

Project factsheet information

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| Project title | “Chiang-Rai MeshTV” : An Educational Video-on- Demand (E-VoD) System for a Rural Hill-Tribe Village via a Community Wireless Mesh Network (CWMN) |
| Grant recipient | The Internet Education and Research Laboratory (intERLab) Asian Institute of Technology (AIT) P.O. Box 4, Klong Luang, Pathumthani, Thailand 12120 http://www.interlab.ait.asia/ChiangRaiMeshTV |
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| Partner organizations | The THNIC Foundation The Mirror Foundation |
| Total budget approved | AUD 30,000 |
| Project summary | The project aimed to setup an educational Video-on-Demand system that runs on top of a Community Wireless Mesh Network (CWMN) in a rural tribal village in Chiang-Rai province located in the northern part of Thailand. The system, ‘Chiang-Rai MeshTV’, brings easy-to-use Video-on-Demand capabilities to a remote rural community, which is lagged far behind modern urban cities. Rural ICT access for tribal ethnic groups requires a specialized approach. Some of the tribal ethnic groups have very low ICT and Internet literacy. They may also not have good commands in English or even in a nation’s official language, as they fluently communicate in their local language. Providing easy-to-use educational video contents along with intuitive user devices, such as tablet computers, to view Educational Video-on-Demand (E-VoD) contents can serve as an initial but highly significant path to connect these tribal people to the global digital economy while preserving their cultural heritage via video and other multimedia recordings. |

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Project Summary

This project aimed to deploy an Educational Video-on-Demand (E-VoD) system running in a Community Wireless Mesh Network (CWMN) for a hill-tribe village known as Huay Khom village, located in a rural area of Chiang-Rai province, Thailand. The system was named 'Chiang-Rai MeshTV'. The villagers of Huay Khom are among those having lowest ICT literacy in the nation, mainly because of their socioeconomic status and the isolation caused by mountainous terrains they live in, where cellular network signals do not reach. This project aimed to bridge the digital divide in Huay Khom, by experimenting with a low-cost low-powered and robust mesh network and added-value services, created by using off-the-shelve networking devices.

The project approach is based on the fundamental view that video is the simplest but most powerful form of media, easy to understand by those with lower ICT literacy. Therefore, with this arrangement, we can use video media to disseminate knowledge and new ideas in the rural community as well as to promote ICT literacy. Although some villagers of Huay Khom have access to television receivers, these villagers have not had much opportunity to use VoD contents like those found in online video-sharing platforms like YouTube™ and Vimeo™. Likewise, the villagers have not been exposed to free, Public Domain, or Creative Commons educational contents, which are available on the Internet. The lack of high-speed links poses a great challenge in bringing VoD content to the rural village. We have technically tried to avoid the bandwidth bottleneck problem through video content caching. Seeing such an opportunity, our team intends bring pre-selected educational VoD contents closer to the lives of Huay Khom villagers through our CWMN technology.

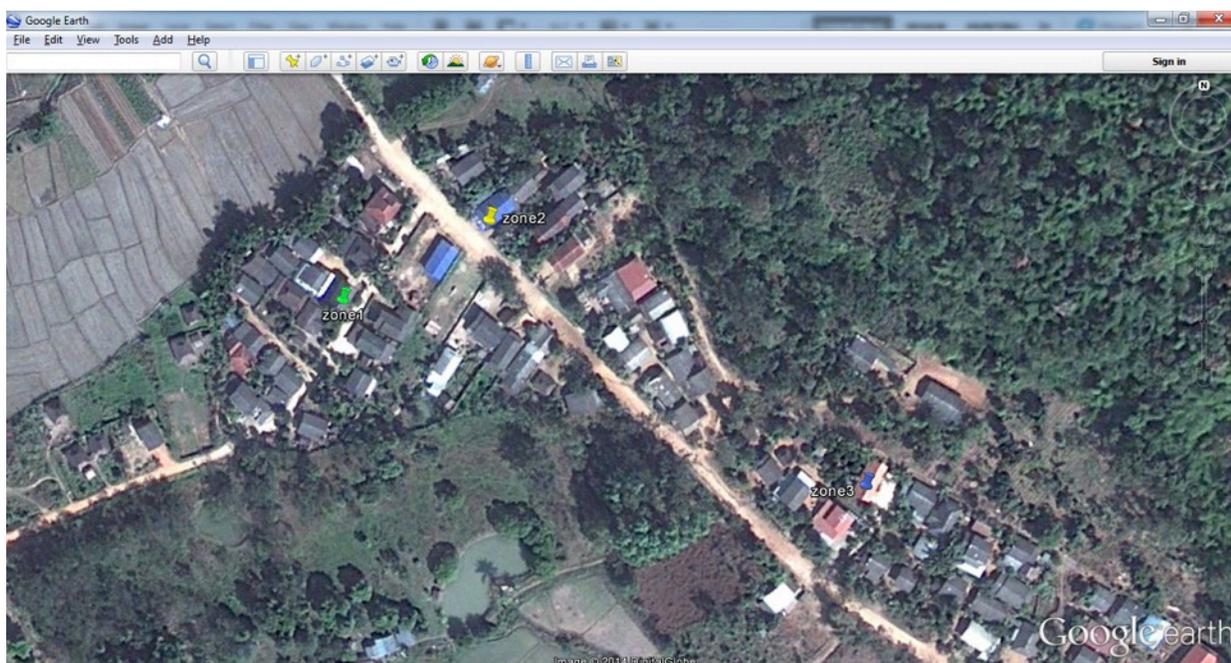
This project is a joint effort among the Internet Education and Research Laboratory (intERLab), the THNIC Foundation (THNICF) and the Mirror Foundation (MIRRORF):

- IntERLab has researched and developed CWMN and E-VoD technologies, which are based on low-cost, off-the-shelve devices. IntERLab's CWMN and E-VoD technologies are primarily aimed at rural ICT for development (ICT4D).
- THNICF has supported intERLab by recruiting young volunteers who are willing to work together in annual ICT camps (i.e. Thailand Networking Group, or THNG, Camps) that deploy experimental ICT test-beds developed by intERLab.
- MIRRORF has been with the villagers of Huay Khom villagers for more than 15 years, supporting Huay Khom community and social development as well as citizenship issues.

This technical report covers the whole implementation and monitoring of the project, which started in February 2014 and ended in early October 2014. The report describes initial planning, deployment, follow-up, on-going work and future plans. The report also discusses a number of deployment issues and shares some insights from our deployment experience. Our project's blog showing videos and pictures from deployment activities in Chiang-Rai is available at <http://www.interlab.ait.asia/ChiangRaiMeshTV>. The blog is best viewed using Safari or Chrome browsers.

Background and Justification

The village of Huay Khom, or Bann Huay Khom, with a population of approximately 550 people and 265 households, is located in Mae-Yao district of Chiang-Rai province in the northern part of Thailand, in an area surrounded by mountains. Most of the residents are of hill-tribe origin. Before the beginning of the project, no home in the village had Internet access. The nearest location where residents accessed the Internet was in the office of the project partner, the Mirror Foundation. Cellular phone signals are weak and unevenly distributed. Cellular voice calls are only possible at a few spots due to geographical obstacles. Cellular data (e.g. 2G/3G/4G) coverage is likewise very spotty and unreliable. Internet and ICT literacy level is therefore undoubtedly among the lowest in the nation.



The village already has electricity supply. A paved road ends near the entrance to the village. Many households depend on government-subsidized electricity. If they use less than 50 Kilowatts-hour per month, then the government waives their monthly electricity bills.

The Mirror Foundation, Chiang-Rai branch, has worked closely with the villagers of Huay Khom for more than 15 years. Their work during early 2000s, dealt with the issues of villagers' citizenship, occupation, and cultural preservation.

The Internet Education and Research Laboratory (intERLab) at the Asian Institute of Technology (AIT) is a regionally recognized research institute working on the topics of Internet Technology, Long Distance Education and ICT for Rural Development. IntERLab has developed a set of low-cost and robust community wireless mesh networking technology and methodology aimed for ICT penetration and adoption in rural communities.

This project aimed to bring to villagers two technological components that have significant potentials to help bridge digital divide. These components are:

- A new form of low-cost but robust community wireless mesh networking technology
- An easy-to-use educational Video-on-Demand (VoD) system that can be managed and updated locally by designated persons in the village.

We believe that by bringing these easy-to-use technologies into the targeted village, the rural villagers, especially the curious-minded youths, will soon become enthusiastic users. This will pave the way for them to adopt and utilize information and communication technologies in their daily lives, as well as to be able to reshape how the community incorporates ICTs, resulting in having many competitive advantages in the long run.

Project objectives

1. To deploy and customize a Community Wireless Mesh Network (CWMN) along with relevant wireless intranet-link services in the targeted hill-tribe village using the CWMN routers that IntERLab has already built and tested.
2. To devise and establish an Education Video-on-Demand (E-VoD) system which can run in such CWMN, by taking the advantages (or bearing the limitations), which exist in the CWMN.
3. To gather, select and create educational video contents, which are suitable for the targeted population in the rural hill-tribe community. Also to make documentary video or other multimedia contents that can help preserve and promote the village's cultural heritage.

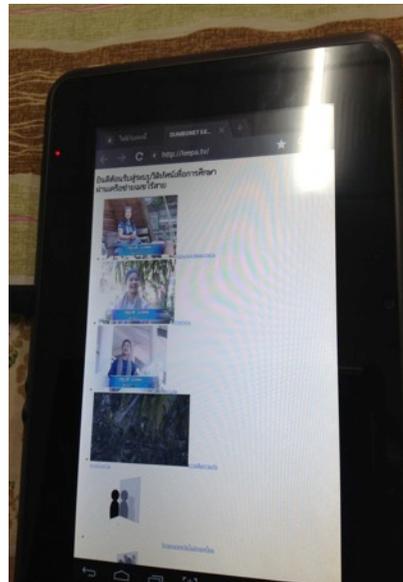
Users and uses

There are two (2) primary user groups in our project.

The first user group is the villagers of Huay Khom. The original proposal estimated that at least 35 to 40 households were going to be able to access the newly deployed CWMN services. With each household having around 3 - 5 persons, that would mean we have the capability to reach approximately 100 - 150 people in this formerly Wi-Fi quiet village. It will definitely take some time for the villagers to get familiar with their new ICT pathway. However, with the coaching activities conducted by our team and the Mirror Foundation, we have confidence that the villagers will eventually learn how to fully utilize the capabilities of our newly deployed services.



In the pictures above: a post-deployment training activity targeted at the villagers



In the pictures above: One of the CWMN routers that has been deployed in the village (left). Each router has a 16GB USB flash drive that can cache video files and deliver such video files to be viewed on user tablets (right).

The second user group is one of our partners, the Mirror Foundation, who will have a new way to reach out to the community that the foundation has been working with for more than 15 years. The Mirror Foundation will have new innovative ways to promote cultural preservation, to expose the villagers to modern knowledge and technologies, and to execute new educational initiatives.

During the project implementation, the project team studied 1) the reactions (or hesitations) of the villagers in adopting new technologies and 2) the villagers' collective ability to sustain our CWMN. The team tackled these issues trying to identify solutions for the sustainability of the system after the project cycle.

In our ongoing work, which continues beyond the timeline of this project, we plan to investigate further ideas including but are not limited to:

- 1) Research into new methodologies and new algorithms for E-VoD and CMWN, such as Named Data Networks (NDN) for video content distribution in CWMN.
- 2) Build local capacity around video contents creation through a small group of youths in the village working with potential support from the Mirror Foundation.
- 3) Create and sustain a network of local content developers around the THNG Camp activities, who can create/edit new video or other form of electronic contents to be used for educational purpose, especially in Thai language with potential support from the THNIC Foundation.
- 4) Create an umbrella mesh network that links CWMN in several regional rural communities. One may view this as a rural, multi-community version of the "Internet" with potential support from the THNIC Foundation for our future THNG Camp activities.

Indicators

| Baseline | Indicators | Progress | Assessment | Course of action |
|--|---|---|---|---|
| <i>Refers to the initial situation when the projects haven't started yet, and the results and effects are not visible over the beneficiary population.</i> | <i>How do you measure project progress, linked to the your objectives and the information reported on the Implementation and Dissemination sections of this report.</i> | <i>Refer to how the project has been advancing in achieving the indicator at the moment the report is presented.</i> | <i>Descriptions should be clear and ideally contain operational terms where needed. Please describe the quality dimensions.</i> | <i>What is the project team planning to do next is very important to document, specially if changes to the original plan have to be implemented for the success of the project.</i> |
| None of the households had the ability to access data network in their premises | We design, inspect and verify the CWMN coverage on households that have data networking access right at their homes | After the CWMN routers have been deployed, approximately 35 to 40 households are now capable to access CWMN either directly (i.e. mounted on their walls) or indirectly (i.e. mounted on a neighbor's wall) | Our plan of deployment was accomplished. The network has been up and running since March 2014 | The system has been remotely monitored and measured for stability and usability. Adjustment to the topology or node locations will be made if necessary. |
| None of the households used ICT in their daily lives. | We survey the number of households that regularly use ICT for educational purposes | We have encouraged the villagers, especially the youths, to use our system on a regular basis. Now more than 30 households actively participate | Our partner, the Mirror Foundation, keeps encouraging the youths in the village to use CWMN more often. | The Mirror Foundation has helped encouraging the youths to use the deployed E-VoD and CWMN in their daily lives, through community-led activities. |
| None of the villagers had access to the educational Video-on-Demand contents in their households | We count the number of educational videos posted on our E-VoD system | We have put more than 200+ educational videos in our E-VoD system. | Initial educational videos come from YouTube and other sources. The videos are effectively cached in the system. | We are working to increase the diversity of the educational video contents. Some will be produced. Some will be acquired through Internet search and collaboration with partners. |

Project implementation: understanding the chain that leads to results

Narrative - project implementation

Our project aimed to setup an educational video-on-demand system (E-VoD) that is deployed within a community wireless mesh network (CWMN) in a rural tribal village known as the village of Huay Khom located in mountainous Mae Yao district of Chiang-Rai province, Thailand.

The project was implemented through a partnership among the THNIC Foundation (THNICF), the Mirror Foundation and intERLab. THNICF has been a key supporter to intERLab's wireless mesh networking research and development since 2010. The Mirror Foundation, Chiang-Rai branch, has worked closely with Huay Khom villagers for more than 15 years around issues of villagers' citizenship, occupation, and cultural preservation, offering a unique link between the technological solution this project focus on and the way of live in the village.

In January 2014, a small survey team from intERLab and THNICF went to the village of Huay Khom to discuss the concept of deployment with members of the Mirror Foundation. The survey team explored the area to identify

potential zones. The survey team returned to Bangkok to make a decision on coverage and zones. Technological solutions, networking design, and system parameters were studied and developed from late February to mid March 2014.



In photos above: our site survey in January 2014

The preparation of deployment involved preparing a number of mobile routers. The team decided for a two-tier network with Ubiquiti Unifi to act as the core CWMN backbone and TP-Link MR 3040 as access routers. The

team started preparing the first core CWMN routers (Ubiquiti Unifi) in February 2014 and finished with the access routers in March. A pair of point-to-point mesh nodes were then later included in the design as it was determined that the distance between the Mirror Foundation office and the village was too far to provide a stable networking link.

The major field deployment activities started in March. The THNIC Foundation and intERLab jointly organized the Thailand Networking Group Camp 2014 (THNG Camp) from March 22 to 28, where 13 young volunteers came to learn about the CWMN technology with intERLab’s staff members. Later on, they helped design and deploy CWMN in the village of Huay Khom. The THNG Camp’s website banner is shown below (<http://www.thng.in.th/4th-camp>).



Thailand Networking Group (THNG) Camp 2014
 วันที่จัดงาน: 22 - 28 มีนาคม พ.ศ. 2557
 สถานที่จัดงาน: หมู่บ้านห้วยชมอาษา ต.แม่ยาว อ.เมือง จ.เชียงราย

หลักการและเหตุผล

Thailand Networking Group หรือ THNG เป็นโครงการหนึ่งที่สนับสนุนโดยมูลนิธิศูนย์สารสนเทศเครือข่ายไทย (THNIC Foundation) มีวัตถุประสงค์เพื่อสร้างกลุ่มอาสาสมัครที่ภาคเทคโนโลยีอินเทอร์เน็ตไปประยุกต์ใช้กับภาคส่วนต่าง ๆ ของสังคม เพื่อเสริมสร้างการเรียนรู้และการใช้ชีวิตของผู้คนในสังคม ภายใต้แนวความคิดที่ว่า "Internet Technology for Society: เทคโนโลยีอินเทอร์เน็ตเพื่อสังคม" โดยมีการดำเนินการดังนี้

🇹🇭 Thai
🇬🇧 English

ผู้สนับสนุนหลัก THNG 4th camp

ผู้สนับสนุนระดับ GOLD

On March 21, intERLab’s staff members arrived in the village of Huay Khom to conduct a more thorough site survey and to work on technical planning. IntERLab’s team also started the work on the core CWMN routing backbone. On March 22, the team of volunteers first met in Bangkok, travelled to Chiang-Rai and arrived to the village the next day. The volunteers met the representatives of the Mirror Foundation who introduced them to the culture and history of the village. The volunteers then learned the concept of community wireless mesh networking by intERLab. The volunteer team had a hands-on session on how to setup and deploy CWMN mobile routers in the right locations.



In photos above: Activities on March 23, 2014 — the first day that THNICF-led volunteers arrived in the village.

March 21, 2014

- intERLab team arrived in the village and began technical survey
- Core backbone deployment started

March 22, 2014

- THNICF-led volunteers left Bangkok and arrived in Chiang-Rai at night
- IntERLab's team continued work on core backbone

March 23, 2014

- THNICF-led volunteers arrived in the village, received technical training
- IntERLab's team continued work on core backbone

March 24, 2014

- THNICF-led volunteers identified the deployment locations of access routers
- IntERLab's team continued work on core backbone

March 25, 2014

- THNICF-led volunteers began the installation of access routers
- IntERLab's team finished the core backbone

March 26, 2014

- THNICF-led volunteers continued the installation of access routers
- IntERLab's team worked on the E-VoD system

March 27, 2014

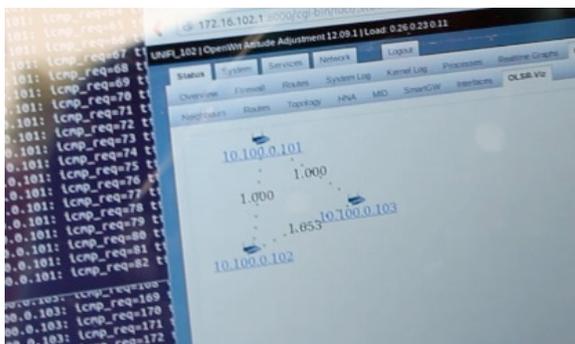
- Distribution of tablets
- Training of villagers
- Further maintenance work discussed with the Mirror Foundation

March 28, 2014

- Chiang-Rai MeshTV was up and running
- Stability tests and monitoring began
- IntERLab, THNICF-led volunteers returned to Bangkok

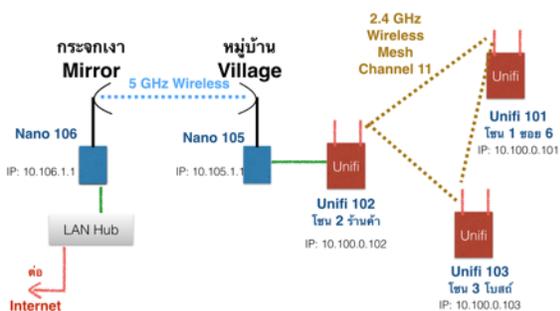
Major deployment activities for Chiang-Rai MeshTV from March 21 to March 28, 2014

The work of establishing a core routing backbone started earlier on March 21 and took a couple of days to finish. This technically challenging task was assigned to intERLab's team. The purpose of the core routing backbone is to interconnect the Mirror Foundation to the three CMWN deployment zones in the village.

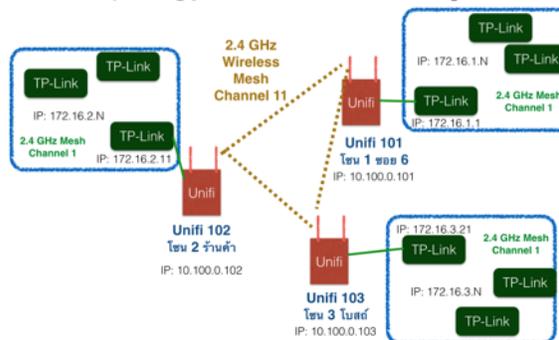


IntERLab's team worked on identifying the locations of the core mesh routing backbone nodes

Topology ในส่วน Backbone



Topology ของเครือข่ายเมชในหมู่บ้าน



Left: core backbone of Chiang-Rai MeshTV. Right: TP-Link MR 3040 routers serve as access routers in three different zones.

On March 24, the volunteers went to meet and ask for permission to install CWMN equipment from the home owners. The volunteers mainly worked on identifying the locations to install CWMN access routers on the walls of many homes in the village. This was a very crucial step. Although the villagers were made aware of our deployment-related activities prior to our arrival, none of the rural villagers knew exactly what the community wireless mesh network is and what the benefits of installing CWMN mobile routers in their home would be. Our volunteers faced a unique challenge of making non-tech savvy villagers understand the strong values of CWMN. These are the values that could later enhance villagers' lives and prosperity.

Among the concerns that the villagers had, one was interesting. Some villagers feared that each mobile router would consume so much electricity that their monthly usage could go beyond a free monthly allowance imposed

by the Thai government. The government has given a free allowance of 50 Kilowatts-hour (KWH) for low-income and small households. If a household's monthly electricity consumption does not exceed such an allowance, the owner does not have to pay the electricity bill. This policy, although benefits many rural villagers, turns out to be a surprising psychological obstacle to our deployment experience. We have estimated that, each of our CWMN routers, rated at 5 Volts x 1A = 5 Watts should consume no more than 5 KWH per month even it is turned on 24/7 (assuming 1W to 1.5W waste in the power adapter). After explaining the issue of electricity consumption to the villagers, some allowed us to pursue the installation. Homes with young children, especially in school ages, appear more enthusiastic to participate. This was a win-win scenario for us.

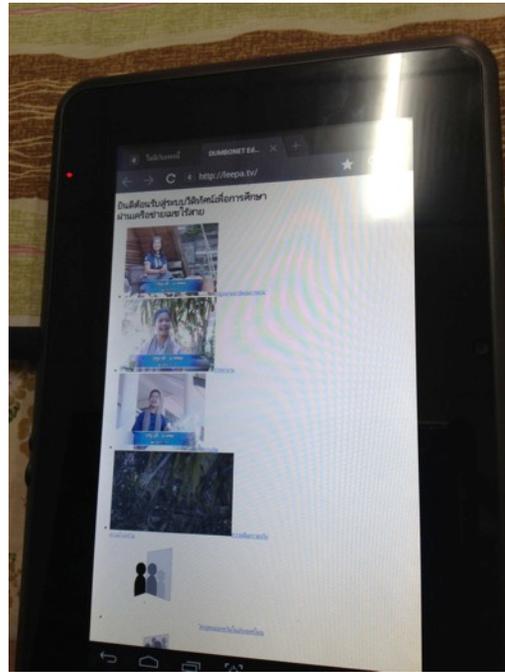


THNIC-led volunteers helped identify and test the installation locations of the CWMN access routers. Each of the CWMN access routers is TP-Link MR 3040 with a customized firmware.

The installation of CWMN access routers in the villagers' houses took four days. During the same period, both THNIC-led volunteers and intERLab staff members became acquainted to many villagers and trained them on how to use our newly deployed CWMN with a Video-on-Demand system. We hosted a number of introductory training sessions for the villagers on the evenings of March 25 - 27, 2014.

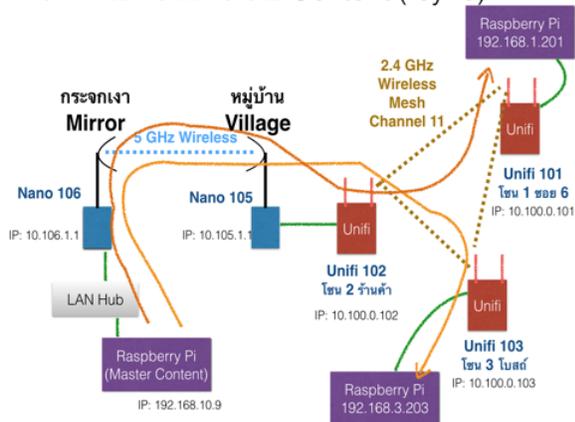
| | |
|-------------------------|---|
| Hardware make and model | TP-Link MR 3040 hardware v.1.0 |
| CPU | Atheros AR7240, 400MHz |
| RAM | 32 MB |
| Flash memory (built-in) | 4 MB |
| Wireless standards | IEEE 802.11n, 2.4GHz |
| External flash memory | 16GB HP USB 2.0 Flash Drive (for video caching) |
| Operating system | OpenWRT 12.09 |
| Mesh protocol | Optimized Link State Routing (OLSR) |

Specifications of the CWMN access routers used in this project.



The training of villagers on March 25 – 27, 2014

การทำงานของระบบกระจาย Content (rsync)

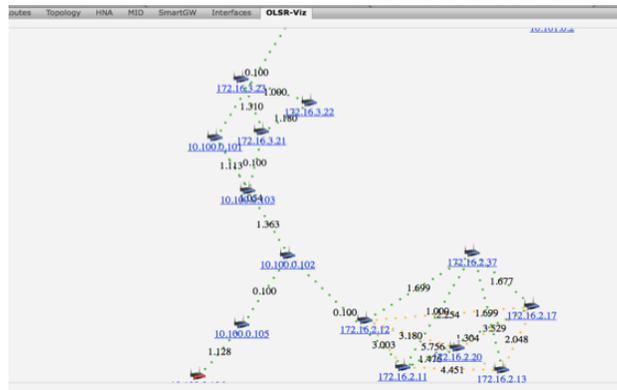


Left: our video content dissemination concept using three (3) Raspberry Pis

Right: Service coverage of the Chiang-Rai MeshTV system : orange = zone1, yellow = zone 2, and blue = zone3

To complete the design, three Raspberry Pi computers were used, each one equipped with a 32GB SD card, to serve as a video content dissemination system. In the initial deployment, a simple but robust video content dissemination methodology was implemented. The Mirror Foundation can put new educational video contents into the Master Raspberry Pi, and the new video contents will be selectively synchronized to two other secondary Raspberry Pis in zones 2 and 3 respectively. Then the video files will be pushed to and cached by each and every access router (i.e. the TP-Link MR 3040) on the router's USB flash drive.

IntERLab is actively working on the research and development of a new generation VoD system, which relies on the concept of Named Data Networks (NDN) and takes the advantage of content routing. We expect to roll out a revised VoD system for CWMN for a field test in 2015, once this current project has concluded.



A partial status view of the Chiang-Rai meshTV CWMN system.

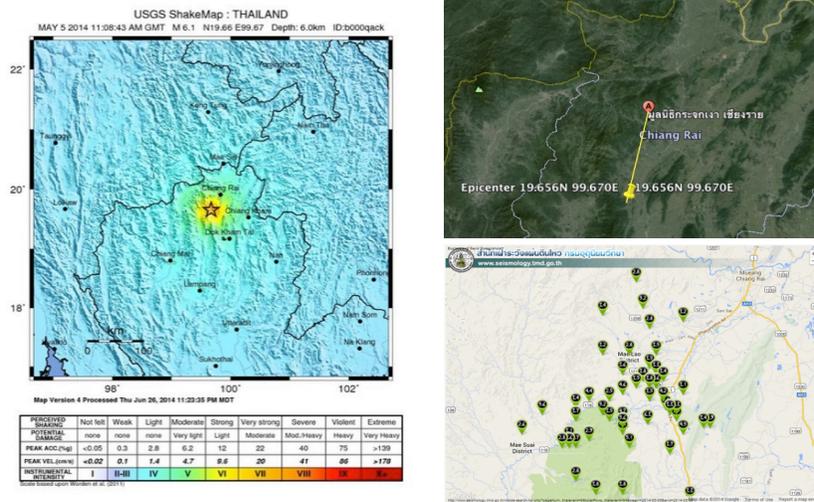
On March 27, the Chiang-Rai MeshTV was up and running. The intERLab team discussed and trained the Mirror Foundation's personnel on how to check status, troubleshoot and resolve problems that often occur in this kind of network. The Mirror Foundation also proposed a number of ideas regarding how to encourage Huay Khom villagers to use the network more. The THNICF-led volunteers and intERLab's team returned to Bangkok on March 28. Chiang-Rai Mesh TV has been operational and monitored ever since.

Since the deployment of Chiang-Rai Mesh TV, the system has endured two natural disasters:

- On April 5, a hailstorm hit the village in the morning. There were no damages to our outdoor networking equipment.
- On May 5, at 18:08:43 local time (GMT+7), a magnitude 6.1 earthquake struck Chiang-Rai causing damages to buildings and some roads within 30 kilometers from the epicenter (19.656N, 99.670E). More than 100 aftershocks of various magnitudes were reported. Fortunately, the system that we deployed in the village of Huay Khom was unaffected. The village of Huay Khom is located approximately 38 kilometers north east of the quake epicenter. Some staff members of the Mirror Foundation, however, had to engage in disaster recovery activities in the nearby areas that were severely affected by the earthquake.

Not only natural disasters have had an impact on project implementation. On the evening of May 22, the military leaders took control of Thailand, citing the on-going political unrests that could soon become violent as the cause to remove the government. Nighttime curfews were strictly imposed nationwide from 10:00pm to 5:00am for several nights. The curfews had considerable impacts on the project, as the researchers could neither work late at night to resolve technical issues nor work on devising some new features. In early June, the nighttime curfews were gradually lifted in some regions. The curfews were eventually lifted nationwide on June 13 and the working situation has since returned to almost normal.

However, the post-coup conditions present a number of challenges, including the shift in the national ICT policies. The first challenge faced, is the cancellation of government supported school students' tablet program — the device, which could be used as a video client by young students. Although this is a setback in terms of accessing E-VoD at home, in our opinion, tablets will slowly and eventually replace normal PC as a primary end-user computing device because of their design, portability and convenience.



The earthquake of magnitude 6.1 that hit Chiang-Rai area on May 5, 2014 (image credit: USGS)

The relative distance from the village marked as balloon A) to the epicenter was approximately 38 kilometers (image credit: Google Earth)

Report of several aftershocks by the Thai Meteorological Department (image credit: TMD)

The other challenge is the indefinite freeze on the National Broadcasting and Telecommunications Commission’s Universal Service Obligation (NBTC’s USO) program. NBTC is Thailand’s national regulator. The USO program was intended to provide funding for rural ICT developments. Prior to the coup d’état event, the team discussed the deployment with the NBTC’s USO program and submitted a proposal for extension and deployment of other networks similar to Chiang-Rai MeshTV as a pilot program in a few more selected provinces of Thailand. However, the activities of the NBTC’s USO program have been suspended indefinitely by the new administration. These political factors beyond the project team’s control, force the team to scale down the near-term plans and revise a strategy for deployment’s sustainability.

With the CWMN network operational, the project focus shifted to the work of selecting or creating educational contents as well as providing such contents to the Chiang-Rai MeshTV system. The work on content selection and content creation started in June and was conducted jointly with the Mirror Foundation and the THNIC Foundation. In July, a team of intERLab and THNICF revisited the deployment site of ChiangRai MeshTV to follow up, adjust some system parameters, and inspect the equipment being deployed. The team also discussed with the villagers to obtain user feedback for future planning purposes.



The follow up visit by intERLab and THNICF in July 2014 - 4 months since the deployment.

| Input | Project activities | Outputs | Outcomes | Timeline | Status | Assessment |
|---|--|---|---|---|--|--|
| <i>Financial, human and material resources</i> | <i>Actions taken, work performed.</i> | <i>Result and/or deliverable produced as a direct result of the project activity. Outputs are under direct control of the project team.</i> | <i>Likely or achieved short and medium term effects. Focus on the changes facilitated by the project for its beneficiaries. Outcomes tend to be under the influence of the project team but not under direct control.</i> | <i>Dates where the listed activity was developed.</i> | <i>Indicate when the activity started, on-going or completed.</i> | <i>Assessment indicating how the activity has been conducted. Describe technologies implemented, methods and techniques used and any challenges that have been identified.</i> |
| - IntERLab & THNICF team in collaboration with MIRRORF | - Site survey - Planning of educational Video-on-Demand and community wireless mesh network services | - Concept and plan of E-VoD and CWMN services | The team produced - a deployment plan - topological map for deployment zones - technology selection. | Jan 2014 - Feb 2014 | Completed | The mission was successful. Both the concept and plan of deployment plan were produced. |
| - InterLab team with CWMN technical expertise | - Network design & preparation of CWMN equipments | - CWMN routers and backend system which are customized for field deployment | The team acquired necessary parts, installed customized firmware, and configured the equipments for field deployment. The equipments were tested by intERLab prior to deployment. | Feb 2014 - Mar 2014 | Completed | The mission was successful. Technical design was produced. Equipments were made ready for field deployment. |
| - THNICF-led volunteer team, intERLab team and MirrorF team - Deployment plan and CWMN routers from the previous steps | - Deployment of Chiang-Rai MeshTV (CWMN + E-VoD system) | - A fully functional system of CWMN and E-VoD named Chiang-Rai MeshTV - A group of 13 young volunteers who are now capable for E-VoD and CWMN deployment | The THNICF-led volunteers now know how to deploy the E-VoD and CWMN system. They also trained the villagers to become knowledgeable in using our system | Mar 21 - Mar 28, 2014 | Completed | Chiang-Rai MeshTV is up and running. Villagers know how to use the system |
| - IntERLab, THNICF, and MIRRORF resource persons - Chiang-Rai MeshTV system produced in the previous step. | - Selection of creative commons and public domain educational video contents by IntERLab and THNICF - Production of educational video contents by MIRRORF - Follow up of E-VoD and CWMN users' behaviors | - Video episodes to be used in our E-VoD system | - IntERLab develops a set of scripts and procedures that automatically disseminate new video contents into the Chiang-Rai MeshTV system - MIRRORF produces a number of new educational video episodes for the rural village. - THNICF negotiates with content partners as well as identifies new and interesting contents from the Internet | Apr 2014 - Ongoing | Dissemination procedure and video production were completed. Content partner negotiation is still on-going | The work in this section was significantly delayed because of two incidents of natural disasters and the military take-over (coup d'état) that occurred in May 2014 We were able to catch up most of the required work before the end of the project. |
| - IntERLab research expertise - Chiang-Rai MeshTV system being used as a research testbed. | Research and development in E-VoD and CWMN-related technologies | Knowledge on E-VoD/CWMN methodologies, system performance, and system stability | - Methodologies for the setup and dissemination of Video-on-Demand contents in CWMN - Monitoring and statistics collection issues - Named Data Networks for VoD service in CWMN | On-going research | Work in progress A poster session on NDN for VoD in CWMN at AINTEC 2014 conference. | This is intERLab's ongoing research. The main objective is to continue improving our methodologies and understandings through field testbed. |

Project outputs, communication and dissemination activities

Our project has produced the following categorized outputs:

New Products and Services:

- A fully functional system of CWMN and E-VoD named Chiang-Rai MeshTV
- CMWN routers and a backend system which are customized for field deployment

Information Sharing and Dissemination:

- Video episodes to be used in our E-VoD system
- Project discussion with the National Broadcasting and Telecommunications Commission
- A Research Poster (Named Data Networks for E-VoD in CWMN)
- Presentations at selected workshops and conferences (e.g. AINTEC 2014)

Knowledge creation:

- Concept and plan of E-VoD and CWMN services

Training:

- A group of volunteers who are now capable for E-VoD and CWMN deployment

Research Capacity:

- New knowledge on E-VoD/CWMN-related methodologies, system performance, and system stability

The project's blog showing videos and pictures from our deployment activities is available at <http://www.interlab.ait.asia/ChiangRaiMeshTV>

| Project outputs | Status | Assessment | Dissemination efforts |
|--|--|---|---|
| A fully functional system of CWMN and E-VoD named Chiang-Rai MeshTV | Completed in March 2014 | A system of 35 TP-Link MR3040 routers, 3 Unifi routers, and 2 NanoM5 routers was successfully deployed in Huay Khom village. The remaining routers will be either used in the on-going CWMN research or kept as spare parts. | IntERLab research team planned for the concept and methodology of deployment. The system was deployed with the help of 13 THNICF-led volunteers. More than 35 - 40 households (~100 - 150 people) are directly covered within the service area of the system. |
| CWMN routers and a backend system which are customized for field deployment. | Completed in March 2014 | 50 CWMN routers were prepared, customized and tested in the lab prior to field deployment. | IntERLab research team acquired, prepared and tested the CWMN routers prior to field deployment. Thirteen (13) THNICF-led volunteers learned how to configure and deployed the CWMN routers. |
| Video episodes to be used in our E-VoD system | Work in progress | Initially, 150 short educational video files with creative commons or public domain licenses were retrieved from YouTube™ and other Internet sources. The video files loaded into the E-VoD system. New videos were later uploaded to the system as a part of ongoing content updates. The Mirror Foundation team has produced approximately 10 video episodes focusing on village's cultural and local issues. | Mirror Foundation has produced a number of new video episodes for the villagers of Huay Khom. IntERLab is setting up a system that will allow volunteers to suggest creative commons and public domain videos to be put into ChiangRai MeshTV Mirror Foundation has encourage local young villagers to participate in video production. |
| Concept and plan of E-VoD and CWMN services | Completed in March 2014 | The survey and planning of E-VoD and CWMN system was conducted in January 2014. The result was a design that we use in deploying Chiang-Rai MeshTV | After producing the concept and plan, IntERLab trained the group of 13 THNICF-led volunteers. The volunteers later surveyed and deployed Chiang-Rai MeshTV in Huay Khom village. |
| A group of 13 volunteers who are now capable for E-VoD and CWMN deployment | Completed in March 2014 | Thirteen (13) volunteers came to learn how to deploy CWMN and succeeded in doing so. | The volunteers were recruited through intERLab's connections with a number of universities. The volunteers are mostly 3rd or 4th year undergraduate students. They came learn how to deploy CWMN and succeeded in doing so. |
| Knowledge on methodologies, system performance, and system stability | Work in progress (this task will be continuing beyond the end of this project) | IntERLab successfully designed and implemented a testbed which has been running since March 2014. Reliability and performance tests have been conducted. intERLab has actively conducted research in Named Data Networks (NDN) which aims to better address future E-VoD systems. Further research topics are being actively discussed within our own team and our research partners. | IntERLab has actively discussed with EU researcher partners on what can be done to improve our E-VoD/CWMN system. Further research and development activities are being planned with our research partners. |

Project outcomes

The project outcomes can be summarized as follows:

On the Medium-term Effects:

This project has shown to be effective to get rural villagers with relatively limited ICT literacy background to accept and adopt ICT in their daily lives. Young rural students are particularly the ones attracted to our deployment. They serve as a catalyst for their parents to accept our invitation to participate.

Effect of a Series of Achieved Outputs:

We have seen the following consequentially effective outputs. First, we now have young volunteers, led by THNICF, who successfully learned and completed the Chiang-Rai MeshTV deployment mission. Second, our E-VoD and CWMN systems were successfully deployed. Third, we have attracted a group of E-VoD and CWMN users in the targeted rural community. Fourth, the deployed platform already brings us a number of new research ideas and directions. Many of these ideas have been discussed with EU and international research partners.

Capture the Changes for the Beneficiaries:

We have successfully created changes for our beneficiaries. First, the villagers of Huay Khom have a new way to access world-class knowledge and digital educational contents. They could do so even from a relatively remote rural community that does not have speedy Internet links. Second, the staff members and volunteers at the Mirror Foundation Chiang-Rai now have a new tool for their community development programs. They can now capture, create, and disseminate knowledge through video contents. They also have a primitively new 'community-cloud' platform that can be used to further develop rural community application services.

Influence but not Direct Control:

The Mirror Foundation has assembled a small team of youths who are assigned to work on taking and making educational video contents for the rest of the village to watch and learn. This initiative has just begun but we believe that, if succeeds, it will create a new generation of rural youths who are capable in new medias, digital content creation and communications. We definitely want to see how their abilities and imaginations will evolve and sustain over time.

Project management and sustainability

In terms of administration, staffing and procurement, intERLab/AIT is primarily responsible. IntERLab has been able to manage the project, assign staff members to work, and acquire necessary hardware items for the deployment. We have at least three intERLab staff members who have been involved since the design phase. Now these intERLab staff members work on monitoring and resolving E-VoD/CWMN technical issues. We have established collaboration with the Mirror Foundation who helps intERLab access Huay Khom villagers as well as to resolve some technical issues in our E-VoD and CWMN system.

The THNIC Foundation co-sponsors the Chiang-Rai MeshTV's deployment activities, especially in terms of recruiting 13 young volunteers to learn the E-VoD and CWMN technology and leading these volunteers to deploy a real system in Huay Khom village.

We have create a website which details our deployment activities. The website contains both videos and photos. The website's URL is <http://www.interlab.ait.asia/ChiangRaiMeshTV> and it is best viewed using Safari or Chrome browsers.

IntERLab still continues to work closely with the Mirror Foundation to sustain the on-going deployment, not only in technical aspects but also in social/community involvements. Although hindered by local political events, our team still tries to seek further funding from both domestic and international organizations to further expand our deployment and enhance new application features.

IntERLab has promoted Chiang-Rai MeshTV in a number of occasions and in different capacities. The project Principal Investigator, Dr. Apinun Tunpan, presented to the sub-committee on Disaster Emergency Telecommunications at the National Broadcasting and Telecommunications Commission (NBTC) on the concepts of community wireless mesh networks (CWMN) as well as services such as E-VoD in CWMN. The sub-committee showed a strong interest and provided very positive feedback. In April, IntERLab submitted a proposal to expand Chiang-Rai MeshTV and to install similar systems in some other regions of Thailand through the Universal Service Obligation (USO) fund of the NBTC. However, the coup d'état that occurred in Thailand on May 22 now results in every USO proposal (not just ours) being put on hold indefinitely. This is perhaps the worst obstacle that we have experienced. Our short-term effort is now focused on sustaining Chiang-Rai MeshTV through some other smaller sponsorships and grants. We still hope, however with diminished certainty, that the political situation in Thailand will return to normal, and we will push our proposal for a re-consideration by NBTC again.

Professor Kanchana Kanchanasut, our project advisor, has been in a discussion with a group of researchers in Europe, particularly in France. She presented our CWMN prototype to a group of networking researchers at LIP6. She has enjoyed very positive feedback and formulated ideas on the research and CWMN service development possibilities that could be studied and tried in the Chiang-Rai MeshTV to expand our knowledge and capabilities.

The Mirror Foundation has been in a discussion with intERLab and the THNIC Foundation on how to create new application services that can be run in parallel with E-VoD in Chiang-Rai MeshTV. There are three major directions being discussed as follows. One is to attract more Huay Khom villagers to use the services. Two is for the villagers to help monitor and maintain the already deployed network. Three is to allow the villagers to develop new contents or application services on their own. This is the other crucial part of sustainability that is driven by the targeted user community (i.e. the Huay Khom villagers) themselves. These three directions will take time and hence will continue beyond the end of the present project.

Impact

The Big Picture

IntERLab started a research area in disaster emergency networking back in 2006. The technology being investigated back then was Mobile Ad hoc Network, MANET which allows self-configuring, self-healing network to form from a number of collaborative nodes. Since 2006, IntERLab's disaster emergency networking research has evolved to research on community wireless mesh networking. We currently aim at two major principles. The first principle is to put self-configuring, self-healing networking technologies that are able to form emergency networks into any rural communities in the form of community wireless mesh network. This means that people in the rural community can connect to the CWMN and utilize its services on a daily basis, whether those are for education, entertainment, or just getting connected with other people. Through additional community planning and exercises, the already deployed CWMN can later be made ready for disaster emergency preparedness.

The second principle is to have one or more empirical test beds with which we can experiment with new application services (e.g. Application-as-a-Service). Our cloud-like aim is obvious in the current project which we have deployed E-VoD. We also envision the possibilities of trying on other different services such as instant messaging, social networking, and e-commerce within a few years from now. But these will depend significantly on the resources and funding that we may attract for our next phases.

The Chiang-Rai MeshTV project will from now serve as a framework to help further realize and experiment with new services in ICT for development (ICT4D), especially on how to get the low-income rural people connected to the modern digital world. Although this process will take time and require more resources beyond what are currently available to us. We remain hopeful in terms of seeking like-minded proponents, getting technological partners, and acquiring further funding to realize our principles.

Overall Assessment

This project has successfully met a number of initial objectives along our milestones. First, the CWMN and E-VoD have been deployed. Second, we trained the volunteers so that they are now capable of deploying more similar systems if needed. Third, Huay Khom villagers have increasingly come to know and use our system.

Some of the remaining work items to be done include the following. First, we have to obtain more new E-VoD contents, either by creating new episodes or by getting new episodes from the Internet and other permitting sources. Second, we will have to encourage Huay Khom villagers and the Mirror Foundation to use the already deployed CWMN and E-VoD systems in their day-to-day activities. One approach is to realize new community applications or services that can benefit the younger generation of Huay Khom villagers. Third, we still have to work on sustainability initiatives. There are some delays, which are the results of political events in Thailand, which we are trying to catch up. These delays mainly affect the production of video contents originally planned for use in the system.

Some of our crucial findings are as follows. In Huay Khom village that we deployed Chiang-Rai MeshTV, there are a number of qualitative factors that affect ICT adoption and hence ICT literacy. The first major factor is the presence of young children in a household actually influences their decision to adopt ICT. Households that have young children tend to be more receptive to ICT adoption and they are obviously more eager to participate, simply because parents want their children to have a better learning opportunity. Households that do not have young children, or those whose children have grown up and moved out, appear more conservative and less interested in getting involved. The second factor is the unexpected influence of the government waiver of electricity fees for households that use small amounts of electricity power per month. There were initially some households that chose not to install our CWMN routers citing that their electricity consumption could increase so much that they would no longer be eligible for the waiver program. Our response to the second factor is to explain the benefits of our CWMN and E-VoD, as well as ICT in general. We also explain to them that our system would consume just a small amount of power — akin to charging one or two mobile phones (i.e. 5 - 10W) — and that it even consumes a very much smaller amount of energy than a typical electric fan (i.e. 30 - 50W). After talking to them, a few more households later decided to adopt our CWMN routers.

We summarize our contributions as follows. Our first contribution is that we have successfully planned, designed, and deployed a fully operational proof-of-concept system of low-cost, low-powered CWMN and E-VoD system. Our system has potentials to strengthen rural communities by raising their ICT awareness and literacy. Our second contribution is that we have trained a small group of young volunteers who now understand and can deploy CWMN and E-VoD. We hope that we can further rely on these young volunteers to deploy more similar systems in other areas. Our third contribution is that we are collaborating with the LIP6 group of researchers in France in order to experiment and expand new types of services that will be deployed in later stages. This collaboration will enhance our networking and engineering knowledge.

In terms of project design, management and implementation, we have seen the following aspects as being important. First, becoming good friends with key local rural people in the targeted area is perhaps the most important factor for success. It is not the technology that matters. But it is about knowing the village people both personally and in a friendly manner so that we can have the opportunity to explain what we are trying to do and what we want to achieve. Once the villagers became our friends, they actually helped a lot in the deployment process, especially in terms of making high poles to mount the networking equipment and allowing us to use their premises. The village people also told us stories and concerns that better made us understand more about their situations and have us rethink our strategy sometimes. Second, the work and support of volunteers led by the THNIC Foundation contributed significantly to the success of the deployment. The volunteers are mostly undergraduate students in their third or fourth year of studies. In fact the deployment of Chiang-Rai MeshTV presents them with a rather unique opportunity. Some of them have studied computer networking in classrooms. But our deployment camp activities presented to them so many technical challenges, phenomena, and problems that general classrooms can never cover. Some of them came to appreciate the work that we initiated and told us that now they understand “computer networking” more than before.

IntERLab has introduced and promoted the CWMN deployed in Chiang-Rai MeshTV to a few selected groups of researchers who show their interests in testing some of their ideas using a real test bed and to those who can benefit from the technology that we have. One of such groups is a group of networking researchers at LIP6, France. This group is interested in porting and experimenting with some of their latest technologies in our CWMN. The other group is a group of medical doctors and researchers in Italy. They are looking for potential technologies that are useful for disease monitoring in border regions. We have been actively discussed on various prospects of research collaboration. We strongly hope that Chiang-Rai MeshTV itself or parts of its technology can be further enhanced or applied for use in different domains.

The following lessons are likely to help improve future performance. The first lesson is that the ability to identify initial key local village persons who can help us access the community is very critical to the success and the pace of deployment. It is very important that such key local persons should be identified in the earliest steps. Examples of such key persons are, but are not limited to, present or former community leaders and teachers who are respected by people in the community. The second lesson is that unexpected events, like natural disasters and major political events, can potentially disrupt our plan, especially in any developing country. Some of these events cannot be foreseen. In our case, the earthquakes in Chiang-Rai and the May coup d'état have had considerable impacts to our work. It took almost a month before the situations return to almost normal that we are able to resume our normal work schedule. But even so, we still have to be careful regarding new regulations and policy shifts that are resulted from the political events.

Recommendations

We are very thankful to have been selected as one of the 2014 ISIF Grant recipients. The ISIF Grant has opened new opportunities for us to explore new methodologies; to experiment and expand our methodologies in rural ICT4D; and to meet and connect with new people through opportunities facilitated by additional support provided by the ISIF Asia Capacity Building Fund to attend the International Summit for Community Wireless Networks in Berlin (Germany) in October 2013 and the School on Applications of Open Spectrum and White Spaces Technologies at the Abdus Salam International Centre for Theoretical Physics (ICTP), in Trieste, (Italy) in March 2014.

We would greatly appreciate if ISIF Asia can continue to connect us to other interested organizations or groups of people who might wish to utilize or expand our deployment concepts and technology. In addition to that we would greatly appreciate if ISIF Asia may assist our attempts to reach some other potential funding sources, especially the international ones, so that we can sustain the already deployed work and replicate it in other regions.

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