Home Internet for Remote Indigenous Communities

Technical Report

Author: Andrew Crouch

September 2014
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The core project team comprised Robin Gregory, Eleanor Hogan, Ellie Rennie, Alyson Wright and me. Whilst implementation and research were distinct aspects of the project, there was much overlap in their execution. Robin Gregory and I shared the bulk of the implementation and support work which are primary subjects of this technical report – a special thanks to Robin for her companionship and dedication to these tasks. The core project team and the research team were one - each of the core team members contributed to particular aspects of the research and across the research program more generally, so I wish here to acknowledge my thanks to Robin, Eleanor, Ellie and Alyson for their contributions to the research that forms the basis for this report, and for reviewing the draft technical report and providing helpful comments.

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1. Introduction

The Home Internet Project (HIP) 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/wp-content/uploads/2012/05/Home-internet-remote-indigenous-communities-project.pdf.
- An implementation phase that included 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 were installed during mid-2011 in the three communities, 4 computers in Kwale Kwale, 5 in Mungalawurru, and 11 in Imangara. Subsequently, a further 2 computers were installed at Imangara. Following the 2011 implementation, training and support continued through to October 2013.
- A longitudinal research phase monitoring the ongoing use of the facilities, from the start of the implementation phase in mid-2011, through to mid-2014.

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

The HIP 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. It should be noted that in the last year, the current Commonwealth Government has moved to fund the placement of trial WiFi access points in a number of remote homeland sized communities, to enable residents and visitors with WiFi capable portable devices such as smartphones and tablet computers to access the Internet. Thus it can be said that there are essentially three types of provisioning model for remote communities, being home computing, computer centres and portable computing.

This report summarises our experience with the technical aspects of the HIP through the planning and implementation phases, and the first 24 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 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 24 months after commissioning of the facilities, up to the end of 2013, when funding for the support and training elements of the implementation phase ceased.
2. Project technical objectives

The objectives for the HIP 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 our experience 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

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 contribute heavily 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. Station store purchase prices for ICT products such as iPads (where these are stocked) are often significantly higher than prices for the same goods in Alice Springs.

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 and causing interruption to power supplies. Mice may also cause damage by invading exposed equipment and materials such as printers and paper stocks. Cockroaches can also be prevalent, and particularly affect printer paper feed mechanisms.

*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 and occasionally remote area retailers 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 Mungalawurr are equipped with a shared un-tariffed reticulated Bushlight\textsuperscript{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 caters for 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 centralised, the cost of electricity for it, although relatively small, is borne by the relevant householder.\textsuperscript{3}

\textsuperscript{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/

\textsuperscript{3} The estimated electrical load presented by the satellite modem and transceiver (with a 240VAC supply) is 60Volt-Amperes, equating to something like 50 cents per day in electricity costs.
3.4. **Availability of Internet services (pre-NBN and 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 long-term NBN satellite service.
Figure 1 – Projected NBN service coverage for the Northern Territory overlaid with HIP community locations

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

Coverage plans and rollout dates for these services were under review, as at November 2013.
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 people’s 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 and Internet connections themselves.

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

**Management of personal information**
Details relating to personal information, including financial details such as bank account numbers and passwords, may sometimes not be in the direct keeping of the individual account holder. For example, these may be recorded and retained on behalf of the individual by a station store manager, or another family member, to be used when purchasing goods or services on their behalf. Older residents in particular often rely on this approach.

Further examination of human factors

Detailed examination of the impact of human factors on the take up and ongoing use of ICT is addressed further within other reports associated with the longitudinal research phase of the project. These factors include (amongst others) differences in the way ICT services are used by males and females and younger and older people, perceptions about ownership and how these affect access to facilities in the community, and people’s preferences for different kinds of learning situation.

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) superseded Australian Broadband Guarantee (ABG) subsidised services, and has been operational since 1 July 2011. ISS is essentially a lower contention ratio service based on existing commercial satellite capacity, and 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 long term NBN satellite service which is scheduled to begin operation in 2015.\(^5\)

**Indigenous Communications Programs**

Over the years, successive Commonwealth Governments have put in place a range of initiatives aimed at improving communications in (primarily larger) remote Indigenous communities.

The current Indigenous Communications Program (ICP) includes a component for providing funding for computer facilities and training to selected remote communities, where the communities were chosen in conjunction with the relevant state and territory governments. The selected communities are generally ones with resident populations of 100-plus persons, so this funding is largely unavailable to outstation sized communities like those that are the subject of this report. The rollout of the ICP computer and training component to new locations finished in mid-2013, though funding has been provided for training and maintenance in the existing communities until mid-2016.

At the time of writing, no commitment had been made by either the former or newly elected Commonwealth Governments to extend ICT facilities to further communities.

**Legislated controls on computer use**

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 ceased to have effect on 18 August 2012, being superseded by the *Stronger Futures Legislative Package*, comprising three Acts. *Stronger Futures* does not contain the publicly funded computer provisions, but the Commonwealth Government has indicated its intention to replace these computer control measures with a non-legislative administrative provision such that all Commonwealth funding agreements will require funded organizations (not just Indigenous organizations) to take steps to minimize inappropriate use of publicly funded computers.\(^6\)

### 3.7. The communications environment

At the start of the project, residents of each of the project communities typically had only one telecommunications option for external communications, either a public payphone (Mungalawurru and Imangara) or a single private landline phone service (Kwale Kwale). This situation is representative of other small remote communities in the Northern Territory. While such services are generally reliable, when failures do occur they are prone to relatively

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\(^5\) While there are differences of policy between the two major Australian political parties with respect to their implementation models for NBN services in the settled areas, both are committed to the same model for remote area satellite customers. See transcript of media interview 24 September 2013, the Hon. Malcolm Turnbull, Minister for Communications, [http://www.malcolmturnbull.com.au/media/press-conference-interim-nbn-statement-of-expectations](http://www.malcolmturnbull.com.au/media/press-conference-interim-nbn-statement-of-expectations)

long restoration times. Some particular incidents on both the Mungalawurru and Imangara payphones during the project period resulted in restoration times of several weeks, often because the repair technician determined at an initial on-site visit that a spare part or parts that they did not carry were required, and a return visit was needed when the part had been shipped to their depot.
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. Some 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, though a laptop was initially provided to one household (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 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.

Computer literacy

The project did not assume an existing level of computer literacy on the part of residents. In practice, residents’ computer literacy at the start of the project 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.

Training
As a consequence of the wide variation in computer literacy at the outset, it was considered that training in a group setting might not be appropriate - a considerable amount of one-on-one tutoring could be required.

At this point in the project, 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. See Section 8.
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 specifications appropriate to the physical environment, and the ability to configure a robust local wireless network over each community – including the installation of appropriately dimensioned directional antennas and wireless transceivers 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, and where funding did not permit the provision of a PC for every member of the community. 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 all 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. On the other hand, relying on one or a few individuals to convey messages both ways was also problematic, as they could not be expected to keep track of the frequent movements of residents to and from other places, or to judge the importance or urgency of the task.

This limitation to external communications with the community members meant that regular project team visits, involving face to face discussions with as many resident householders as were present at the time, was the best means of maintaining the dialog.

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 and management of the building itself (and all the Imangara houses) is now vested in the NT Government Department of Housing, Remote Housing NT, to be underpinned by a long term (typically 40 year) ‘whole-of-township’ leasing agreement\(^7\) between the Australian Government and the Traditional Owners of the land on which the community buildings stand.\(^8\)

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 wireless connected homes in its cluster. Clear line of sight for wireless signals was necessary between the roof of the satellite service / wireless 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\(^9\), 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 wireless distribution. It also had its own electricity meter, which meant that sharing the electricity cost would be

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\(^7\) This lease was signed in August 2013.

\(^8\) In 2011, ownership of the buildings was vested in the NT Government Department of Local Government and Regional Services (DHLGRS) Remote Housing Unit, although at the time the implementation was taking place, the ownership position was unclear.

\(^9\) Following the election of a Coalition Government in September 2013, this department was renamed the Department of Communications.
easier to arrange. Two computers were also placed there, as that suited the needs of the residents of the adjacent houses at the time. 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 wireless 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 wireless 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 supervisor 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 was the actual owner.

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, to answer their questions, and to discuss issues of a community-wide nature that arose from time to time.

Impact of community business and regional events

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.

Other events outside the community but involving various community members could also have a significant effect at times. These included major sports or other regional events such as football carnivals, the Tennant Creek Show, the Mt Isa Rodeo, and funerals in other communities in the region. Often because of the distances involved and the size and duration of the events themselves, a considerable proportion of the population of the community could be absent from home for up to a week. Extended visits to other family members elsewhere were also common.

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 from CAT to residents

One aim of the project was that at some point the residents would make a decision to take formal ownership (referred to below and elsewhere in project documents as Western Legal 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. There is also a clause that allows the owner to opt out of the project later if they no longer wish to participate.

The actual timing of the transfer also depended in practice on the residents who were the nominal owners or custodians (nominated 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 did not change residents’ access to the computer or their ability to obtain training or support in any way. In those cases where the nominal ownership changed hands at an early stage of the project or the resident did not continue to be associated with a particular computer, transfer did not take place. In practice, 17 transfer agreements had been signed by September 2013 (2 at Kwale Kwale, 6 at Mungalawurru and 9 at Imangara). At Mungalawurru, Western Legal Ownership of one particular computer changed hands within the community twice.
6. Technology, equipment and service selection

Internet connection

At the time of implementation, satellite Internet service subsidies were available through the Department of Broadband Communications and the Digital Economy’s (DBCDE’s) Australian Broadband Guarantee (ABG) program\(^\text{10}\). 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\(^\text{11}\) 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 retail Internet Service Provider (ISP). A number of these retail ISPs utilise the same wholesale satellite provider service (the IPStar satellite owner), 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 Skymax 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, Skymax and its installation contractors, for the families who were the actual applicants for the services. Skymax 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.

Local area networking

As discussed earlier, distances between community houses and other buildings were significant in some cases. These distances dictated that a radio/wireless solution to interconnecting the local network with the Internet services 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

\(^{10}\) 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.

\(^{11}\) Safeguards contracted through back to back commercial agreements between each ABG provider and the Commonwealth Government
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 wireless 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 wireless 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 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), one or more additional standard 2.4GHz WiFi Access Points with omni-directional antenna were provided to cater in a limited way for such devices - in one case for the laptop computer that was initially 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 can 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 (where the device design allows it) 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 HIP, 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**

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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**

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

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 the small number (3) and low volume of use of the Kwale Kwale printers has not allowed this proposition to be adequately tested.

User applications

The computers were equipped with a licensed Microsoft Office software suite (Windows 7 plus Office Home and Business 2010), 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\textsuperscript{12})
- Content filter (Integard Home\textsuperscript{13})

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 shared the overall ISP-managed quota (17GB per month or about 500MB per day), and that quota was 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.

VoIP phones

A supplementary function included in the configuration was the trialling of Voice over IP (VoIP) telephones. Noting that the complexity of managing the call costs associated with providing a capability for making calls outside the community was considered to be beyond the scope of the project, the trial was limited to use within the community. Experience of others with software based client-only VoIP products indicated that they were generally complex to configure and not commercial grade products. A number of commercial hardware based offerings were examined, and one was found (Vtalk) which appeared to be suitable for this intercom function (although it was also capable of being configured for external calls).

The Vtalk system consists of a compact PBX unit about the size of a modem connected centrally to the local network, and a number of VoIP phones connected to the network at the

\textsuperscript{12} AVG Free Antivirus Download
\textsuperscript{13} Internet content filter and chat monitor software, Integard
household. For trial purposes, DECT cordless phones with VoIP base units were chosen, so that the residents could roam with the phone in and around the house. A first trial stage with 2 phones was set up at Mungalawurru in November 2012.

**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\(^\text{14}\).

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.

\(^{14}\) In one instance where one of the computer tables needed to be moved to another house, the main front door opening width was found to be narrower than 790mm, necessitating the temporary removal of the door.
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 seating of some kind. 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. Over the course of the project, some residents chose to relocate the computer and desk from the bedroom to the lounge room or vice versa.
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**

<table>
<thead>
<tr>
<th>Event</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request for quotation</td>
<td>1</td>
</tr>
<tr>
<td>Quotations received</td>
<td>3</td>
</tr>
<tr>
<td>Order placed for site surveys</td>
<td>6</td>
</tr>
<tr>
<td>Site surveys</td>
<td>8</td>
</tr>
<tr>
<td>Revised final quotation received</td>
<td>14</td>
</tr>
<tr>
<td>Order placed for equipment</td>
<td>15</td>
</tr>
<tr>
<td>Equipment in store at supplier</td>
<td>17</td>
</tr>
<tr>
<td>Equipment configuration</td>
<td>18</td>
</tr>
<tr>
<td>Transport to site &amp; installation</td>
<td>19</td>
</tr>
</tbody>
</table>

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 a mandatory requirement in any future tender documentation/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**

3. 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

4. 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. Tender documents for any similar future project should make this requirement mandatory.

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.
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

5. 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

6. It is preferable in a remote community project of this type to make the scheduling 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 wireless 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 individual 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 initially 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

<table>
<thead>
<tr>
<th>Community</th>
<th>Total onsite work hours</th>
<th>Number of buildings</th>
<th>Average work hours per building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwale Kwale</td>
<td>30</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>40</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Imangara</td>
<td>60</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

**Antenna mounting**

For the majority of buildings, it was possible to mount the Wireless (local area 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 6 shows examples of the antenna mounting arrangements.
Figure 6 – Antenna mounting variations
Implementation costs

The costs for planning and implementation incurred in the HIP (excluding CAT staff travel costs) are tabulated in Table 4. This represents an average cost per computer or household of $9,500.

Table 4 HIP Implementation costs

<table>
<thead>
<tr>
<th>Budget Item</th>
<th>Expenditure ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wireless network:</strong></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>27,100</td>
</tr>
<tr>
<td>Antenna masts &amp; installation</td>
<td>31,700</td>
</tr>
<tr>
<td><strong>Household equipment:</strong></td>
<td></td>
</tr>
<tr>
<td>Computer hardware &amp; software including VoIP equipment</td>
<td>66,700</td>
</tr>
<tr>
<td>Printers</td>
<td>3,900</td>
</tr>
<tr>
<td>Furniture</td>
<td>17,400</td>
</tr>
<tr>
<td>Filter licences</td>
<td>400</td>
</tr>
<tr>
<td>Staff time for project management, design, procurement, household equipment configuration, installation and introductory training (including salary related on-costs and overheads)</td>
<td>40,700</td>
</tr>
<tr>
<td>Freight</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>189,900</strong></td>
</tr>
</tbody>
</table>
8. Training and technical support

The time CAT staff spent at each of the visits over the 21 months of operation following implementation of the facilities in mid-2011 was shared between providing technical support of the facilities and training/tutoring of residents in their use of the computer, Internet and various applications. Virtually all of these interactions occurred face to face, and in our experience very few of these could be successfully carried out using remote methods of support, given that none of the households had access to a telephone (fixed or mobile) within the house. 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 personal presence on site. In practice, project team time divided approximately in the ratio 70% (for technical support) and 30% (for training).

FINDING

7. Support planning and resourcing for a project of this type should assume that most support will require a site visit.

Profile of digital literacy amongst participants

An assessment of a sample group of 28 of the adult participants in the project was undertaken by the full project team partway through the project, once the researchers had become reasonably familiar with the capabilities of each participant. The assessment was based on two criteria, the subjective skill level of the participant relative to the highest skill level within the group, and the participant’s perceived level of engagement or preparedness to seek external help for an ICT problem or question. The intent of the two questions in combination was to gauge the potential for each participant to develop into a mature digitally literate user. While this qualitative assessment was not linked to any external benchmark, it indicated a broad range of potentials for the group, ranging from a high potential for five individuals, down to a very low potential for eight individuals.

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.
As a training model, 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 within the project. This method is also logistically straightforward, because requirements can be taken up ad hoc, whenever a resident enquires during the course of a visit. It is nevertheless time consuming for the tutor, and the amount of time needed to respond to each request is difficult to predict or schedule.

When residents were asked in July 2012 during the post-installation phase what their preferred training method was, 88% of respondents nominated the one-on-one approach, either by themselves or with a close friend or partner, in their own community.

The alternative of structured training sessions for a group of participants may be appropriate in some circumstances, but the logistic issues include:

- Publicising the event in advance and attracting participants
- Maintaining participant attendance, which includes arranging the session times and durations to take account of participants’ other obligations
- Arranging a suitable venue (a building space with chairs and tables which is typically unavailable in an outstation setting)
- Ensuring participants’ particular personal needs are met e.g. that they have functional glasses or hearing aids where required
- Arranging transport for participants, and meals as appropriate
- Where necessary, arranging and remunerating a trainer
- Devising session content and delivery methods to match the differing skill levels of the range of participants
- Taking account of cultural constraints such as avoidance relationships.

Group training might have the advantage in large communities that it would be easier and cheaper to enrol a quota of participants for a prescribed or explicitly funded course, but it does not follow from this that its effectiveness on a per user basis would be any better than in smaller communities.

Group training has the advantage in equity of input terms of more nearly allocating the same amount of attention to each learner, but in a community situation such as the HIP context where learners are of widely differing ages and skill levels, it has become obvious that the amount of time and attention required by residents to learn a particular skill (such as managing email) has varied so widely that equity of outcomes would be difficult to achieve using this method. A compromise approach might involve streaming the group training sessions so that a given session engaged residents of similar age group, interests, and probably gender.

The group training method was only attempted once during the course of the project. In that instance we were unsuccessful, as we failed to attract sufficient participants, in part because of conflicting community activities.

The volume of requests for training 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

8. 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 project, 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 wide range of skill levels amongst the residents, and is also favoured by most of these residents over group training. Training using this method is also logistically simple to deliver.

As a general principle, the training location, delivery style, and timing should be tailored to the participants’ expectations to maximise its effectiveness.

Technical support

Technical support has been required for a variety of matters, as listed in Section 9 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 or the Internet connection, there has sometimes been another computer available that they could use until repairs were effected. Printer problems were relatively frequent, particularly in the latter part of the operational period, although some of these such as 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. See Section 9.

In most cases, the resident concerned did not contact CAT about a computer problem prior to us visiting, despite being encouraged to do so verbally by the project team and in pre-visit emails or notices at the local store. 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 on each visit to allow for contingencies.

Liaising with service providers

Account and billing management for the four satellite Internet services was required on occasion, though mainly in the first 6 months. 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. The services were provided with a web-based account management tool, which allowed aggregate
usage of each service to be monitored at hourly, daily, and monthly intervals, and also permitted additions or changes to user email addresses where required.

*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, cable ties, and some cleaning materials. A stock of printer cartridges, printer paper, spare printer(s), USB headsets, mice and mouse pads, speakers, power boards, and miscellaneous power and data cables 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.

*Costs associated with training and technical support*

Costs for training and technical support break down into three main components, namely on- and off-site staff time, materials and travel.

**Staff time**

Training and support staff are engaged in providing support both on-site within the community, and off-site. For HIP, the average hours spent by CAT staff on training and technical support for the 26 month post-installation period amounted to 13 hours per week over the three communities including an average of 4 hours per week travel time. A total of 53 support visits were made, comprising 20 to Kwale Kwale, 16 to Imangara and 17 to Mungalawurru. It was possible to combine the implementation and support visits to Imangara and Mungalawurru on 15 occasions to reduce the cost of travel.

Excluding travel time, the time expended represents 0.44 hours per week per installed computer.

**Materials**

A typical inventory of spare parts and materials carried in the support vehicle included parts identified as being required to address previously reported problems or shortages, plus a stock of items such as printers, printer inks, printer paper, and accessories such as mice, cables, headsets, speakers, keyboards, power boards and a spare monitor.
Copies of software (including Windows 7, Microsoft Office, school applications, device drivers) were also carried.

Supplementary items also carried included facilities for making a cup of tea for the resident group (since from time to time there was a need for an informal meeting to discuss issues that affect the residents as a group) and a cleaning kit.

A more extensive stock of similar items was securely stored at the support base location, and replenished as required. In addition to the above, this included items such as spare computer units and WiFi Access Points.

Indicative content of the spare parts inventory is provided in Table 5.

<table>
<thead>
<tr>
<th>Spare parts / consumables stocked at base</th>
<th>Stock normally carried in support vehicle</th>
<th>Indicative cost per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer units</td>
<td></td>
<td>$1000</td>
</tr>
<tr>
<td>Printers</td>
<td>✓</td>
<td>$130</td>
</tr>
<tr>
<td>Monitor</td>
<td>✓</td>
<td>$200</td>
</tr>
<tr>
<td>Injector plus power cable</td>
<td>✓</td>
<td>$40</td>
</tr>
<tr>
<td>WiFi Access Point/router</td>
<td></td>
<td>$150</td>
</tr>
<tr>
<td>Network LAN switch</td>
<td>✓</td>
<td>$60</td>
</tr>
<tr>
<td>Cables (240v computer/monitor, UTP various lengths, USB, printer data)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mice</td>
<td>✓</td>
<td>$15</td>
</tr>
<tr>
<td>Keyboards</td>
<td>✓</td>
<td>$25</td>
</tr>
<tr>
<td>Headsets</td>
<td>✓</td>
<td>$40</td>
</tr>
<tr>
<td>PC speakers</td>
<td>✓</td>
<td>$25</td>
</tr>
<tr>
<td>Multi-outlet 240v power board</td>
<td>✓</td>
<td>$10</td>
</tr>
<tr>
<td>Multi-outlet 240v power board (surge protected)</td>
<td>✓</td>
<td>$70</td>
</tr>
<tr>
<td>Printer ink sets</td>
<td>✓</td>
<td>$100</td>
</tr>
<tr>
<td>Printer paper</td>
<td>✓</td>
<td>$6</td>
</tr>
<tr>
<td>Software copies</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Padlocks</td>
<td>✓</td>
<td>$20</td>
</tr>
<tr>
<td>Cable ties</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Cleaning kit</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Travel

Travel costs can be a significant component of the overall operational cost associated with providing ongoing support and training, depending on the distance between the support person’s base location and the community, and the nature of the road network between these locations. In central Australia, the route typically resolves into sealed and unsealed road
components, where the quality of the latter can vary depending on the weather and the volume of traffic the road has carried since it was last graded or repaired. In practice, reliable travel over any unsealed component beyond a very few kilometres dictates the use of a high clearance four wheel drive vehicle equipped with additional recovery tools, first aid kit, satellite phone and drinking water. The need for capacity for weatherproof carriage of and ready access to spare parts and materials dictates a further requirement for more luggage space than the typical station wagon can provide. Together, these requirements add up to a four wheel drive covered tray utility vehicle (or similar), where the cost of ownership and running costs are typically in the range $1.30 -$2 per kilometre in 2013 dollars. To this must be added the cost of travel time for the driver and support person.
9. Experience with the equipment and services

Section 6 described the main items of equipment, software and services provided through the project.

In this section, we discuss the experience with these (including their performance and failure rates), and related topics.

Satellite Internet 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 6 provides examples of measured speeds. All of these measurements were recorded using the same Internet speed test tool\textsuperscript{15} 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.

An obvious feature of these measurements is the very low upload speeds. 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\textsuperscript{16}. If this criterion were applied, few of the times at which the Table 6 speeds were sampled would have been suitable for videoconferencing.

These often quite low Internet speeds, particularly in the upload direction, meant that the service plan used on the project, while being typical of the higher speed offerings available under the Australian Broadband Guarantee (ABG) scheme, was not well suited to a multi-user situation. The Long Term Satellite Service (LTSS), to be offered from 2015-2016 on the National Broadband Network, will be configured to match the maximum numbers of subscribers to the available capacity (i.e. with low contention ratios\textsuperscript{17}), whereas the ABG services are not limited in this way.

\textsuperscript{15} Ozbroadband speed test: \url{www.ozspeedtest.com}
\textsuperscript{16} Technology Whitepaper - Preparing your network infrastructure for UC collaboration and video deployment
Buckley, D and Anscombe T, Gen-I Australia May 2012
\textsuperscript{17} In this context, contention ratio is the number of services of a nominal data speed that share a data link with that same data speed capacity. If all those services attempt to use the link simultaneously, each one will be restricted to the nominal speed divided by the contention ratio.
Without improvements to Internet speeds, some of the opportunities that have been envisaged for remote communities, such as the use of videoconferencing for purposes such as health checks and consultations or access to health and education programs online, will not be available in the near future. In addition to link speed, latency of the geo-synchronous satellite link creates an absolute physical limitation, particularly for two way communications. It appears though that except for specialised applications where the latency delay added to normal human reaction time would compromise the performance of the application (such as a remote guidance medical application that relied on immediate feedback from the guided object), the normal satellite latency of about 0.25 seconds in each direction – a round trip delay of half a second – would allow satisfactory application performance.¹⁸ Thus for a videoconferencing application, link speed is likely to be the main practical constraint.

Table 6 – Examples of measured Internet speeds

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Time of day</th>
<th>Download speed recorded (Mbps)</th>
<th>Upload speed recorded (Mbps)</th>
<th>Pre/ post commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwale Kwale</td>
<td>21/1/2011</td>
<td>0730</td>
<td>3.7</td>
<td>0.3</td>
<td>Pre</td>
</tr>
<tr>
<td>Kwale Kwale</td>
<td>5/4/2011</td>
<td>1500</td>
<td>0.3</td>
<td>0.1</td>
<td>Pre</td>
</tr>
<tr>
<td>Kwale Kwale</td>
<td>11/4/2011</td>
<td>1530</td>
<td>0.4</td>
<td>0.1</td>
<td>Post</td>
</tr>
<tr>
<td>Kwale Kwale</td>
<td>23/5/2011</td>
<td>1500</td>
<td>0.2</td>
<td>0.2</td>
<td>Post</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>5/6/2011</td>
<td>0720</td>
<td>2.9</td>
<td>0.5</td>
<td>Pre</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>22/6/2011</td>
<td>1235</td>
<td>2.6</td>
<td>0.1</td>
<td>Pre</td>
</tr>
<tr>
<td>Imangara</td>
<td>2/8/2011</td>
<td>1500</td>
<td>3.7</td>
<td>0.5</td>
<td>Pre</td>
</tr>
<tr>
<td>Imangara</td>
<td>4/8/2011</td>
<td>1100</td>
<td>0.8</td>
<td>0.1</td>
<td>Post</td>
</tr>
<tr>
<td>Imangara</td>
<td>19/10/2011</td>
<td>1730</td>
<td>0.5</td>
<td>Not recorded</td>
<td>Post</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>1/2/2012</td>
<td>1145</td>
<td>0.8</td>
<td>0.3</td>
<td>Post</td>
</tr>
<tr>
<td>Kwale Kwale</td>
<td>26/3/2012</td>
<td>1150</td>
<td>1.1</td>
<td>Not recorded</td>
<td>Post</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>30/5/2012</td>
<td>1030</td>
<td>0.9</td>
<td>0.2</td>
<td>Post</td>
</tr>
<tr>
<td>Imangara</td>
<td>31/5/2012</td>
<td>1310</td>
<td>1.5</td>
<td>0.2</td>
<td>Post</td>
</tr>
<tr>
<td>Imangara</td>
<td>5/7/2012</td>
<td>1625</td>
<td>0.3</td>
<td>0.2</td>
<td>Post</td>
</tr>
<tr>
<td>Mungalawurru</td>
<td>20/7/2012</td>
<td>1230</td>
<td>2.0</td>
<td>0.2</td>
<td>Post</td>
</tr>
<tr>
<td><strong>Average of samples</strong></td>
<td></td>
<td></td>
<td><strong>1.4</strong></td>
<td><strong>0.2</strong></td>
<td></td>
</tr>
</tbody>
</table>

**FINDING**

9. 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**

Starting with the 20 computers initially installed by early August 2011, failures or other factors meant that on average, 15 computers with Internet connections were fully operational for the period from August 2011 through to end September 2013.
Damage, failures and losses are described in detail in this section under *Failures & losses*. In addition, two computers at Kwale Kwale and one at Imangara were taken out of service for various periods at the residents’ request. The reasons for this included:

- Residents of one of the houses had died, and the senior resident did not want material relating to the deceased persons to be viewed by others
- An unwanted visitor had been accessing one or two of the computers without permission and viewing undesirable material on his own DVDs, and it was difficult for the residents to manage this situation without removing the computers in question altogether.

*Performance of applications*

*Operating systems*

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

*Skype*

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.

*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 (.pst) disappearing several times and Outlook failing to access the mail server at some other times. Once understood, the data file problem was soluble, but not by the residents themselves. Possible causes are slowness of the Internet uplink causing a timeout, or blocking by the content filter firewall.

Later in the project, we encouraged some residents to use webmail to avoid or temporarily overcome the Outlook problems, and a few people did this to good effect. A disadvantage with webmail however, is that the user must enter a password to log onto it on each occasion.

A number of residents made progressively more use of email during the course of the project. As their usage grew, the volume of spam grew commensurately, and combined with residual ‘legitimate’ messages they would often be faced with the situation that several hundred emails had built up in their inbox. The consequence of this was that this masked useful new messages for some people. None of the residents as far as we are aware developed a
discipline for dealing with this issue, either by regular purging of unwanted emails or developing their own folder system.

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

FINDINGS

10. Because the operation of the Microsoft Outlook email application is somewhat more complex than web based email, it would be better for projects like this to use web based mail such as Hotmail or the ISP’s webmail service in the first instance until users are in need of more advanced email features.

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

Other issues

A few other instances of application problems have occurred, usually as a result of a resident or their kids 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.

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:

a. 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.

b. 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.

Passwords
Each computer was initially set up with a single unpassworded user account and a password protected administrator account. In addition, passwords were required for Skype accounts and for email accounts.

Some password related issues arose over the course of the project. These were:

- Some residents had difficulty remembering or retaining records of passwords for email and Skype. This was not been a serious problem given that those applications do not normally demand a password at each activation.
- At the beginning of the project, the administrator accounts had been set up with a common password for all computers which was known only to the project team members. This same password was also used for access to the content filter configuration. However, a few residents wished to download applications, which required administrator account access. On rare occasions, problems also arose with the audio settings, which also required access to the administrator account. In such cases, the administrator account password was changed to one chosen by the computer owner, and (as far as we were aware) known only to them.
- Over time, a few people wanted more privacy for their material and to stop visitors from using their computers (i.e. allowing people to say ‘no’ without verbally saying ‘no’, and therefore wished to create passwords for their user accounts. Some of these were created independently by the residents, and others were created by project team members on request.
- WiFi Access Points were provided at two households to allow residents with tablet computers to connect them to the Internet. The first of these was provided with a WPA password, but the residents had some difficulty recording the password and using it, so the second point was installed without a password, although with the understanding that one could be added at a later date if necessary. As far as we are aware there have been no difficulties flowing from this latter arrangement.

**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.

The printer model installed in the majority of houses (Canon iP3600 inkjet) became difficult to procure, then ultimately obsolete at mid-2013, close to the end of the project funding period. Two other models were used for replacement in the latter stages of the project:

- Canon MG 5460/5560, which was the nearest model match to the iP3600 in terms of footprint and function. However, this printer was an all-in-one model, including a fax
function (which could not be used in the environment as configured) and a scanner function. The scanner function required top load access to the printer, which was difficult to achieve within the confined space of the cover.

- Hewlett Packard 8600, which was a physically larger and more expensive all-in-one printer recommended by the local computer retailer in Tennant Creek as being relatively robust, and economical in ink consumption. This unit was too large to fit within the available space inside the cover, and was installed in only one household to compare its performance in these respects with the other models, and to assess the usefulness of the scanner function to the residents. Indications over the period December 2012 to date from this sample of one are that this printer is performing reliably, although we are unable to confirm how its ink use compares with the other printers.

One resident asked for help in laminating photos printed from her computer. The project provided a laminator which she subsequently put to good use, both on her own behalf and for other members of the community.

Printer reliability is discussed further under the heading ‘Failures & Losses / Printer failures’ in this section.

**Consumables**

Most use of consumables related to printing. Printer cartridges were required reasonably frequently (maintenance records showed an average of one full set at around $100 per six month period per active printer), and residents were shown how they could replace these themselves after the first replacement occasion. Printer paper consumption averaged about 250 sheets per printer per 6 months. This represents an ink cost per printed sheet of about 40 cents, which suggests that the bulk of printing use is for colour 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. Unfortunately, there is little consistency of ink cartridge types across printer models within brands, so there typically is a need to stock full sets of spares for each printer model in service.

**FINDING**

13. The dominant consumable cost is in the replenishment of printer ink cartridges – about once every six months per printer.

**Failures & losses**

Failures are described under two broad headings, core equipment and accessories:

a. Core Equipment

Failure or loss of core equipment including the computer processor or printer and network equipment. These and other incidents of this type are tabulated in Table 7.
Table 7 – Failures or losses of core equipment  
August 2011 to September 2013 inclusive

<table>
<thead>
<tr>
<th>Item</th>
<th>Total installed population</th>
<th>Qty lost/removed by resident (A)</th>
<th>Qty failed or damaged beyond repair (B)</th>
<th>Qty non-functioning and repaired (C)</th>
<th>Mean time between failures (months) (B &amp; C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>22</td>
<td>2</td>
<td>8</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>Monitor</td>
<td>21</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>68</td>
</tr>
<tr>
<td>Computer/Monitor</td>
<td>22</td>
<td>2</td>
<td>15</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Printer</td>
<td>18</td>
<td>2</td>
<td>22</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>UPS</td>
<td>20</td>
<td></td>
<td>8</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Network</td>
<td>19&lt;sup&gt;21&lt;/sup&gt;</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>45</td>
</tr>
</tbody>
</table>

Computer failures

Occasionally, computers failed to start up at turn on. The first time this occurred, the fault was repaired by the supplier under warranty by removing and cleaning the processor memory boards internal to the computer. On subsequent occasions, the same repair action was undertaken in the field by CAT staff, with varying success. Some of these faults may also have been symptomatic of a minor design problem. Thick dust was sometimes present inside the computer, particularly around the fan intake areas. Figures 7A & B show examples of penetration of dust and bugs inside the computer casing.

There was considerable variation in the number of times computer failures occurred in particular households. One household had their computer replaced 4 times, and another twice. Causes of the failures were partly physical damage to the computer, and partly hard drive failure, the latter possibly being attributable to dust and/or overheating. A contributing factor in both cases seems to have been the number of young kids living in the house and using the computer.

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<sup>19</sup> For the majority of the project duration, desktop computers were provided with discrete monitors. Late in the project several all-in-one computers were provided as replacements.

<sup>20</sup> By comparison with this total of 22 computer failures over the 25 month project period, a large survey of failure rates in corporate desktop computers referenced at [http://www.partnerinfo.lenovo.com/partners/us/products/downloads/thinkcentre-mseries/TBR-Quality-Study-ExecSummary.pdf](http://www.partnerinfo.lenovo.com/partners/us/products/downloads/thinkcentre-mseries/TBR-Quality-Study-ExecSummary.pdf) recorded an average 15.29% failure rate requiring warranty repair over the first two years of service, or 3.5 failures for an equivalent population of 22 computers over 25 months.

<sup>21</sup> Two further connections were provided using (broadcast) WiFi Access Points subsequently
Losses

On two occasions, the computer and printer were removed by residents to another location, and have not yet been returned to the community. The onus was placed on those residents to return them, so these items have not been replaced.

Printer failures
Printer failures were the most frequent type of failure of core equipment. In addition to irreparable 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. In most cases the paper feed was changed to upper tray feed in an effort to overcome this problem, but the upper tray in the iP3600 printer is also uncovered, and there was no clear evidence as to whether this change resulted in a reduction in printer failure. In some cases, it was possible to recover the printer by judicious manual cleaning and/or invoking the inbuilt maintenance routines for print head or roller cleaning.

The most obvious trend in printer failures was a marked increase in irreparable mechanical failures in year 2 (4 instances in year one, 15 instances in year two out of a total installed population of 18 printers). On these figures, each printer typically had a service lifetime of about 2 years. In practice, the ink cartridges for a given printer model in this price range became difficult to source after about this time, so the combination of limited printer lifetime, the need for frequent maintenance, and difficulty of ink sourcing made printing problematic.

Network failures

Network failures are defined for the purpose of this report as failures outside the computer itself that caused a loss of Internet connectivity. The networking equipment comprised:

Centralised equipment

- Satellite dishes and associated electronics
- Satellite modems and network switches housed in protected enclosures, typically wall mounted equipment cabinets
- Roof or eave mounted antennas and local area wireless transceiver equipment
- Lead-in and data cabling

Household equipment

- Roof or eave mounted antennas and local area wireless transceiver equipment
- Power injectors
- Lead-in and data cabling

No hardware failures occurred in the centralised equipment during the course of the project. On one occasion the power to a satellite cabinet was inadvertently turned off, resulting in loss of connectivity for the connected houses for 3 days until the source of the problem was identified.

No failures occurred in the household roof-mounted equipment, although where lead-in cable was exposed to sunlight the outer cable sheathing had deteriorated by
September 2013. It appears that the cable utilised by the wireless installation contractor was not Ultra Violet stabilised. See Figure 8 for an example.

**Figure 8 – Deteriorated lead-in cable sheathing**

All other network failures related specifically to the injector or cabling located in the vicinity of the computer desk inside the households. Two of these failures were hardware failures, but the majority resulted from cables being unplugged by the residents and not being correctly configured when restored.

**FINDING**

14. Failure rates over the project period for core household equipment, particularly printers and to a lesser extent for computers, was high. In contrast, no failures occurred in the centralised network equipment.

b. Accessories

Incidents of failure or loss of accessories including headsets, computer mice, keyboards, cover padlocks are tabulated in Table 8.

**Table 8 – Failures or losses of accessory equipment**

**August 2011 to September 2013**

<table>
<thead>
<tr>
<th>Item</th>
<th>Total installed population</th>
<th>Qty lost/removed by resident</th>
<th>Qty failed or damaged beyond repair</th>
<th>Qty failed or damaged and recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headset</td>
<td></td>
<td>12</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Accessory</td>
<td>Damaged</td>
<td>Lost</td>
<td>Forced Open</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------</td>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Mouse</td>
<td>3</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keyboard</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Padlock lost and / or hasp forced open</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power board</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speakers</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The design of the computer accessories is such that they are relatively fragile, being connected by low strength cables and manufactured of light duty materials. In particular, headsets are vulnerable to failure for this reason.

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. In practice, the covers were rarely locked after the first few months of the project.

It was unfortunate in respect of the computers themselves that power boards and external speakers can be useful in other applications. These items often ‘disappeared’ or were borrowed for other household purposes.

**FINDING**

**15. 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.**

**Repairs**

Where possible, computers were returned 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, or where there were lengthy delays waiting for replacement parts or repairs under warranty.

**Quota adjustment**

As people moved between houses or to and from the community, it was occasionally necessary to change the daily Internet quota of one of the computers. This was 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 was raised by one relatively advanced household at Imangara, but they did not ultimately take up the option.
Physical environment and 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 an approach that has been adopted since the computers have been installed. 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, only a small number of residents close down the cover regularly after use. In four documented instances, mice made their way into printers through their open cover and either damaged it through nesting inside or destroyed the paper stock. See Figure 9 for an example.
In a number of other cases, it appears that residents attempted to remove ink cartridges by manually forcing the cartridge carrier to the central access position, rather than the correct procedure, which was to turn the power on to the printer and wait as instructed for 30 seconds or so for the cartridge carrier to move into the access position. This resulted in some permanent printer failures.

The nature or function of the building (shared community building or residential house) also has some bearing on protection of the computer equipment. The Women’s Centre at Imangara, which housed two of the computers for most of the project duration, 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 such as the CDEP shed at Mungalawurru 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. Continual education / awareness raising is needed in those cases.

Energy use

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

The primary purpose of the content filters was to prevent access by users (conscious or otherwise) to undesirable material, such as pornographic or violent content. The configuration of the filter on a computer could be changed to vary the allowed categories of access, either as individual categories, or as groups of categories under broad user type headings such as ‘child’, ‘adult’ or ‘unrestricted’. For example, in configuring the project computers ‘adult content’ and ‘violence’ categories’ were disallowed for all groups. Generally speaking, the group selected was determined by the project team to correspond with the youngest person likely to use a particular computer.

From time to time, filter reports taken by project team members, either at random or in response to a concern expressed by a resident, indicated an attempt to access undesirable website material, so some tightening of groups or categories was carried out on the relevant computer.

It also became apparent later in the project that the content filters were not 100% effective in blocking access to undesirable websites, and at this point, safe search modes were programmed on all computers for the Google search engine and YouTube. This appeared to eliminate such access on the small number of computers in question.

One incidental effect observed with the design of the Integard content filter was that the daily filter quota limit only activated at the end of a current application session. This means that if a resident started using the computer to download a movie or similar large file while there was quota remaining, the filter limit would only stop further download activity once the movie download was 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 did not respond.

A useful feature of the content filter was that with some address translation configuration changes to the satellite modem, it was possible to access individual filters remotely to make changes to it. This method depended on the computer in question being turned on, and also on any firewall or firewalls in the remote access path being transparent to the forwarded port numbers. In practice, its usefulness was limited by these factors, and access to the filter port did not always function reliably.

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 far better arrangement in terms of providing physical protection from damage by people or table legs hitting it, but is still unsealed at both ends, and thus vulnerable to infestation by cockroaches and wasps.

**VoIP phone trial**

As described in Section 6, the Vtalk system was installed in 2 houses at Mungalawurr in late 2012. Despite being set up purely for local operation within the community, the equipment design required communication with the supplier’s external Sydney based server over the Internet, as part of its initialisation / power-up sequence. It also emerged that the Vtalk central PBX unit needed to communicate continuously with the external server.

Whilst its operation had been tested successfully in Alice Springs, on installation at Mungalawurr the Vtalk PBX unit which was located in the Bushlight shelter failed to communicate correctly with the external server, requiring the supplier (who was also the system designer) to make changes to the Vtalk software remotely. This resolved the initialisation problem.

It later became apparent that when the power to the VoIP phone base unit in a house was lost (due typically to residents using up the day’s electricity quota for the house), the phone did not always re-register when the power came back on, and when it did, it took several minutes. This was contrary to normal telephone behaviour, and made the phones somewhat cumbersome and inconvenient to use.

Our conclusion after experience with these arrangements over a few months was that this system really needed a continuous ‘always on’ power source at each house, and that without it the phone was of limited use.

**NTER measures**

As described in Section 3.6, the provisions of the *Northern Territory National Emergency Response Act 2007*, which were active during early part of the implementation project, placed a number of controls on owners of publicly funded computers located in prescribed communities in the Northern Territory, which included all of the Project communities.

These controls included 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.

The content filter is discussed earlier in this section. Because the context of use of the HIP computers was different from the majority of situations where the NTER provisions applied, in being essentially household computers rather than access centre computers, lists of the custodian names were supplied in lieu of usage records. Audits were conducted at November 2011 and May 2012, after which the NTER provisions ceased to apply. The audits were conducted by a member of the project team in the manner prescribed by the then Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA). FaHCSIA supplied a USB stick containing the audit program, which was executed in all accessible prescribed computers, and the results stored on the same stick in encrypted form. The stick was then returned by post to FaHCSIA. Because of the nature of the process, no indication of the result was given by the software to the person conducting the audit. No subsequent feedback was provided by FaHCSIA.
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 project (December 2011 to September 2013). The average over this period was 26%, or about 4 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. At the end of the project, 16 Internet connected computers and 1 offline computer were in service.\textsuperscript{22}

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. Imangara has about twice as many occupied households as either Kwale Kwale or Mungalawurr, with commensurately higher usage. Usage at each of the communities was quite variable. In some cases this variability can be attributed to specific known causes. For example, in November 2011 the community at Imangara was particularly affected by the consequences of a serious accident, which resulted in several of the houses being vacated and computers remaining idle from partway through November 2011. A partial explanation for the relatively low and variable use at Kwale Kwale was that two of the four computers there were temporarily removed for safe keeping at the residents’ request at various times during the project.

\textsuperscript{22} At Imangara, a housing replacement program commenced during September 2013. Some houses with computers were temporarily affected by the program. These figures have not been changed to include those effects.
The total monthly quota for Kwale Kwale and Mungalawurru was 17GB (including both peak and off peak use), and 34GB for Imangara where two satellite services were deployed; Internet use occasionally exceeded the quota everywhere except for Kwale Kwale.

**Figure 6 – Internet volume of use by community**

![Graph showing Internet volume of use by community over time.](image-url)
11. End of project transition arrangements

Funding for the implementation project provided for the facilities and services to continue to operate from the installation in mid-2011 through to the end of September 2013. Ownership of the household equipment (the computer, printer and desk) in a Western legal sense had been transferred to 15 of the householders by the end of the project. The end of project funding meant that maintenance of the equipment, purchase of consumables (paper and ink cartridges) and payment of monthly fees for Internet access became the responsibility of each computer owner.

Planning the transition to self-funding

Because of the administrative complexities associated with making the transition from project funding to self (resident)-funding, the project team commenced a dialog with the residents starting early in 2013. With respect to the Internet service, each computer owner essentially had three choices:

- Maintain their existing shared satellite Internet access connection and ISP service, and make arrangements to share the cost of the monthly Internet access fees
- Abandon the existing arrangement, and obtain a new individual service for their own household and computer, or
- Opt out of Internet connectivity, and operate the computer only in off-line mode.

Few households explicitly wished to opt out of Internet connectivity. There were a number of factors which influenced and in some cases complicated the choice, including:

- Residents were generally more inclined to opt for a single household service than to maintain their existing shared arrangement.
- All of the original Government-subsidised satellite Internet services were obtained under the ABG scheme. Applications for new services of this type after mid-2011 were required to be made under the new NBN ISS program eligibility rules. Unfortunately these rules preclude anyone participating in our project who had an existing operational ABG service from transitioning to ISS - this meant that none of the four original ABG applicants was eligible for ISS.
- The tariffs for ABG-comparable ISS services are generally lower.
- The mechanism for paying the monthly tariffs for Internet service typically involves a direct debit against a bank account, or a credit card transaction. In one or two cases, the householder did not operate a bank account with a sufficient rolling balance to use the first option, and/or did not operate a credit card account. We explored the option of using a resident’s BasicsCard for this purpose with the relevant service provider, the Commonwealth Department for Human Services (DHS). While not expressly precluding it, DHS officers indicated a preference for the resident to use other options.
- A few residents had moved away from the house they were previously living in, either within the community or to another community.

The need to work through the various issues and options with each householder meant that it took some months before residents had made a clear choice, and the associated paperwork
was completed and signed. The latter was in itself a multi-stage process, involving registrations with NBNCo (completed online by the project team on behalf of the applicants), signature by each applicant of their registration form posted out by NBNCo, selection of the appropriate plan, and completion and mailing of forms and bank account details to the selected ISP. In a small number of cases, the resident did not personally have a record of their bank account details at hand – they had to obtain these from another person whom they had entrusted them with.

As at September 2013, the households had opted to make the transition as follows:

- At Kwale Kwale, two of four resident households planned to retain and share the cost of the existing ABG service.\(^{23}\)
- At Mungalawurrru, at the end of the project there were four households sharing the ABG service. Two households opted for individual ISS services. One family was in the process of moving into Tennant Creek township, and wished to obtain a service there – in the event, the street in question (in one of the town camps) does not have terrestrial broadband (ADSL) access, so the only option available is mobile broadband. The fourth household was undecided.
- At Imangara, at the end of the project there were 8 households sharing the ABG services, 3 temporarily offline, and one family had moved out of the community. Of the 11 households remaining in the community, 8 opted to transfer to ISS services, one planned to retain their existing ABG account, and 2 were undecided.

In total then, 15 of 19 households wished to retain an Internet service at their own cost.

**Post transition experience**

**Termination of project funded ABG services**

With the exception of one of the services at Imangara which was taken over by a resident household, the project funded ABG services were cancelled at the end of October 2013 when that funding expired. Similarly, the funding for support and training activities expired at the end of calendar 2013, so visits by the project team for those purposes finished with a final visit early in December 2013, although there was continuing phone and/or email contact after that time, and an opportunity to visit and make face-to-face contact again through the longitudinal research program at longer intervals starting in April 2014.

**Actual take-up of ISS services**

In the event, take-up of ISS services for the majority of householders was consistent with their intentions at September 2013, though there were a number of changes:

At Kwale Kwale, one of the householders intending to retain the the ABG service left the community, and the other, being employed full-time in Alice Springs, decided not to maintain the service at home.

\(^{23}\) Subsequently, in October 2013, one of the resident users left the community. Another household was still considering taking over the existing service.
At Mungalawurru, two households applied for ISS services, and these were installed on 14/10/13 and 23/12/13.

At Imangara, seven households applied for ISS services, and all but one of these were installed on 18/10/13 (1 service) and 28/11/13 (5 services). A number of factors prevented the last service from being installed, primarily the absence of the householder from the community for an extended period whilst occupied with a newly born child. A further household opted to retain and take over payments for one of the existing ABG services, and the local wireless configuration was rearranged so that the household next door could also continue to use that service. Finally, one household which had previously had a shared connection via WiFi decided they would like to apply for their own ISS service, though this decision was made in April 2014 after the Government announced that the ISS was fully subscribed. This household is awaiting announcements on the extension of the ISS that may allow them to apply for a connection toward the middle of 2014.

Thus in total, 10 households (compared with 17 households or community buildings originally connected in the project) have ultimately retained the use of the Internet to date. There has been considerable change in the total composition of households engaged in the project since the original implementation in mid-2011: a number of households have been added and/or changed resident members and most of the shared building computers have been re-distributed to individual households along the way. Table 9 summarizes these changes.
TABLE 9 – CHANGES OF STATUS OF BUILDINGS AND HOUSES DURING THE PROJECT

<table>
<thead>
<tr>
<th>Community</th>
<th>Building</th>
<th>Original status mid-2011</th>
<th>Post transition status early 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Internet connection?</td>
<td>Internet connection?</td>
</tr>
<tr>
<td><strong>Kwale Kwale</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community shed</td>
<td>2 shared</td>
<td>yes - both</td>
<td>1 shared computer</td>
</tr>
<tr>
<td>Residence 1</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 2</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 3</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td><strong>Mungalawurru</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community shed</td>
<td>2 shared</td>
<td>yes - both</td>
<td>nil</td>
</tr>
<tr>
<td>Residence 1</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 2</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 3</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 4</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td><strong>Imangara</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women’s Centre</td>
<td>2 shared</td>
<td>yes - both</td>
<td>nil</td>
</tr>
<tr>
<td>Residence 1</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 2</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 3</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 4</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 5</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 6</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 7</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 8</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 9</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 10</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 11</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 12</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td>Residence 13</td>
<td>computer</td>
<td></td>
<td>1 computer</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20 computers</td>
<td>20 of 20</td>
<td>21 computers</td>
</tr>
</tbody>
</table>

Note 1: Computer is now located in Tennant Creek township. Resident obtains Internet connection via a smartphone.
Note 2: These houses were demolished and rebuilt during 2013.
Note 3: Computer is not installed in this house at the time of writing.
Note 4: This house had Internet connection from January 2013 until end October 2013 i.e. prior to the transition.

Initial experience with ISS services over the first 3 months

Initial experience with the computer and ISS Internet services since the transition has been mixed. While only one household experienced a technical problem with their computing equipment and services, a number of service holders experienced account related problems, and the amount of usage made of the service varied greatly between the households. Of the ten households:

- Only one household had accessed either their email or their account information after the ISP changed most of their passwords in November/December 2013. The ISP informed them of the action by letter subsequent to making the change, but that letter required the affected account holder to place a phone call to obtain the new password.
Only one of the six affected in this way had done so, and it appears the letter simply created confusion.

- 3 households were unable to maintain sufficient balance in their nominated bank accounts to support the monthly payments. The pattern of unsuccessful transaction attempts suggests that if there were sufficient funds to pay the monthly fees, they were only in the account for a very short period before being withdrawn by the householder for other purposes. All of these households are nevertheless committed at the time of writing some 6 months after the transition to persevering to maintain their service.

- At least 5 households had very high peak monthly levels of usage, ranging up to 3 or more times the monthly quota for each of these households (note that all of these services are shaped services, so that over-quota data continues to be provided, but at a much slower speed (typically 128kbps for the new services). These high levels were even higher than those experienced prior to the transition, suggesting that these residents were making greater use of the Internet than was possible prior to transition. This could be due to the fact that the filter limit that was in place prior to the transition to ensure the available quota was evenly shared between households was removed because it was not needed for the individual household services post-transition.

In contrast, 2 households had very low levels of usage. For one of these households, this may be due to cable damage preventing connection of the computer to the satellite service, and for the other, it is possibly due to the householder being absent from the community for a prolonged period.

- The status of 2 households is unknown. The project team has not obtained authorization from the ISP to access their account information.

### FINDINGS

17. There has been considerable change in the occupancy of households and buildings used by computer users engaged in the project over the three years of the project, with around half of households or buildings no longer occupied by the original residents or used for that purpose.

18. The major change for resident householders at the transition was the need for them to pay for their own individual Internet accounts. About half of the overall number of households opted to do so.

Of those, about half of the householders have been unable so far to maintain sufficient balance in their nominated bank accounts to support the monthly payments. All of these households are nevertheless committed at the time of writing to persevering to maintain their Internet service.

19. Most of the computers in shared community buildings have been re-distributed to individual households (by residents suggesting and agreeing to these changes) during the course of the project, suggesting that the preferred computing
approach for small self-managing communities is individual household ownership rather than the shared building option.
12. Cost, technical and administrative barriers to take-up

Following is a discussion of some of the barriers to take-up of home-based Internet and computing facilities, and measures that might be needed to make continued use of these facilities sustainable.

Cost barriers

The cost that would accrue directly to the residents to fully self-fund facilities and services in the form provided by this project would likely result in them seeking cheaper alternatives or choosing not to have home Internet at all. The 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, technical support for computing and printing, and computer furniture. The cost of an individual satellite connection per eligible household would be of the order of $35 per month on current pricing for the lowest speed and quota\(^24\), compared to somewhat less for a higher capacity service shared between 5 households (say $25 per month per household). The extra cost of the individual household connection would be offset by avoiding the need for a local (WiFi) distribution network.

Viewed from a ‘life-cycle’ perspective for the whole community, there are a number of factors that affect the achievement of an effective and sustainable computing and Internet access outcome:

- From the implementation perspective, a collective approach to the planning is more time consuming and expensive, but is likely to offer a better prospect for the members of all households to obtain a timely and comparable level of service, regardless of the abilities and level of motivation of the individual householders. Since the planning expertise for such a collective approach is unlikely to be found within a community, it is probable that its cost would have to be met by an external subsidy of some kind.

- Experience through the project has shown the shared network equipment to be robust (see Section 9). Thus whether a multi-household or individual household approach is adopted for Internet connections is not likely to be a decisive factor for long term sustainability.

- 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, even if not subsidised. For others, the outcome of an individual approach would potentially be similar to that already experienced with satellite TV subscriptions, where people’s ability and interest in maintaining payments fluctuates according to other demands on their finances. Some services might be suspended for periods when those other demands are more pressing.

Experience with planning the transition phase in the last months of the project has demonstrated that a majority of households, given the need for self-funding, will opt for individual Internet services and accounts, suggesting that most householders are

\(^24\) Based on pricing plans for retail ISPs providing services under the NBNCo Interim Satellite Service (ISS) as at September 2013. See for example Activ8me [http://www.activ8me.net.au/internet/nbn-satellite-broadband-plans](http://www.activ8me.net.au/internet/nbn-satellite-broadband-plans) and Skymesh [http://www.skymesh.net.au/services/nbn/satellite/srss.php](http://www.skymesh.net.au/services/nbn/satellite/srss.php)
unenthusiastic about paying for their neighbours’ use. Thus while a shared, externally funded Internet connectivity option offers advantages in initially getting the whole community engaged, such a model may not be sustainable once these funds disappear.

- For cost and space reasons, if the introduction of computing and Internet connectivity is to be fully self-funded by the residents, it is unlikely that the computer could be guaranteed its own table, and even less a cover and room to itself. In the HIP, only two of twenty households were able to provide a specific purpose ‘computer room’. It therefore seems more probable that residents would choose a portable device (laptop or tablet) in these circumstances. For similar reasons most would probably dispense with the need for a printer. Experience with the project suggests that laptop equipment is more vulnerable to failure or loss. Anecdotally, residents’ experience with tablets such as iPads indicates that failure of such devices due to them being dropped or otherwise damaged is also not infrequent. So the prognosis for a sustained long term facility is not good where the facilities are self-funded and the owner by necessity or choice does not provide an environment that is protective of the equipment. There would be a greater prospect for sustainability if subsidy funding is provided for the protective environment (robust computer table and cover).

- In a broader context, people have a self-interest in taking greater care of belongings where they themselves are responsible at least in part for purchasing or maintaining it. This is a sustainability argument for encouraging residents to contribute to the purchase and maintenance of equipment, particularly the equipment that is vulnerable and that they themselves have some direct control over, namely the computing device itself.

Since the transition, further evidence has emerged that highlights the significance of cost as a key factor in affecting people’s access to Internet services. The immediate change for resident householders after the transition was the need for them to pay for their own individual Internet accounts. Most had chosen a plan at the low end ($35-40 per month) of the range. About half of those householders have struggled over the first 6 months to maintain sufficient balance in their nominated bank accounts to support the monthly payments when they become due, resulting in temporary loss of access to the Internet in some cases, and much larger withdrawals when the accrued fee is eventually debited. While theoretically a pre-paid account option that might relieve this situation is available, that option requires payment for 6 months’ usage in advance, which is too high a lump sum payment for residents operating on very low incomes.

One obvious improvement would be a ‘pay by the Gigabyte’ pre-paid satellite broadband option (analogous to the well-established pre-paid SIM option for mobile phones), which would overcome the need for involvement of the customer’s financial institution in both the application process and monthly billing.

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25 This phenomenon may be related to the study of ‘source dependence’, where the manner in which a person acquires something affects its value to the acquirer.
FINDINGS

20. A level of external subsidy funding is desirable for some of the up-front costs (planning, and implementation of the network component and protective environment for the household equipment).

21. An operating subsidy would assist those who would otherwise struggle to allocate the funds for Internet access fees, but unless this subsidy is likely to be maintained in the long term, an individual rather than shared subscription model is the more sustainable approach.

22. Residents should be encouraged to contribute to the purchase and maintenance of the computing device itself.

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, particularly the use of facilitator(s) to liaise with ISP administrative and installation staff.

Once the facilities are established and bedded down however, the complexities reduce, and there is a greater opportunity for local involvement. Our experience 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. Four to six-weekly support visits as undertaken for this project 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. 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.

Solving most of the problems would not be beyond the skills and experience of a person with broad ICT-user 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 (for example Papunya). The questions then are how to engage such people, and how to deploy them. Such a model would enable the person employed for this work to be employed on a substantial part- or full-time basis, whereas limiting their focus to a single community would probably not provide sufficient employment hours to maintain either their interest or expertise. If this person was an Indigenous person with connections to that community, cultural issues would probably preclude them from working effectively there, for example where individuals can’t have dealings with some others due to avoidance relationships, or where they have social obligations which might result in differing service levels being provided. Employing non-Indigenous persons in this role would resolve the cultural issues, but is less desirable in terms of providing local employment and the person’s likely long-term commitment to the region.

FINDING
23. 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.

The ongoing support role may be able to be filled by a person based in a larger
remote community with the appropriate experience, servicing their own and
other communities in their region. If this person was an Indigenous person with
connections to that community, cultural issues will probably preclude them from
working effectively there.

Administrative barriers

To connect their computer to the Internet through the NBNCo Interim Satellite Service, a
remote area resident currently has to proceed through the following sequence of steps:

• Run the NBNCo Broadband Service Locator online mapping tool to determine what
  services are available in their location. Where the customer does not have access to
  the Internet, or they prefer to make an application by phone, they can call NBNCo to
talk them through this step over the phone. The Locator typically generates a list of
about 6 NBNCo registered retail satellite service providers (ISPs) who may be
prepared to offer and install services in the customer’s area.\(^\text{26}\)

• Register their details on the website, resulting in them being posted an information
  pack by NBNCo, which lists the contact details for the listed ISPs, and a Customer
Declaration Form. The householder / customer must sign this form to confirm their
permanent residency at the premises indicated, and the permanency of the building
itself.

• Contact one or more of the listed ISPs, and obtain and compare their service offerings
in terms of access speeds, quotas, pricing plans, shaping vs. excess charges, contract
duration and any other features of interest.

• Having selected an ISP, they then forward the signed Declaration Form together with
their contract application form to the ISP to apply for service. The contract
application form includes details of their bank account or other payment method.

• When the application has been processed and approved, the ISP or their installation
sub-contractor contacts the customer to arrange a tentative installation date within the
next few weeks. The normal assumption is that the customer has a mobile phone and
can be contacted in the first instance by text message to initiate this part of the
process.

• When the date of installation is imminent, the installer contacts the customer again to
confirm or adjust the time. This may involve several changes to the schedule, for
example due to weather conditions affecting road access either in that customer’s area
or for other customers who form part of that installer’s current round.

• Assuming the customer has arranged to provide a continuous 240 volt power supply
in advance, and is at home to provide physical access, the on-site installation process
itself is usually quite time efficient – taking about 2 hours to mount and align

\(^{26}\) This process assumes that the community does not have access to either terrestrial broadband (such as ADSL)
or cellular mobile broadband. If such services are available, they are unsubsidised, and the householder must
apply to an ISP directly.
hardware (dish, receiver, lead-in cable, and modem) and conduct tests to confirm Internet performance. The service is then signed over to the customer, and normal contracted ISP billing and support processes ensue.

Complexities and Complications

This series of actions is reasonably straightforward if the customer is readily contactable by phone, has a good grasp of English, and has sufficient knowledge about broadband services to be able to make an informed choice of service plan. The process becomes significantly more complicated where the customer does not meet all of these criteria, as is often the case for people living in remote Indigenous communities, where the only external communications option is a single payphone (Example 1).

**Example 1 - Registration delays**

The NBNCo administrative process for obtaining a satellite broadband service included the step of contacting the resident by phone to confirm certain personal details. The phone nominated was the only available phone in the community - the community payphone. In four cases, the NBNCo database record of these transactions showed that their staffer had apparently phoned and left a 'please call back' voice message because no one answered the call. The four applications were meanwhile put on hold pending the residents’ responses. Since this phone was a public payphone, it was not technically possible to leave a voice message, so the residents were unaware of the need to call. For three of the applications, the ‘on hold’ status had no effect and the installations proceeded, while the fourth remained in limbo for three weeks, without the system alerting either the NBNCo staff, project staff or the resident.

Customers may also be confused by the multiple parties involved in the tiered service delivery system (NBNCo, the ISP, their installation project management company, and the installation contractor, all of whom have contact with the customer at particular times during the process). It is further complicated where a person who might be assisting the customer is located at a considerable distance from the customer’s community (Example 2).
During the transition phase toward the end of the current project, CAT facilitated the application for ISS services and their implementation on behalf of 12 households (3 were not completed for a variety of reasons). This was the most resource intensive component of the transition: expecting the residents to succeed in carrying out the various steps independently with their limited telecommunications options and knowledge of the processes, combined with the relatively uninformed perception by NBNCo and ISP staff of the remote community realities, represented a real barrier to a successful transition. Each instance required a mix of online, postal, text message, email, and phone transactions, including obtaining the householder’s signatures for the registration, service application and payment forms. While the majority of such transactions proceeded smoothly, they required regular liaison between the facilitator, the customer and the provider, for example to ensure that the customer would be at home when signatures were needed or when the installer was due to arrive on site.

Despite the constant liaison, a number of administrative errors occurred, as illustrated in examples 3 & 4.

**Example 2 – Password errors**

The ISP’s process had an analogous step, whereby the provider’s installation project management company notified the resident (via a project team member – the customer’s nominated facilitator) by SMS to provide their new email address and password. In one case the password transmitted contained an error, making the email account unusable. This error was discovered on the installation day, and was reported immediately by various modes to the ISP’s technical help desk (text message, email, phone call-back and ultimately waiting on the phone), but it took until the next day until a response was received. By that time the installer had left the community, so the customer was unable to use their email facility until a message could be got to them some time later by other means.

**Example 3 - Technical changes not flagged**

When transitioning the residents’ Internet services to the NBNCo Interim Satellite Service (ISS), it came to light that the satellite modems associated with the new services were different to those provided for the existing ABG satellite services, and were not equipped with a routing capability. This point of difference between ABG and ISS was not highlighted as a change in the ISS documentation, and necessitated changes to the WiFi Access Point equipment for those residents who intended to continue using WiFi equipped tablet computers.
Example 4 – Inconsistent security procedures

An unfortunate complication arose when the project team was assisting residents to check that their new Internet arrangements were working at the time of installation.

The residents’ applications for their new Internet services had included the contact details for the project team to help in coordinating the installations, and the ISP made use of these to forward the residents’ new email addresses and passwords prior to installation. This enabled the project team to create an advice note to inform the residents of these and provide them with a written record. This step was necessary because the installers themselves were not given this information, and none of the residents was directly contactable by mobile phone, the ISP’s preferred method of contact.

However, part way through the installation phase the ISP decided that the provision of these passwords to the project team was a security breach, because the project team members were ‘not authorised contacts for the residents’. As a consequence, the ISP then unilaterally changed most of the passwords, thereby cutting the project team and therefore the residents out of the dialog. Because some residents had already received their new Internet service, and because they were effectively un-contactable except by post, this meant that they could not use email and could not access their online account details. Ultimately a letter arrived in the post from the ISP some time later advising them to phone in for their new password, but this left most residents in a state of confusion.
FINDING

24. The application process described here for NBNCo Interim Satellite Services involves several steps and choices that are not straightforward for a remote community customer. 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 application and implementation process needs to be considerably streamlined and simplified to make it suitable for remote community residents themselves to use without the need for an external facilitator.

A 'pay by the Gigabyte' pre-paid satellite broadband option (analogous to the well-established pre-paid SIM option for mobile phones) would simplify the process.

This finding is also pertinent to the planning for the upcoming NBNCo long-term satellite service.
13. Other issues

While the cost, technical and administrative factors discussed in Section 12 can constitute major barriers to ICT take-up and sustainability, other social, cultural and human factors also play a key role in the extent to which individuals adopt and use ICT, and how the ICT facilities are designed and managed.

The discussion in this section relates to socio-cultural factors, insofar as they have a direct bearing on issues raised elsewhere in this technical report. In a broader sense, socio-cultural factors such as gender or the difference between Western and Aboriginal notions of ownership which might influence computer use and related behaviour will be addressed in detail in forthcoming publications by the research team.

Socio-cultural factors may include a range of cultural values that people place on having access to or owning such facilities, such as their perceived utility value, prestige value, educational value or value in providing membership of a community of users.\(^{27}\)

They may also include existing cultural attributes which can pre-dispose people to be more (or less) inclined to adopt ICT.\(^ {28}\)

For discrete Indigenous communities, where each particular community is located on the continuum between unfamiliarity with ICTs and their widespread adoption will also be a factor – existing exposure to mobile phone coverage, nearby presence of institutional ICT services such as Internet Access Centres, Centrelink access facilities, and cultural knowledge databases can all play a part.

Group norms, which may operate within one community or embrace a particular age group more widely, are also important.\(^ {29}\) Attitudes to social networking in general, and even to specific social networking applications such as younger community members’ greater use of Facebook, are examples of this type.

Socio-cultural factors could also dampen the HIP project team’s perhaps unrealistic expectations of how, and how quickly, community members might respond to the various opportunities offered through access to computers and the Internet, and also contribute to the extent of adoption. A simple example of this is the project team’s preconception that email would be a very convenient means of maintaining communications with community residents between visits, given the lack of telephone options. In fact, whilst residents were generally prepared to use this medium, the relative lack of exposure to and use of email within their own social and family networks outside the community meant that they were less likely to

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see the email application as a communications tool of choice, and in most cases were only inclined to access it infrequently.

Other socio-cultural issues identified in this report include:

- (Lack of) appreciation of the fragility of computing equipment and its vulnerability (discussed in Section 9).
- People being disinclined to attempt to fix minor problems themselves
- The impact of assigned uses for buildings on ICT facility design and use
- The impact of mobility on ICT implementation and use

**Disinclination to fix minor problems**

Minor issues with computers and printers included incidents such as cables being inadvertently unplugged, paper jams in printers, intermittent failure of particular keyboard keys, and loss of power to network equipment.

The first observation to make on this matter is that preparedness to attempt solutions to these problems varied considerably between individuals. As project team members we observed or were made aware of a number of instances where particular residents did attempt and sometimes succeed in resolving these problems for themselves, while others took a more passive approach. Also, we only saw the instances where the problem remained unsolved, and there may well have been others which had been resolved and were not raised with us.

To an extent, some residents may have relied on the project team members, knowing that a support visit would happen within the next few weeks, and judging that they could manage without the particular function until then, since requests for assistance to others in the community would involve some form of social obligation which people might wish to avoid. The range of attitudes to problem solving suggests that there might be individual personal factors such as their own prior experience, education and perceived aptitude for solving such problems rather than solely cultural factors involved.

A possible solution to this general category of problems was for the project team to publicly enlist the support of other residents with identified talent and experience to act as local community ‘trouble shooters’, since it did not necessarily follow that all residents would look to others in the community with these skills for assistance. To an extent this happened informally during the project, though it seemed that the more experienced individuals concerned were sometimes reluctant to admit that they had been approached, or that they had provided such assistance.

**Impact of assigned building uses**

The primary examples of this type were the shared community buildings at Kwale Kwale and Imangara, those being the Multi-purpose shed at Kwale Kwale and the Women’s Centre at Imangara. The CDEP or art shed at Mungalawurr with was loosely in the same category, but
because that building was of very limited utility due to its size and poor condition its assigned uses were notional only – it was not actually in use for any purpose other than computing on any occasion when the project team visited.

The Kwale Kwale shed was physically divided into three sections, each with its own external doors and fixed metal walls separating it from the adjacent sections. Initially, two of the computers and desks and a shared printer were installed side by side along one wall in one of these sections, which was nominally an open space art and craft room. This arrangement worked satisfactorily for a time as a shared resource for all community members (who were all members of a single multiple generation extended family, but about mid-way through the project the residents sub-divided the room into two with a high partition wall, necessitating a rearrangement of the computer desks. In the event, this change was easily achieved, in part because the network connections for these computers were wireless connections within that portion of the shed, so that there were no data cabling changes required.

The significant point about this example is that in smaller outstation-sized communities communal building space is at a premium, and it is not surprising under these circumstances that external factors can dictate a change of role for these buildings as needs change. The computing facility configuration needs to be flexible enough to adapt to such changes.

The Imangara Women’s Centre was earmarked at the beginning of the project by the senior community women as a place where the computers would be reasonably well protected because the building itself was lockable and supervised during the day by a resident (male or female) who was responsible for managing the meal preparation kitchen facilities in it. Two computers and desks and a shared printer were placed there with the intention that they would be available for use by the minority of residents who did not choose to have a computer in their own house at the beginning of the project. In practice, these computers were almost exclusively used by the meal preparation staff themselves, their children and a few of their close family or adult friends. In our observation, ‘Women’s Centre’ was not an accurate description of the function of the building or the computers during this time.

**Mobility**

The mobility of residents is observed at two levels, residents moving their place of residence within the community, and residents moving to or from the community, either temporarily or on a permanent basis. In the following, mobility will only be considered to the extent that it has some impact on the technical arrangements for the facilities. How residents’ movements interrelate with ownership or perceived ownership of the computing equipment is discussed in a separate project paper on the topic of ownership.

**Intra-community mobility**

Where people move residence within the community, there may be a need for the computing facilities to follow them, or alternatively stay in place and be re-allocated to another group of householders who move in to take their place. In this project, the computer in a building was not tied in a logical/configuration/addressing sense to the networking facilities associated with that particular building, so that a user could move their computer to another existing network point (i.e. another house) without the need for any configuration changes.
A complication arises where the computer is moved to a house that has no connection to the local network. In this case, one option is to install network facilities (antenna, wireless transceiver, injector and cabling) in the new house. A less ideal but much simpler option is to install a WiFi access point in another nearby house with network connection, and a USB- or PCI-WiFi adapter on the computer being moved. The latter option relies on the ad hoc performance of the WiFi link between the two houses, which is subject to variables such as the materials of the intervening walls and the distances between the two WiFi devices. Both methods were used on occasions during the course of the project. In practice the ad hoc WiFi method only worked reliably where the houses were adjacent, and the gap between them was no more than about 20 metres.

Where a computer was to stay in place and be re-allocated, the personal files of the previous users had to be removed or at least secured. A convenient but less than ideal option was to secure the existing user files with a password, and to create a new user account for the new users. This option was suitable where there was a likelihood that the original user would return at some stage. Alternatively, it was necessary to create a backup copy of the existing users’ files on removable media, then delete them from the computer hard drive. Both methods were used occasionally.

Vacation of dwelling following death of a community member

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 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 deceased person’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.

Permanent movement outside the community

Residents who had signed the ownership transfer agreement (see Section 5) were entitled to treat the computer and printer entirely as their own private property. This meant that if they chose to move permanently away they might decide to take their computer with them. In practice this happened for one family, and a further two individuals removed this equipment without signing the agreement, and did not return it.

Building ownership and changes caused by rebuilding activity

Because the house ownership mix in the project communities included both freehold and rental properties, there was an additional need to consult and seek approval from the building
owner, in this case an agency of the Northern Territory Government, whenever the installation or re-installation of permanent fixtures (such as an antenna or fixed cabling) in a rental property was proposed. This situation arose at Imangara, where seven houses were demolished and rebuilt during 2013 under Government housing programs, and the affected residents had to move into other houses for several weeks. While resulting in a very positive outcome for the residents, it did mean that the computer and Internet equipment in a number of houses had to be dismantled and stored, then re-installed in the new houses.

Responding to mobility

As described in Section 11, there was considerable change in the occupancy of households and buildings by computer users over the three years of the project. This high degree of mobility added complexity to the computing arrangements, in terms of both the need for a project management response to the movements as they occurred, and the need for changes to the facilities themselves. This situation places the emphasis on flexibility, and puts any solution based on fixed hardware at a disadvantage compared to wireless based solutions.
14. Models for community computing and Internet access

Having examined some of the specific issues associated with the implementation of the HIP, we now turn our attention to points of comparison between the Home Computing model and other options for community computing.

Table 10 summarizes the features of three models that have typically been used for providing computing and Internet access at remote community level.


<table>
<thead>
<tr>
<th>Feature</th>
<th>‘Home Computing’ Model (distributed Internet facilities and computer in each household)</th>
<th>‘Community Wi Fi’ model (centralised Internet facilities with users connecting to those using WiFi capable computing devices)</th>
<th>‘Community Internet Access Centre’ model (centralised Internet facilities and computers in a supervised room within a community building)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical funding model</td>
<td>External funder pays for individual Internet connections and computing devices; households pay own Internet access fees</td>
<td>External funder pays for Internet access and WiFi facilities; users supply their own computing devices</td>
<td>External funder pays for all facilities and supervision</td>
</tr>
</tbody>
</table>
| Capital costs | High aggregate cost for individual satellite Internet connections and computer hardware at all households | • Medium cost for shared local area network hardware and satellite Internet connection at community level  
• High costs to users for computer hardware | • Medium cost for centralised shared satellite Internet access and PC hardware in single building  
• High building cost (either capital cost for new building or ongoing rental cost for existing building) |
| Operational costs | • High aggregate Internet access charges  
• High maintenance costs for computing devices (borne by user) | • Medium Internet access charges  
• Low network maintenance costs | • Medium Internet access charges  
• Low network maintenance costs |
<table>
<thead>
<tr>
<th>Feature</th>
<th>‘Home Computing’ Model (distributed Internet facilities and computer in each household)</th>
<th>‘Community Wi Fi’ model (centralised Internet facilities with users connecting to those using WiFi capable computing devices)</th>
<th>‘Community Internet Access Centre’ model (centralised Internet facilities and computers in a supervised room within a community building)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall costs</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Focus</td>
<td>Family centred</td>
<td>Individual user</td>
<td>Individual user or small groups</td>
</tr>
<tr>
<td>Suitability for mixed gender use</td>
<td>Yes, but the model may encourage stereotyped gender roles i.e. that the women are responsible for managing and paying for it</td>
<td>Yes, but care needed with placement</td>
<td>Group(s) of one gender may dominate use, making the other reluctant to use the facility</td>
</tr>
<tr>
<td>Suitability for young children</td>
<td>Yes</td>
<td>No – access to portable devices unlikely</td>
<td>Yes, with parental supervision</td>
</tr>
<tr>
<td>Facilitating school learning</td>
<td>School student friendly with parental support</td>
<td>Limited</td>
<td>Collateral support for schooling with teacher and supervisor collaboration</td>
</tr>
<tr>
<td>Suitability for older residents</td>
<td>Yes</td>
<td>Limited – familiarity with mobile computing devices less likely</td>
<td>Group(s) of younger users may dominate use, making older people reluctant to use the facility. Physical access (walking distance) may also be an issue.</td>
</tr>
<tr>
<td>Feature</td>
<td>‘Home Computing’ Model (distributed Internet facilities and computer in each household)</td>
<td>‘Community Wi Fi’ model (centralised Internet facilities with users connecting to those using WiFi capable computing devices)</td>
<td>‘Community Internet Access Centre’ model (centralised Internet facilities and computers in a supervised room within a community building)</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Compatibility with capacity offered by NBN satellite consumer services?</td>
<td>High</td>
<td>Medium – multiple satellite services may be needed</td>
<td>Medium – multiple satellite services may be needed</td>
</tr>
<tr>
<td>Reliability of network services and equipment</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Reliability of computing devices</td>
<td>Low – exposed to home environment</td>
<td>Low – exposed to outdoor environment</td>
<td>High – assisted by physical environment and supervision</td>
</tr>
<tr>
<td>Suitability for high level of resident mobility between households?</td>
<td>Low</td>
<td>High – supports portable devices</td>
<td>Varies depending on where residents move to</td>
</tr>
<tr>
<td>Limitations</td>
<td>Home environment often not suitable for care of computing hardware (PC, printer)</td>
<td>• Multiple WiFi Access Points required for larger communities • Limited or no coverage within buildings</td>
<td>• Suitable community building may not be available • Only accessible during staffed hours • No option for the resident to own their own computer, so may be seen as ‘second choice’</td>
</tr>
</tbody>
</table>
The Home Computing model

In overall terms, the primary ‘Home Computing’ model is a high cost model because all the facilities are duplicated at each house. Nevertheless, this model fits well with the household managing the facilities available within the house as a family unit. In essence this is the current model in mainstream society.

The Home Computing model sits comfortably with the speed and quota characteristics of the domestic satellite broadband services offered by the National Broadband Network (NBN), and experience with the Home Internet Project has demonstrated a high level of reliability of the network related components.

In the Home Internet Project, this model provided computing access for the whole family, including school children and ranging from grandparents down to young pre-school aged children. At Imangara, where school aged children attend the Murray Downs School adjacent to the community, the home computers were also used by those children to play the same educational computer games that the school provides, at home.

Management of the HIP computer facilities seemed to be perceived in most cases to be the domain of the senior woman in the household – in one or two cases an explicit statement was made by male family members to that effect. While men certainly used the computer, it was the women who made the choices about how it should be shared and paid for, and followed up with the project team if something was not working, and ultimately it was their bank account that paid for the Internet fees after transition, and they who bore the brunt of the billing problems that emerged.

The HIP’s post-transition phase experience also indicated that unless significant changes are made to billing arrangements (for example, a pre-paid option), Indigenous families in remote communities are likely to struggle with managing Internet plan payments. Similar situations have emerged in other central Australian communities without mobile coverage, in which local families applied for satellite dishes under the NBN so they could have Internet access on a household basis.30 These Internet services have since fallen into disuse after families defaulted on payment for broadband plans. Households were unable to pay the bills because their resources were spread too thinly amongst a large number of highly mobile residents, making regular payment almost impossible. These residents struggled with the administrative processes required to terminate the direct debit arrangements, because of the level of ‘English legalese’ needed to negotiate with service providers. Some people who signed up for direct debit for Internet plan charges are still being billed, even though they no longer receive a service. There was no on-site or external expertise available to repair or replace any computer equipment that was damaged. Essentially, this household computing arrangement languished because of a lack of ongoing IT technical support to assist community members with maintenance and administrative issues. As with that of the HIP, this experience indicates that the existing

subsidies for satellite broadband connection in remote areas are not sufficient to support ongoing home computer and Internet access for remote Aboriginal communities without external assistance for the installation process and for more complex technical and maintenance support issues.

This model also has limitations in coping with movement of families within and beyond the community. Since the hardware to connect to the Internet (including the satellite dish and modem and the computer itself) is attached to the house, a family that is moving house and wants to retain the use of the computer to connect to the Internet must move the computer and associated accessories to a house with an existing broadband connection. This was a constraining factor in several instances with the Home Internet Project.

*The Community WiFi model*

This model focuses on the individual user as the supplier and owner of a portable laptop, tablet or smartphone computing device. As such, the model is gender neutral in its applicability, except that if the placement of the WiFi Access Point or Points in the community is chosen without consideration of the privacy and personal safety concerns of women in particular, it may inadvertently discourage them from using it.

Portable computing devices have been taken up strongly by young people, and to that extent this model could be seen as less attractive to older residents, who may find computing at home to be a more comfortable option. At the present time, portable computing tends to be used in communities more for social and communications purposes, so is less likely to be of value in facilitating school learning.

Most implementations of the Community WiFi model that have been implemented in remote communities to date have consisted of a single WiFi Access Point, which concentrates all the Internet users and hence traffic around a single point and Internet source in the community. Unless the community is small (i.e. family sized), it is likely that a single domestic NBN service will not have capacity to provide sufficient broadband speed for all the users who may wish to connect simultaneously. In a coverage sense, WiFi is technically limited to a radius of about 50m from the Access Point, and coverage typically diminishes further with obstacles such as vegetation and building walls (particularly metal clad walls) in the way, making use within community buildings and houses unreliable. As communities become larger, more Access Points are needed to provide realistic coverage.

*Community Internet Access Centre model*

This is the model that has historically been adopted for provision of Internet access in remote communities under government funded programs over the past decade such as the Telecommunications Action Plan for Remote Indigenous Communities (TAPRIC 2002-2005), Backing Indigenous Ability (BIA 2007-2008) and the Indigenous Communications Program (ICP 2009-present). The model offers the lowest cost of the three models for implementation because all the facilities are centralised and shared, but the operational costs can be very high.

These may include the cost for renting secure building space (assuming that is available, which is often not the case), or the expensive alternative of constructing a new building, and for providing and accommodating a supervisor for the centre. Supervision brings the obvious benefit that the supervisor is on hand to assist users in using unfamiliar applications and solving particular support problems, but at the cost of employing a person to fulfil this role. In many cases, these supervisory positions are staffed by one or more volunteers to reduce costs, but that approach introduces a greater than normal administrative overhead to recruit, orientate and manage volunteers who may only stay in the community for one or two months.

The nature of the access centre space is such that it may attract specific sub-groups of residents, such as young men, or those with a particular interest such as making and playing music publicly. While this can be a positive thing, it may in turn discourage other groups (women, older people, and young children) from participating. Appropriate supervision is the key to effectively managing the balance.

The Internet Access Centre can be an effective vehicle for supporting school-based computing activities provided there is effective collaboration between the schoolteachers and the Centre supervisor.

Like the WiFi model, the concentration of users around a single broadband facility may overload a single Internet connection. If the requisite technical skills are available, the external download traffic may be reduced by introducing a local caching server capability within the centre.

The Access Centre model will always be constrained by the need for the security of the facility and the availability of a supervisor, and for these reasons most centres only open during business hours and sometimes for only a few days per week.

Hybrid models

A number of variations on these models are possible.

An example is that initially implemented in the HIP for shared-use computers within houses and community buildings, where Internet services were shared and paid for by the external funder. Other combinations include a WiFi hotspot provided in conjunction with a community Internet Access Centre so that users may either access a desktop computer within the centre or connect using their own portable device; and the community contributing to the cost of an Internet Access Centre.

Comparing the models

Each of these models has both advantages and disadvantages. It seems evident from the foregoing discussion that there is no obvious 'best fit' model. Where public policy and funding is directed at encouraging sustainable computing in small remote Indigenous community settings, it should consult with community members and jointly select a model that takes account of each community’s physical size, population and age profiles, and any other local factors such as proximity to a school.
15. Concluding remarks – toward a sustainable approach

A number of factors identified in this report contribute (either positively or negatively) to the overall sustainability outcome for community-wide home computing and Internet facilities of the type implemented and supported through this project. These include:

- The high cost of planning, implementation, training and support of ICT network and household infrastructure in small outstation-sized communities, where their remoteness and isolation and the associated transport costs are key contributors (Sections 7 & 8)
- The high reliability of network and satellite infrastructure (Section 9)
- The high attrition rate of household equipment, particularly printers and to a lesser extent computers, due to the harsh operating environment (Section 9)
- The trend toward an overall increase in use of the facilities over the project period, both during the time project funding supported the Internet services and beyond, where the residents are paying for Internet access themselves (Sections 10 & 11)
- The ongoing cost and administrative barriers to maintaining Internet services (Section 12)
- The lack of skilled resources for implementation or support locally at small community level (Section 12)
- The very limited telecommunications options available to residents of small remote communities for communications outside the community - typically a single payphone and no mobile phone coverage (Section 3). Computers with Internet connection can provide an alternative option, particularly to cover occasions when that payphone is faulty
- A significant majority of the residents have taken full ownership of the computer, and demonstrated a strong level of interest in maintaining the Internet connection for their computer at their own cost (Section 11).

Coupled with the small likelihood that Government funding would be forthcoming for a comprehensive future program for implementation and support of residential ICT services in small Indigenous communities, these factors collectively represent a barrier to providing and maintaining computing services to residents of small remote communities, despite the significant use made of those services, and the perceived value placed by the residents on maintaining them.

A solution, or at least a partial one, to this conundrum is hinted at by the difference between on one hand the high attrition rate for the household equipment, and on the other the high reliability of the network and satellite infrastructure, most of which is outside the house. If the provision of network connectivity such as that provided under the HIP (whether individual household satellite connections or several households sharing a single service across a local wireless network) were to be the responsibility of an external funder, and the household user equipment (which increasingly includes portable devices as well as desktop computers and printers) were to be the responsibility of the householder or individual resident, this would limit or reduce the
subsidy cost, while placing the onus of sustaining the user device on the resident. Such an arrangement would focus the resident’s care on those items that they use directly and relate to most closely and which they pay for themselves, while giving the funder the best prospect of a sustainable investment of their resources. This approach is an extension of the one adopted recently under the Commonwealth Government Indigenous Communication Program, where individual WiFi hotspots have been introduced in a significant number of (mainly very small) remote Indigenous communities, leaving the users to provide their own portable computing devices. While the HIP did not incorporate resident funding for the computer purchase and therefore did not test this option directly, there was some evidence from later in the project to suggest that this approach might work. This was demonstrated by three families (each of whom had already been provided with a computer through the project) purchasing tablet computers themselves for their children to use in conjunction with the HIP network facilities i.e. accessing the Internet through the latter.

Where people wish to opt for a more permanently located desktop or laptop computer, external funding for a robust table and cover to house the computer and a compact printer would increase the longevity of the facilities over and above what might be expected for portable computing devices that are carried around out in the community or elsewhere. Despite the less than satisfactory experience with printers over the course of our project, we believe that printer lifetimes would have been even shorter if they and their cabling had not been protected inside the computer cover.

The Home Internet Project has indicated that a shared funding arrangement contributed to both by an external funder for the network components and self-funding by the residents of their computing hardware and ongoing Internet payments is a model which offers some advantages and attractions to both parties. Whether residents are able to obtain sustained benefits from such an arrangement will depend on their ability and interest in maintaining their personal computing hardware over time.
16. 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 14).

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 21).

3. 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 32).

4. 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. Tender documents for any similar future project should make this requirement mandatory (page 33).

5. 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 34).

6. It is preferable in a remote community project of this type to make the scheduling 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 35).

7. Support planning and resourcing for a project of this type should assume that most support will require a site visit (page 40).

8. 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 wide range of skill levels amongst the residents, and is also favoured by most of these residents over group training.

As a general principle, the training location, delivery style, and timing should be tailored to the participants’ expectations to maximise its effectiveness.
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 48).

Because the operation of the Microsoft Outlook email application is somewhat more complex than web based email, it would be better for projects like this to use web based mail such as Hotmail or the ISP’s webmail service in the first instance until users are in need of more advanced email features (page 50).

The performance of applications that are dependent on a reasonable Internet speed or quota for their effective function is variable (page 50).

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 51).

The dominant consumable cost is in the replenishment of printer ink cartridges (page 52).

Failure rates over the project period for core household equipment, particularly printers and to a lesser extent for computers, was high. In contrast, no failures occurred in the centralised network equipment (page 56).

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 57).

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. Continual education /awareness raising is needed in those cases (page 59).

There has been considerable change in the occupancy of households and buildings used by computer users engaged in the project over the three years of the project, with around half of households or buildings no longer occupied by the original residents or used for that purpose (page 68).
18. The major change for resident householders at the transition was the need for them to pay for their own individual Internet accounts. About half of the overall number of households opted to do so.

Of those, about half of the householders have been unable so far to maintain sufficient balance in their nominated bank accounts to support the monthly payments. All of these households are nevertheless committed at the time of writing to persevering to maintain their Internet service (page 68).

19. Most of the computers in shared community buildings have been re-distributed to individual households (by residents suggesting and agreeing to these changes) during the course of the project, suggesting that the preferred computing approach for small self-managing communities is individual household ownership rather than the shared building option (page 68).

20. A level of external subsidy funding is desirable for some of the up-front costs (planning, and implementation of the network component and protective environment for the household equipment (page 72).

21. An operating subsidy would assist those who would otherwise struggle to allocate the funds for Internet access fees, but unless this subsidy is likely to be maintained in the long term, an individual rather than shared subscription model is the more sustainable approach (page 72).

22. Residents should be encouraged to contribute to the purchase and maintenance of the computing device itself (page 72).

23. 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.

The ongoing support role may be able to be filled by a person based in a larger remote community with the appropriate experience, servicing their own and other communities in their region. If this person was an Indigenous person with connections to that community, cultural issues will probably preclude them from working effectively there. (page 73).

24. The application process described here for NBNCo Interim Satellite Services involves several steps and choices that are not straightforward for a remote community customer. 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 application and implementation process needs to be considerably streamlined and simplified to make it suitable for remote community residents themselves to use without the need for an external facilitator.
A 'pay by the Gigabyte’ pre-paid satellite broadband option (analogous to the well-established pre-paid SIM option for mobile phones) would simplify the process.

This finding is also pertinent to the planning for the upcoming NBNCo long-term satellite service.

(page 77).
17. References


