comparable and sustained level of service.

    Considering the costs to implement a facility of this type, it is unlikely that residents could afford the capital expenditure. It is also unlikely that residents could afford a sustainable solution to the provision and protection of the household computer equipment itself. A level of external subsidy funding is desirable to ensure sustainability for both Internet connection and household equipment.

    (page 52)

18. External resources will be required to:
    - project manage the implementation
    - provide a program of regular support coupled with one-on-one training of the individual users at community level

    (page 52)

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