

## Project factsheet information

<b>Project title</b>	Dili Village Telco
<b>Grant recipient</b>	Rowetel 9 Nelson Ave Flinders Park 5025 SOUTH AUSTRALIA Tel. +61 www.rowetel.com
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<b>Partner organizations</b>	FONGTIL, Village Telco project
<b>Total budget approved</b>	AUD 40,000.00
<b>Project summary</b>	<p>This project has built a “Village Telco” mesh network to provide a low cost local telephony service in Dili, the largest city in Timor Leste, and one of the poorest countries in Asia, where mobile and fixed phone service is available but simply too expensive for the average Timorese. This deployment allowed the technology to be tested in a real life scenario, along with the business model proposed to make it sustainable.</p> <p>The mesh network was build from low cost, rugged Wi-Fi telephony devices called the Mesh Potatoes. Every one of these devices provides a single telephone landline to the end user, and is connected to other Mesh Potatoes via a mesh Wi-Fi network.</p> <p>The project trained the Timorese team in all associated technologies (mesh Wi-Fi, VoIP, mesh node installation and maintenance). Overcoming problems caused by Line-of-Sight and interference that affected cross town Wi-Fi links, the team was able to deploy a 70 node Village Telco network across 3 sites in daily use. Local telephones calls made through the network have been surprisingly popular. However this means a new business model for sustainable, long-term operation must be found (the Village Telco business model to date depended on profit margin on long distance calls).</p>

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## Project Summary

This project has built a “Village Telco”<sup>1</sup> mesh network to provide a low cost local telephony service in Dili, the largest city in Timor Leste, and one of the poorest countries in Asia, where mobile and fixed phone service is available but simply too expensive for the average Timorese. This deployment allowed the technology to be tested in a real life scenario, along with the business model proposed to make it sustainable.

The mesh network was build from low cost, rugged Wi-Fi telephony devices called the Mesh Potatoes. Every one of these devices provides a single telephone landline to the end user, and is connected to other Mesh Potatoes via a mesh Wi-Fi network.

The project trained the Timorese team in all associated technologies (mesh Wi-Fi, VoIP, mesh node installation and maintenance). Overcoming problems caused by Line-of-Sight and interference that affected cross town Wi-Fi links, the team was able to deploy a 70 node Village Telco network across 3 sites in daily use. Local telephones calls made through the network have been surprisingly popular. However this means a new business model for sustainable, long-term operation must be found (the Village Telco business model to date depended on profit margin on long distance calls).

The project objectives were: 1) Train Timorese to roll out a Village Telco network and in associated technologies (mesh Wi-Fi, VOIP, mesh node installation and maintenance); 2) Deploy a 100 node Village Telco mesh network to build a local call telephone network; and

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<sup>1</sup> Village Telco Project <http://villagetelco.org>. Rowetel is a key participant of the Village Telco project.

3) Use the Mesh Wi-Fi network to provide a community IP backbone across metropolitan Dili to encourage local IP traffic and local content.

The first objective has been met and exceeded, while the second objective has been met with 70 nodes deployed across 3 sites and in daily use. At the time of submission of this report, the third objective was not achieved for reasons explained in the following sections of the report.

Among the principal findings, we have found that:

- The end users really value the free phone call service and there is significant demand for expansion. FONGTIL is so impressed it has decided to invest it's own funds into expanding the network in 2011/2012, after the ISIF funding is complete.
- Line of Sight (LoS) and interference have created problems for cross-town Wi-Fi links. Tools and methodologies have been developed to address this and it is anticipated a repeatable solution will emerge over 2011/2012.
- The local telephones calls service provided become surprisingly popular. Although that is a very positive thing, it also means that a new business model for sustainable, long-term operation must be found, as the Village Telco business model to date depended on profit margin on long distance calls.
- When the problems caused by LoS and interference were absent, the Mesh Potatoes have been very easy to set up and have the potential to spread virally.

## Justification

Although the GSM mobile telephone networks are widespread in Timor Leste, phone calls are too expensive for the average person. There are very few landlines, so even to call the next office 100m away requires an expensive GSM phone call. At the time of writing current mobile costs is US\$0.21/minute, while the Timorese per-capita GDP/day is US\$1.52. The Village Telco is designed to address this problem with technology that enables free telephone calls over unlicensed Wi-Fi spectrum.

The second problem that this project seeks to address is the lack of IP-backbone infrastructure in Timor Leste. There is almost no local Internet infrastructure. For example it is impossible to send an IP packet from one side of Dili to the other without sending the packet overseas using a VSAT link or a dedicated Point-to-Point Wi-Fi link. The cost of connecting to the Internet via VSAT discourages local content provision. Connectivity is typically provided via small ISPs, which often distribute Internet from a VSAT using a 10 to 20 node Point-to-Point Wi-Fi networks. These networks require tall, expensive, and often unsafe masts. Each ISP re-crosses the same path as neighboring ISPs, a waste of resources and an inefficient use of spectrum. The mesh network deployed by the Village Telco network can address this problem.

As the project rolled out we experienced an increasing demand (greater than expected) to address the need for local phone calls. The difficulty to establish cross-town, long distance Wi-Fi links, breaks the citywide mesh into smaller islands of nodes covering smaller areas. Surprisingly, this is still very useful for VoIP, as most calls are to the same number, often to a site a few meters apart (100m). There is no PBXes or landlines available in the country. However without wider mesh connectivity the usefulness of a local IP backbone (as planned in Objective 3) is more limited. Interest in the local IP backbone is still strong, but will wait until the longer distance links issues have been addressed.

## Project objectives

The project objectives are:

1. Train Timorese to roll out a Village Telco network and in associated technologies, such as mesh Wi-Fi, mesh node installation and maintenance, and VoIP.
2. Deploy a 100 node Village Telco mesh network to build a local call telephone network.
3. Use the Mesh Wi-Fi network to provide a community IP backbone across metropolitan Dili to encourage local IP traffic and local content.

As the project team experienced severe Wi-Fi interference problems in Dili they grew curious to see if these problems were present in more remote, rural locations. The team was also interested to explore the possibilities to test how a second generation of training could be done -Timorese training Timorese-. The team identified skilled personnel available in rural locations whom were extremely enthusiastic about the possibilities of deploying the Village Telco technology. The ability to make a simple local phone call a few km across the region has huge value (for example in Ermera the only way of sending a message from one side of the region to another is via a 3 hour 4WD vehicle trip or transcribing over 2-way radio). As a result, the team decided to add 2 more objectives to the project implementation:

4. Deploy a 14 node network in Baucau, a major regional town 80km East of Dili.
5. Deploy a 10 node network in Ermera, a village 40km South West of Dili.

The first objective has been fulfilled and exceeded. In April 2010 David and Rosemary Rowe visited Dili for a training workshop conducted with the FONGTIL team. The FONGTIL team were trained, and shown how to test, diagnose and fix mesh links. Since then, FONGTIL has conducted 2nd generation training, i.e. Timorese training Timorese in Mesh Potato configuration and set up. Given the complexity of Wi-Fi, this is a remarkable result, and suggests that Village Telco technology is viral – capable of spreading without expensive training by first world consultants.

The second objective was delayed due to equipment manufacture and shipping delays, but has now been satisfactorily completed. From April to August a 10 node pilot network was successfully operated by FONGTIL. In early August 90 more Mesh Potatoes and associated hardware were delivered to Dili. Since then Mesh Potatoes have been deployed on a daily

basis. There is strong demand from local NGOs for Mesh Potatoes (FONGTIL is a coordinating body for NGOs in Dili). At the time of writing 50 Mesh Potatoes have been deployed in Dili, 10 in Baucau, and 10 in Ermera.

Execution of the third objective has been delayed due to the interference difficulties described before. A few Wi-Fi Access Points have been deployed to test the concept, and given good Wi-Fi links it works well. Interest remains strong and FONGTIL have indicated they wish to continue this work in 2011/2012.

The expansion to two other regional sites has been very successful. Ten node networks have been deployed in Baucau and Ermera. An exciting outcome in Baucau was the development of a second-generation training in how to set up Village Telco networks (Timorese training Timorese). Renowned consultants from the developed world were present. Once the training finalized, the team deployed its own network in Baucau, where the interference free environment facilitates reliable service provision, increasing demand for more nodes to be deployed.

In Ermera the Village Telco network has been integrated with an existing mesh data network using 3rd party hardware, which is a significant technical achievement by an operator of a local NGO. Ermera has no GSM connectivity, so the Village Telco network is being used to connect relevant local services such as clinics, local hospital, and the police while is saving many hours of walking.

**Project implementation**

Project objectives	Overall assessment
Train Timorese to roll out a Village Telco network and in associated technologies (mesh Wi-Fi, VOIP, mesh node installation and maintenance)	Completed. Rowetel staff spent 3 months preparing for the Dili workshop, designing the network, procurement of equipment, preparing workshop materials and technical documentation, visiting the pilot sites and installing pilot nodes. FONGTIL staff spent several months planning and executing the training workshop, then the equivalent of one-person full time from April to January (made of up part time efforts by several people). The Village Telco community also assisted with troubleshooting during the April Dili Workshop.

Project objectives	Overall assessment
<p>Deploy a 100 node Village Telco mesh network to build a local call telephone network</p>	<p>Atcom is a manufacturer of VOIP hardware based in Shenzhen, China. They kindly donated several man months of effort to build 100 Mesh Potatoes especially for this project. They also sourced weatherproof boxes and telephones. Staff from Rowetel, spent approximately 1 day/week from May to September, on management, equipment procurement, shipping and remote troubleshooting. From December to January approximately 1.5 months was spent on software development, preparation, and travel to Timor Leste.</p> <p>During the April workshop significant problems were discovered while setting up several Mesh links. As Dili has no landline infrastructure, there is a large amount of Point-to-Point Wi-Fi in Dili. A site survey at FONGTIL headquarters indicated over 40 active networks. This, coupled with the Omni directional Mesh Potato antennas caused interference on several links even over relatively short distances (e.g. 300m). Interference has been overcome by the use of directional antennas. In Dili this was achieved by the use of Nanostation 2 devices running mesh-networking software. However this is a non-ideal solution as Nanostation 2 hardware is expensive when delivered to developing world locations and does not directly support telephony. Unlike the Mesh Potato Nanostation 2 hardware is manufactured by a third party and is not under control of the Village Telco project. A better solution would be a low cost directional antenna option for the Mesh Potato.</p> <p>A second problem is the Line of Site (LOS) requirement for Wi-Fi. Dili is a tropical city with many trees over 25m. This means a Mesh Potato near 25m trees must be located at least 25m high to achieve a clear LOS link to other nodes in the mesh network. At some sites this presents a large mechanical engineering challenge making it impossible to set up a usable link.</p> <p>Rowetel developed several open source software tools to support the team in Dili and assist in debugging mesh links. These include (i) "Dilimesh", a Google Maps application for mapping mesh nodes and link quality, (ii) Audio Ping, an Asterisk application that renders ping information as audio beeps in a Mesh Potato telephone handset and (iii) a software spectrum analyzer, that plots graphs of interfering Wi-Fi activity. This software is documented on the project Wiki.</p>

Project objectives	Overall assessment
Use the Mesh Wi-Fi network to provide a community IP backbone across metropolitan Dili to encourage local IP traffic and local content.	Line of Sight (LoS) and interference have created problems for cross-town Wi-Fi links. Tools and methodologies have been developed to address this and it is anticipated a repeatable solution will emerge over 2011/2012.
Deploy a 14 node network in Baucau, a major regional town 80km East of Dili	Ten node networks have been deployed in Baucau and Ermera. An exciting outcome in Baucau was the development of a second-generation training in how to set up Village Telco networks (Timorese training Timorese). Renowned consultants from the developed world were present. Once the training finalized, the team deployed its own network in Baucau, where the interference free environment facilitates reliable service provision, increasing demand for more nodes to be deployed. In Ermera the Village Telco network has been integrated with an existing mesh data network using 3rd party hardware, which is a significant technical achievement by an operator of a local NGO. Ermera has no GSM connectivity, so the Village Telco network is being used to connect relevant local services such as clinics, local hospital, and the police while is saving many hours of walking.
Deploy a 10 node network in Ermera, a village 40km South West of Dili	

## Project outputs and dissemination

The major project output is a local telephone network in Dili, with smaller networks in Baucau and Ermera. These networks are being enthusiastically expanded and maintained by local Timorese with minimal input from personal from developed countries. These networks are being used every day by NGOs to communicate with each other. The availability of free local calls is proving very popular with end users.

The project has been extensively documented. The project plan, network design and technical “How to” information has been documented on the project Wiki. The experience of network set up and installation has been extensively documented in a series of blog posts. There have been several media interviews on Radio Australia and in the Timorese Media. Here is a summary:

The Dili Village Telco Wiki: Contains the project plan, network design and “how to” information on how the Dili Village Telco technology. <http://dili.villagetelco.org>.

**Media Stories:**

March 2010	Latin Radical pod cast <a href="http://vensol.blogspot.com/2010/03/timor-village-phone-project.html">http://vensol.blogspot.com/2010/03/timor-village-phone-project.html</a>
April 2010	David was interviewed on Radio Australia's Tech Stream program <a href="http://blogs.radioaustralia.net.au/techstream/tech-stream-047">http://blogs.radioaustralia.net.au/techstream/tech-stream-047</a>
April 20, 2010	Radio Australia Connect Asia Program <a href="http://www.radioaustralia.net.au/connectasia/stories/201004/s2877541.htm">http://www.radioaustralia.net.au/connectasia/stories/201004/s2877541.htm</a>
April 20, 2010	Radio Australia Pacific Beat Program <a href="http://www.radioaustralia.net.au/pacbeat/stories/201004/s2876899.htm">http://www.radioaustralia.net.au/pacbeat/stories/201004/s2876899.htm</a>
April 20, 2010	Komunikasaun Alternativa foun Baratu ba Timor oan Timor Expose news story (Timorese news site in Tetum). <a href="http://timorexpose.com/?p=425">http://timorexpose.com/?p=425</a>

**Presentations and Training Courses:**

A non-technical overview of the Dili Village Telco Project (Open Office). <a href="http://www.rowetel.com/downloads/timor/dili_village_telco_overview.odp">http://www.rowetel.com/downloads/timor/dili_village_telco_overview.odp</a>
Introductory technical course on the Village Telco, Mesh Potato, and mesh networking. <a href="http://www.rowetel.com/downloads/timor/village_telco_introduction_course/index.html">http://www.rowetel.com/downloads/timor/village_telco_introduction_course/index.html</a>
Village Telco demonstration at ICTD 2011, Royal Holloway, London, 2010.
Dili Village Telco presentation at linux.conf.au (LCA) January 2011, Brisbane, Australia. Slides available in Open Office and PDF form. <a href="http://rowetel.com/downloads/dili_village_telco_lca_2011_v0.3.odp">http://rowetel.com/downloads/dili_village_telco_lca_2011_v0.3.odp</a> <a href="http://rowetel.com/downloads/dili_village_telco_lca_2011_v0.3.pdf">http://rowetel.com/downloads/dili_village_telco_lca_2011_v0.3.pdf</a>

A 2 hours training course has been developed to introduce the Village Telco and cover the basics of Mesh Potato configuration. Simple English terms were used to facilitate translation. This course has now been presented several times by the Timorese team in Tetum (one of the official languages of Timor Leste) and Indonesian.

The Timorese and Australian teams have gained experience in how to set up reliable mesh Wi-Fi links and how to diagnose problems. This has been carefully documented in blog posts. Serious problems have been reflected back to the Village Telco project for further consideration.

Rowetel has gained experience in third world project execution and collaboration with third world partners. A successful formula has been found that effectively transfers knowledge and skills with excellent results (project goals being met, 2nd generation training).



**Blog Posts:**

April 20, 2010	David and Rosemary arrive in Dili, talk about the plans for the project, and what it's like to visit Timor Leste <a href="http://www.rowetel.com/blog/?p=156">http://www.rowetel.com/blog/?p=156</a>
April 22, 2010	Training day <a href="http://www.rowetel.com/blog/?p=157">http://www.rowetel.com/blog/?p=157</a>
April 24, 2010	Assembling mesh nodes <a href="http://www.rowetel.com/blog/?p=159">http://www.rowetel.com/blog/?p=159</a>
April 24, 2010	Problem with interference <a href="http://www.rowetel.com/blog/?p=160">http://www.rowetel.com/blog/?p=160</a>
April 25, 2010	Installing mesh nodes at the University <a href="http://www.rowetel.com/blog/?p=161">http://www.rowetel.com/blog/?p=161</a>
April 25, 2010	Training on testing mesh links <a href="http://www.rowetel.com/blog/?p=162">http://www.rowetel.com/blog/?p=162</a>
April 29, 2010	Ermera mesh network and Batman over Ethernet <a href="http://www.rowetel.com/blog/?p=164">http://www.rowetel.com/blog/?p=164</a>
April 29, 2010	Lessons learned from April 2010 Trip <a href="http://www.rowetel.com/blog/?p=165">http://www.rowetel.com/blog/?p=165</a>
May 25, 2010	Ten node Pilot Network and WP3000 complete <a href="http://www.rowetel.com/blog/?p=166">http://www.rowetel.com/blog/?p=166</a>
August 31, 2010	The Dili Village Telco rolls out <a href="http://www.rowetel.com/blog/?p=845">http://www.rowetel.com/blog/?p=845</a>
November 26, 2010	Anders Hofstee has integrated Mesh Potatoes with his existing OSLR/Robin mesh network in Ermera, Timor Leste. <a href="http://www.rowetel.com/blog/?p=1159">http://www.rowetel.com/blog/?p=1159</a>
November 30, 2010	Alipio Simoes trains local Timorese to set up a Village Telco in Baucau, Timor Leste. <a href="http://www.rowetel.com/blog/?p=1165">http://www.rowetel.com/blog/?p=1165</a>
December 3, 2010	A Mesh Potato Spectrum Analyser: Checking Wi-Fi spectrum for interference and cardboard directional antennas. <a href="http://www.rowetel.com/blog/?p=1224">http://www.rowetel.com/blog/?p=1224</a>
January 9, 2011	We visit Baucau and talk to some very happy end users. Well done Alipio! <a href="http://www.rowetel.com/blog/?p=1422">http://www.rowetel.com/blog/?p=1422</a>
January 23, 2011	Dilimesh mapping application, improving Links, ease of use, future of the Dili Village Telco. <a href="http://www.rowetel.com/blog/?p=1447">http://www.rowetel.com/blog/?p=1447</a>

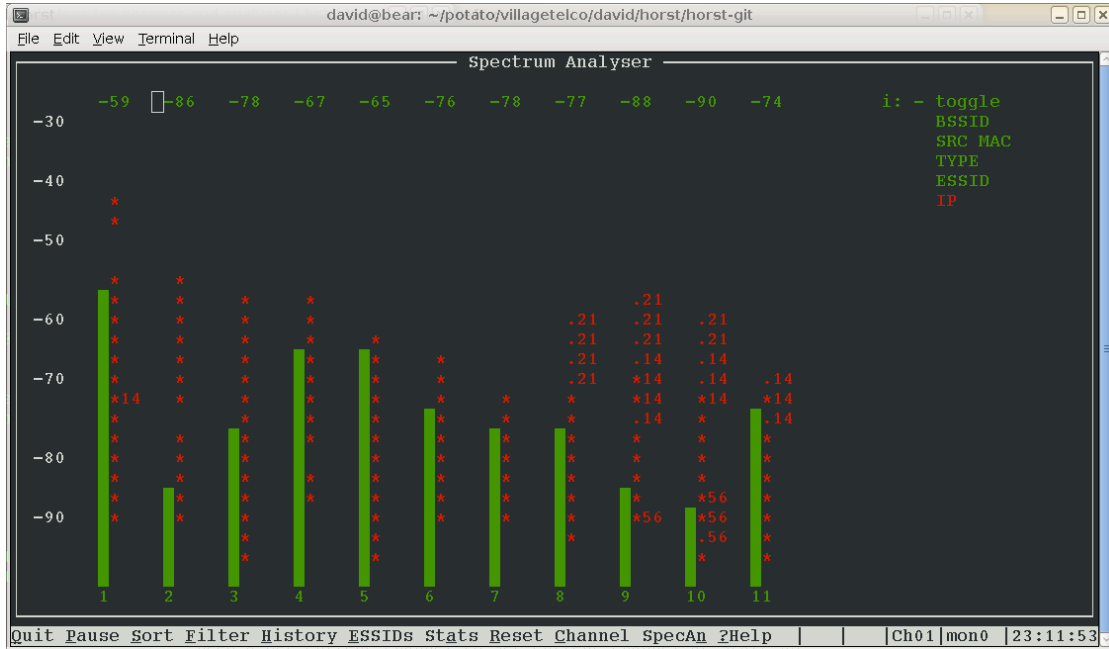


Figure 1: Software Spectrum Analyser

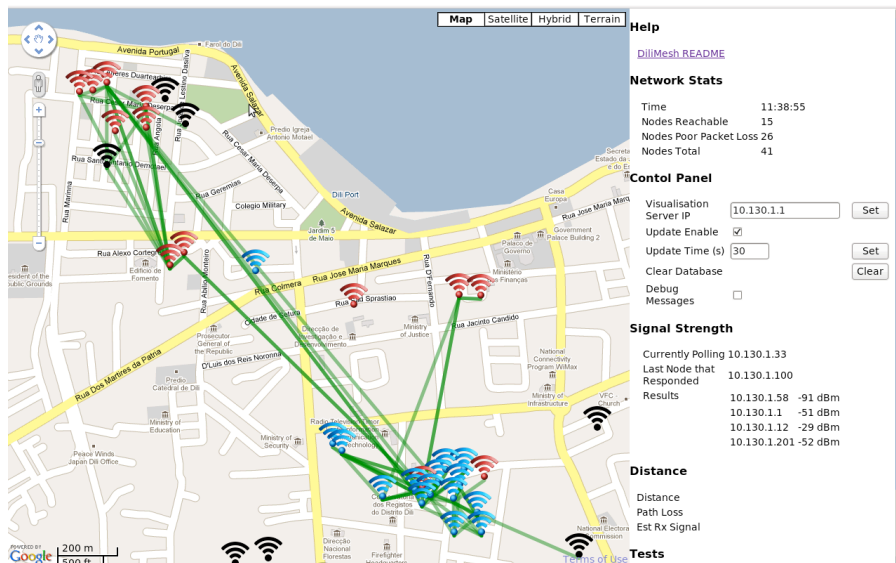


Figure 2: Dilimesh Mesh Mapping Application

Rowetel developed several open source software tools to support the team in Dili and assist in debugging mesh links. These include (i) “Dilimesh”, a Google Maps application for mapping mesh nodes and link quality, (ii) Audio Ping, an Asterisk application that renders ping information as audio beeps in a Mesh Potato telephone handset and (iii) a software spectrum analyser, that plots graphs of interfering Wi-Fi activity. This software is documented on the project Wiki.



This work has been developed with the financial support provided by the Information Society Innovation Fund – 2010.



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## Lessons learned from project implementation

We have proved that local people in a third world country can be easily trained to set up a Village Telco local telephone network. The Mesh Potato is so easy to configure and use that 2nd and n-th generation training is possible in a short time. This makes the Village Telco viral – given enough hardware it can spread without intervention from external consultants coming from developed countries and with limited support.

The “ease of use” theme of the Village Telco breaks down in areas with significant Wi-Fi interference and where Line of Sight (LOS) links are difficult. An unsatisfactory work around for interference is third party hardware, we do not have an effective, low cost solution for LOS.

Local phone calls are the surprising “killer application” for the Dili Village Telco. We had initially planned to install a server to allow connectivity with the Timorese GSM network and up-stream VOIP calls. However the Timorese end users simply want a way to make low cost (in this case free) local phone calls. Everybody has GSM mobiles, it's just that they can't afford to use them. In the developed world VoIP is associated with low cost long distance. We have forgotten the magic of a simple local phone call.



Photo 1: The Director of Women’s NGO Hafoti using the Mesh Telephone Network.

End user demand has been surprisingly strong. In January we interviewed several end users. A good example was Joao Do Carmo Pinto, who runs the CDC, an NGO in Baucau that helps people develop businesses around local skills and produce. Examples were small business canning or preserving local fish and fruit.

When asked about the Village Telco Joao said:

"It works really well, as long as the power is on it is 100% reliable. My GSM phone bill has dropped. I would love to see this deployed all over Baucau and would be happy to help promote it". When asked how we could improve the Mesh Potato, "Multiple phones at the one site, for example one in each room. All my staff want them at home."

FONGTIL has people visiting them daily to ask about Village Telco Technology. In January I met the IT manager for the Rede Feto (Women's networking) organisation. He spent some time discussing what equipment he would need to buy (Nanostations, MPs) to link his 5 sites together. Members of Rede Feto call each other at these same 5 sites all day. With minimal training he can install all of this equipment himself - the Mesh Potato is that easy to use. We have proven many times here in Timor that local people can install mesh telephony networks with very little training (just a few hours). This is in contrast to the very high skill levels and several months+ required to install and maintain IP networks for other applications.

FONGTIL are keen on expanding the network in 2011 and working through the link problems. They have invested 40% of their 2011's IT budget in Dili Village Telco expansion. When asked why, Lemi (leader of the FONGTIL team) replied:

"We only have to invest one time. Then we can make phones calls for free. No ongoing costs. If it works really well, we will expand to other districts." The fact that FONGTIL now wishes to invest it's own money after our grant-funded project has finished says a lot for the effectiveness of Village Telco technology.

Some "Best Practices" I think we have achieved:

1. Careful logistics and planning so that the Timorese team had all the hardware they needed for the project. Including the last nut and bolt, quality tools, even Ethernet cables.
2. Careful training and documentation on the project Wiki so that the Timorese team was equipped with the skills and knowledge required for the project. When asked about the effectiveness of the project Wiki Lemi commented:

"If you get stuck, or start training you can go to Wiki. Instructions there are very clear, easy to read, don't have to send email. The Wiki teach you. I would like to publish it as a book. Have it downloaded for off line reading when power/Internet is down. So many tasks in the technology require special knowledge, e.g. one little conf file option. We all forget after a few days, so it needs to be written down."

3. The training focused on faultfinding, e.g. how to fix problems without input from

external consultants from developed countries. For example a Mesh Potato that is incorrectly configured can be hard to debug. So the Timorese team members were shown how to re-flash a Mesh Potato to bring it to a known, stable state. FONGTIL is a veteran of many Wi-Fi projects of varying success, so can compare with the Village Telco project. When asked to compare, Lemi said:

"Village Telco is easy to set up". Maintenance is easy. If you get problem with equipment you just re-flash, so you don't need specialist Wi-Fi and IP knowledge. No command line, can use phone or Web User Interface"

4. Only stable software and hardware was allowed to hit the ground in Timor Leste. A third world deployment is not the place to test alpha software and buggy features. The entire system (including training) was initially tested at a first world site in Australia. The idea is to remove issues that are simple to fix in a first world country but show stoppers in the developing world.
5. The Mesh Potato is easy to use. This is a combination of the use of mesh networks, Omni directional antennas, and the ease of use philosophy of the Village Telco project. For example a Mesh Potato network is much easier to set up and use than a traditional point-point Wi-Fi network with directional antennas. The user interface (a telephone) can be used by anyone, even the illiterate. This is the key to a viral system that can spread without input from highly skilled personnel from developed countries.



Photo 2: Local mesh Potato Assembly and Training in Dili

Many of the NGOs receiving Mesh Potatoes are women's advocacy groups. These include Alola Foundation, Hafoti, GFFTL, Fokupers, Rede Feto, Caucus, FKSH, and APCTL. The first Mesh Potato in Dili was installed at the Blind Union, a support organisation for Blind people in Timor Leste.

## Project management and sustainability

The one major delay (around 3 months) was been procuring and delivering the Mesh Potato hardware. This was due to the hardware being custom manufactured, and an error in shipping by the courier (the shipment went to Afghanistan rather than Timor Leste!).

Village Telco skills are easy to acquire, indeed they are multiplying through Timor Leste as I write. This makes staff retention much less of a problem that many other ICT4D projects. Mesh Wifi links are (with some exceptions) far easier to set up that point to multi-point Wi-Fi links.

There is a problem with financial sustainability. The original Village Telco business model included a “Village Telco Entrepreneur”, or VTE. This person would maintain the network, and make money from charging a small profit on “off mesh” calls to GSM networks and long distance locations via VOIP. However the Timorese are only interested in local calls. They all have GSM handsets, and there is no advantage in using a Mesh Potato to call the GSM network via a gateway.

This means we need to find a new business model for expanding and sustaining a Village Telco networks in Timor Leste. We do have a lot of enthusiasm and end user demand for the system. This suggests a sustainable business model will be found. One example is a subscription model, where end users are asked to pay a few \$ every month. FONGTIL already uses this model for other services such as IT support.

There is a lot of value in being part of the Dili Village Telco due to network effects. FONGTIL is finding that NGOs are prepared to fund all or part of their own Mesh Potato installations, for example paying \$100 for a mast. So end users may actually fund the capital costs because of the extreme value they perceive in the system, much like a person from the developed world invests in a headset or laptop to use a peer-peer network like Skype.

## Impact

The information produced has been enthusiastically received and absorbed. There are now in excess of 20 people in Timor Leste capable of setting up their own local telephone network using Village Telco technology. This knowledge has been used to give 70 people affordable telephone communications. The Dili Village Telco is one of the most popular projects at Fongtil – staff members at all levels enjoy project activities such as training, climbing trees and towers, and Mesh Potato installation. They feel empowered as they control and understand it. It usually works, and when it doesn't they know how to fix it.

The target end-users (principally NGOs in Dili) can communicate for free. For example one campus of the University can provide technical support with the other campus. Long conversations can be held without concern for cost. Tech support is difficult if phone calls are timed and expensive. In Ermera, where no GSM phone service exists, a phone call can save a 3 hour drive in a 4WD vehicle.

It is hard to explain the impact of low cost telephony to first world people. Prior to the Dili Village Telco, people would walk across town when their phone credit ran out, wasting hours of time. Invitations to inter-NGO events at FONGTIL would be hand delivered by car to avoid paying for phone calls. Remote villages like Ermera had no communications except police 2-way radio. Many people had never seen a landline telephone and had to be “trained” to hang it up at the end of a call.

The Timorese are happy to spend money up front to develop project, as ongoing calls are free. The ability to make a call over 1km for free makes people very happy as they are used to putting huge amounts of their income into phone calls. A phone call therefore has very high value here. Every call is like a big, valuable Christmas present!

The Dili Village Telco helps NGOs reduce calls costs. For example it is directly helping Women’s NGOs and the Blind society as they saving valuable money on every phone call. This money can be kept for other worthy purposes. Free communication leads to stronger networks between NGOs, which directly impacts the development of Timor Leste.

No one is afraid to use the phone any more.

## Overall Assessment

The Village Telco has been a 2-year project involving many people and several companies from around the world. The Dili Village Telco is the first field trial of the Village Telco in the world. It is therefore an extremely important test of the system. Many assumptions are made when developing a new system or product. Field-testing allows us to determine which assumptions are correct, and which assumptions incorrect. Until you hit a real end user you never know if a system or product is correctly designed. There are always surprises.

More time than expected was invested in planning, preparation, and in logistics, for example careful design and testing of the mesh network before deployment in Timor Leste, and shipping equipment. However this appears to have paid off – the Timorese team has absorbed the training and are now deploying three Village Telco networks with very little support from the Australian team.

The project quickly uncovered weaknesses in the “ease of use” goal of the Village Telco technology: interference leading to poor mesh links and the problems in setting up Line of Site (LOS) links in a tropical environment with high trees. Finding effective long-term solutions to these problems is beyond the scope of this project, but the issues have been communicated to the parent Village Telco project. Rowetel has developed some (open source) software tools to help visualise and debug these problems. However FONGTIL is confident the link problems can be solved with the addition of third party equipment and (locally manufactured) directional antennas.

Surprising results were the general ease of training, 2nd generation training leading, the expansion of the trial to three networks, the popularity of free local phone calls, and the strong demand for further expansion.