

Te Whaiti Broadband Connection

The WAND group at the University of Waikato and Tefa International have been asked by the Ministry of education to design and implement a wireless network connecting Te Kura Kaupapa Maori O Huiarau, Te Kura Kaupapa Motuhake O Tawhiuau and Te Kura Toitu o Te Whaiti-nui-a-Toi .

The radio technology that will be used to build the proposed network is “line of site” (meaning that the radio waves will not travel through obstacles such as hills or trees). This means that a number of repeater sites will be required if the schools are to communicate with each other. For example, in Figure 1, it is not possible for **A** to communicate directly with **B** as there are hills between. For **A** to communicate with **B** it must send its data to the repeater at **C** which sends it to the repeater at **D** which finally sends it to **B**.

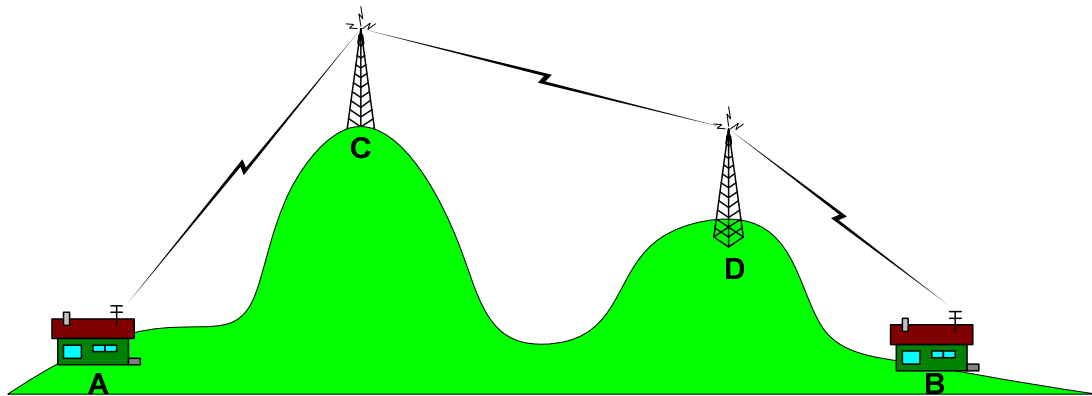


Figure 1 Use of Repeaters to meet line of sight requirements

In the first stage of the project we have been working on the connecting the Huiarau Kura and the Tawhiuau Kura. The design includes a repeater site on the top of Tawhiuau Mountain. Figure 9 shows the proposed sites for stage one of the project which is currently being built and should be completed by March 2004.

The second stage of the project is to look at connecting the Te Whaiti Kura to the network. The Te Whaiti Kura is in a deep valley and does not see directly any of the other sites in the proposed network. This means that a repeater will be required to enable the school to connect to the rest of the network.

The rest of this document describes the requirements for the Te Whaiti repeater site including possible locations, the radio technology to be used and the maintenance requirements.

Te Whaiti Repeater.

Some initial site surveying has been conducted to identify suitable sites for the repeater. We have found that many of the hill/mountain tops that can see both the

school and another node in the network are covered in tall trees making them unsuitable for repeater sites. However, we have identified from an area to the south of the school that can both see the school and the top of Tawhiuau Mountain that could be used to site a repeater. The picture in Figure 2 shows the view from the top of Tawhiuau Mountain. The non-greyled out areas in Figure 3 and Figure 4 represent the areas that can be seen from the top of Tawhiuau Mountain. At this stage we do not have pictures with the view from the school although it is like that a sight at a reasonable level of elevation will be required to clear the trees near the school.



Figure 2 View from the top of Tawhiuau mountain towards Te Whaiti



Figure 3 Area of Te Whaiti that can be seen from top Tawhiuau Mountain



Figure 4 Close up of TeWhaiti area that can be seen from top of Tawhiauau mountain

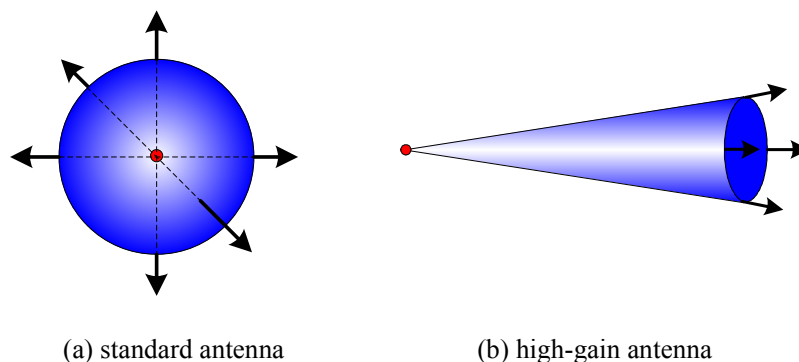
Most of this area is on Farmland that is owned/leased by the MacDonald family. In addition there are a number of potential sites on the hills to the east of the farmland. However access to these areas for installation and maintenance would be more difficult.

The next stage in selecting a site will be for the WAND group and the local community to work with the custodians of the land to attempt to establish a suitable site to install a repeater. As a part of this process issues such as access to land to install and maintain the repeater site would need to be addressed.

Radio Equipment

All of the links in the proposed network will be run in the 2.4GHz ISM band. The radio transmitters used to drive the links in the network are 35mW (0.035W). Using the antenna (aerials) built into the radio cards allows for transmission over 100's of metres in an outdoor environment. To enable the links to work over the required distance high gain antenna will be required. The built in antenna in the transmitter radiate radio waves in all directions with equal power as shown in Figure 5(a). The high gain antenna focuses these radio waves so they are transmitted as a narrow beam as shown in Figure 5(b). Because the energy of the radio waves has been focused into a narrow beam they travel much further.

As a comparison of the output of the output power of the radios that we are using, a standard cell phone can use up to 1W of transmit power.



(a) standard antenna

(b) high-gain antenna

Figure 5 Antenna output patterns

The antenna that we propose to use will be 24dB parabolic grid antenna as shown in Figure 6. The parabolic grid is 1M by 0.6M and made of cast aluminium which is UV powder-coated. The open frame design is to minimise wind loading. Two of these antenna will be required for the repeater site.



Figure 6 24dB Antenna

The repeater site will require a structure to hold the antenna, solar panels, batteries and wireless routers. As a reasonably large area of solar panels will need to be accommodated, the proposed structures are to four legged and stand between 4 and 5 metres tall as shown in Figure 7. The structures will be galvanised and then painted green as a part of the installation. The Battery and equipment box is to be made out of stainless steel.

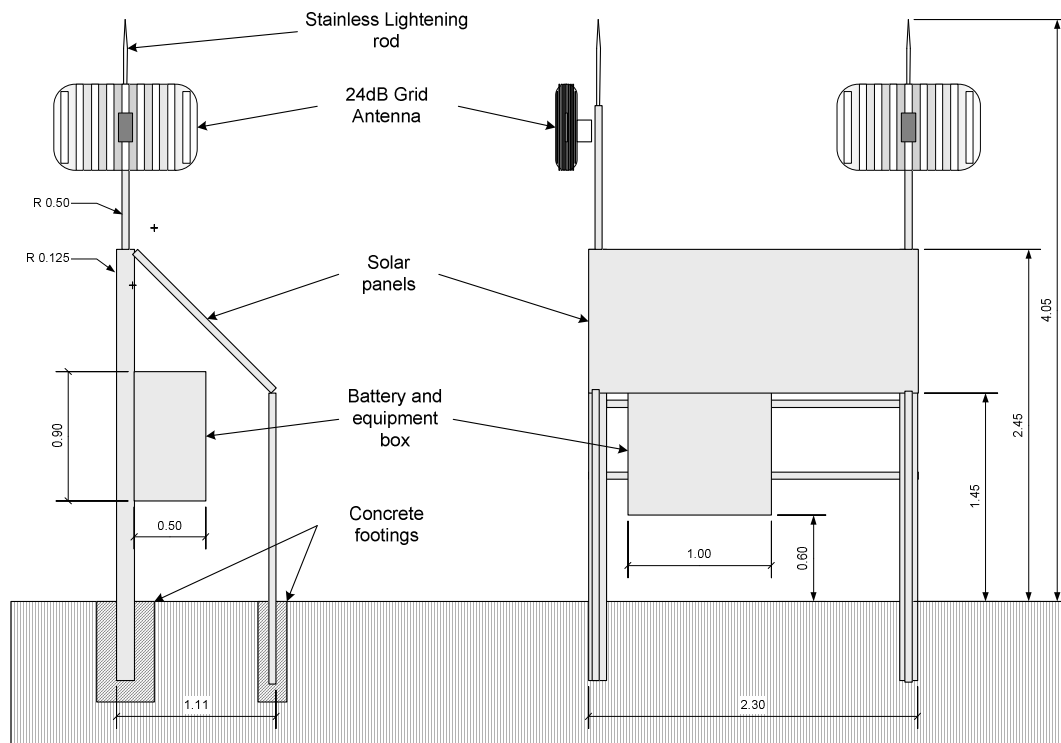


Figure 7 Proposed structures for Tawhiau site

The WAND group has built one other solar-powered repeater in the Waikato as shown in Figure 8. This site has now been in operation for two years. It should be noted

that the proposed design uses thinner diameter tubing where possible and will be painted to blend in with the local environment.



Figure 8 Solar Powered Repeater

Installation

The WAND group will provide all of the components for each installation in a *kitset* form. Prior to the installation the WAND group will provide the necessary training so that the communities involved so they can perform the installations. During these installations the WAND group will provide technical supervision.

Maintenance

For the repeater site, both scheduled and unscheduled maintenance visits will be required. It is not expected that many unscheduled problems will occur. For example

the solar powered site that we have on Mount Pironga in the Waikato has not had an unscheduled outage in well over eighteen months.

Scheduled visits (by members of the local community) will be required to the solar sites every six months so that the conditions of the guarantees on the batteries are met. During these visits a number of measurements on the batteries will be required as well as topping up the batteries fluid levels. These visits will also be a good opportunity to inspect the sites to identify any other potential maintenance problems in advance.

From time to time it may be possible that problems arise at the various sites. The design of these sites incorporates the ability to perform detailed remote monitoring which should enable most problems to be diagnosed before having to visit the site.

For problems associated with the Soekris routers the WAND group will ship exchange routers that can be swapped with the faulty devices. If problems cannot be diagnosed remotely a site visit will be required by a suitably qualified person. While the WAND group has the expertise to perform these visits it may not be possible to do so in a commercial time frame. Any site visits performed by the WAND group during the life of the CRCnet project (currently scheduled to end July 2005) will be charged on a cost recovery basis. If maintenance visits will be required in a commercial time frame the WAND group will work with the communities to devise a maintenance strategy which would more than likely include a commercial party. Provision for the funding on maintenance will need to be provided by the Ministry of Education. At the end of the CRCnet project the WAND group will work with the interested parties with a view to identify a new strategy for the management and maintenance of the network.

To enable the communities to participate in the maintenance of the sites, documentation and basic training will be provided to nominated people in each of the school communities. The schools will also be provided with phone numbers which can be called for further support during working hours (9am to 5pm Monday to Friday).

The WAND group will maintain control of the wireless network for a trial period, likely to be the end of the CRCnet project. At the end of the trial period and once the necessary training has been completed then control of the network will be handed over to the schools that the network connects. The landowners and/or guardian of the land will be actively involved in the arrangements.

Disclaimer

It is important to acknowledge that the creation of the network involves the installation of highly sensitive equipment in extreme topographical conditions. As such, the University will take all reasonable care regarding the design of the network but will not accept liability for any results or consequences which arise from events or circumstances beyond its control.

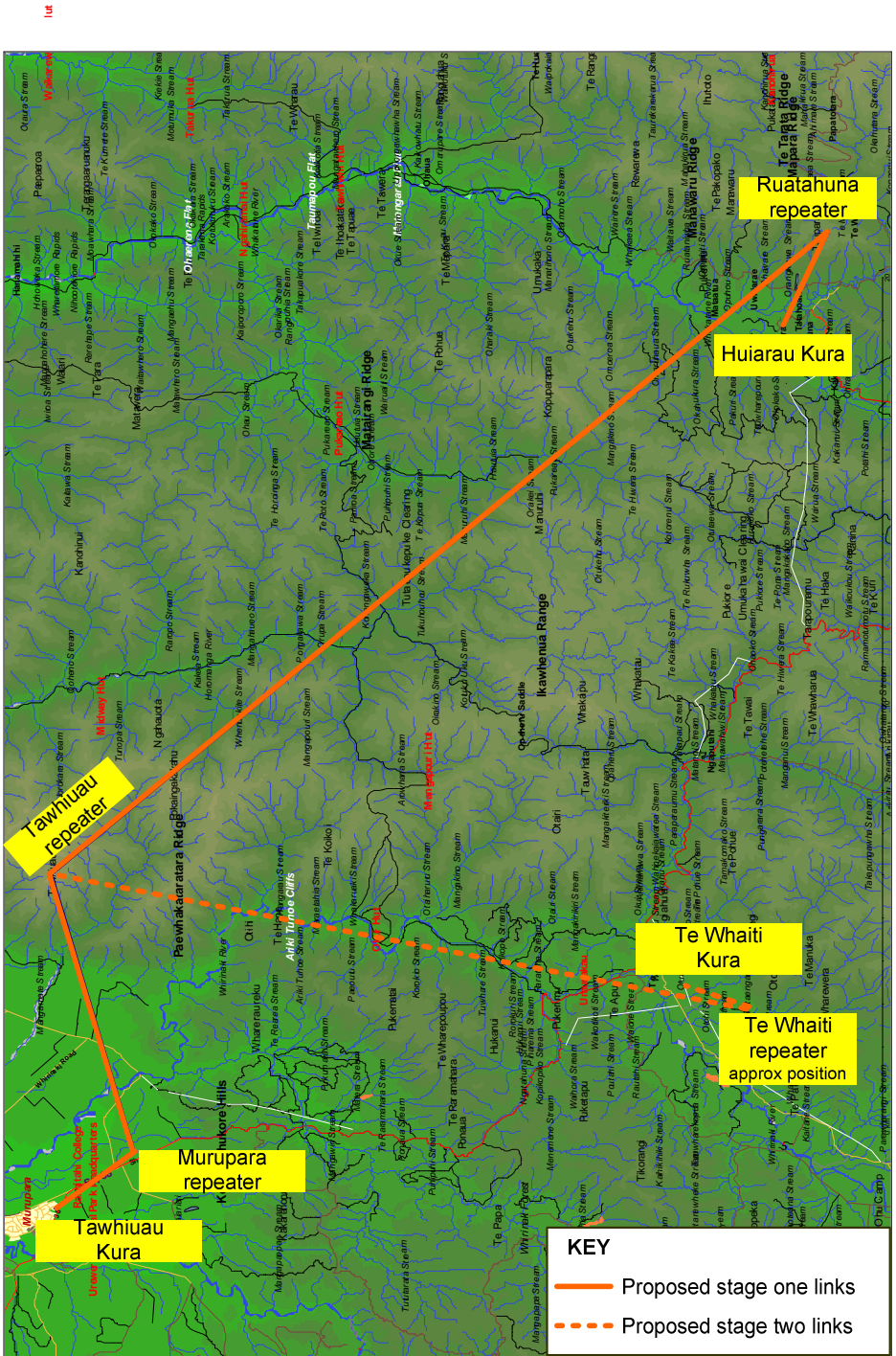


Figure 9 Network Structure