

Interim Technical Report of Dualler Volunteer Project

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1. BACKGROUND

Dualler volunteer project aims to develop a low cost, human powered, and mobile information communication terminal for villages in developing countries. This mobile terminal will enable villagers and local micro-enterprises to access Internet and exchange information with the world by using it.

2. OVERALL DESIGN

To provide the functionalities stated in section 1, *Dualler* consists of a tricycle, a personal computer, a pedal-powered electric generator, and a communication equipment. Figure 1 shows these components.



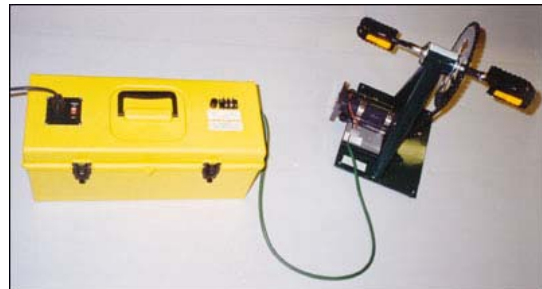
(1) Tricycle



(2) Personal computer



(3) Communication equipment





(4) Pedal-powered generator

Figure 1. Necessary components of Dualler

3. ELECTRIC GENERATOR

3.1 Pedal-powered generator

Pedal-powered generator can be easily purchased and the price is around US\$850. Below is the package sold by *Windstreampower*®.

Picture	Part	Specification
	MK III Human Power Generator	12 volts DC output
	Portable Power Pack	Convert the DC output to 120 volts AC output Includes (a) Storage battery (b) 200W inverter (with 300W peak power) (c) LED battery voltage readout (d) Connection cable (e) 120 volts AC outlet

In order to supply stable output, a battery is essential as it works as a buffer and can even out the voltage. The typical average continuous power that can be generated by pedaling is about one-sixth horsepower or 125 watts, more or less, depending on the weight, strength, and endurance of the person pedaling. Hence, it takes a person 2 hours pedaling to enable a personal computer (250W) to work 1 hour. Thus, it is preferred that the computer used in Dualler has low power rating.

3.2 Solar power generator

Due to low power output, solar power is not suitable to be used independently. But solar power can actually be used as an integral part of Dualler's electric generator. Photovoltaic modules generate DC electricity directly from light. They consist of a number of silicon photoelectric cells connected in series, sealed inside glass-fronted panels. The full rated output of a photovoltaic (PV) panel is obtained with the panel directly facing full sunlight, but some power is generated even under cloud cover. Individual PV panels are typically designed to directly charge 12-volt batteries through a charge controller.

If the size of roof is larger than 1.5m x 0.7m, we can install a Kyocera® 120W photovoltaic panel on top of Dualler. By combining the solar power with human power, the battery charging will be much easier. The price of a Kyocera® 120W photovoltaic panel costs around US\$1,000.

4. COMMUNICATION EQUIPMENT

Unlike power generator, communication equipment cannot be chosen without knowing the specific conditions of a country. Under different telecommunication infrastructure, we need to choose different communication equipment for Dualler.

4.1 GPRS and WAP

With GSM or CDMA network present, access to Internet is as easy as step 1, 2, 3. Although it is not likely that a place without electrical power has communication network, this situation does happen sometimes. For example, electrical power network is much more vulnerable to natural hazards and wars than wireless communication network. Therefore, during post-disaster or post-war time, we may have access to GSM or CDMA communication network but have no or not stable power supply. In this situation, the communication equipment for Dualler can be as simple as a mobile phone. Here is the steps of using mobile phone to dial.

Step 1: Install infrared port for the desktop

Plug the cable that extends from the back end of the infrared sensor into the RS-232, printer, or USB port. Install the software that comes with the IR adapter. No driver installation is required as Windows® has included drivers for infrared data communication. An infrared port for desktop costs around US\$100.

Step 2: Obtain necessary information about WAP or GPRS

- Dial-up phone number for WAP or GPRS special dial-number of the mobile phone used
- Login name and password for WAP
- IP address of WAP Gateway server
- WAP homepage of service provider
- DNS server address (optional)

Step 3: Set up the WAP

Turn on the infrared on the mobile phone, and place it in the range of the infrared port of the desktop. During the first infrared connection, the desktop probably will recognize the mobile

phone, and set up a new MODEM device. An icon showing infrared activity should show up in the taskbar.



Figure 2. Infrared logo in taskbar

Step 4: Connect to the provider

After connected to the service provider, the desktop will show this.

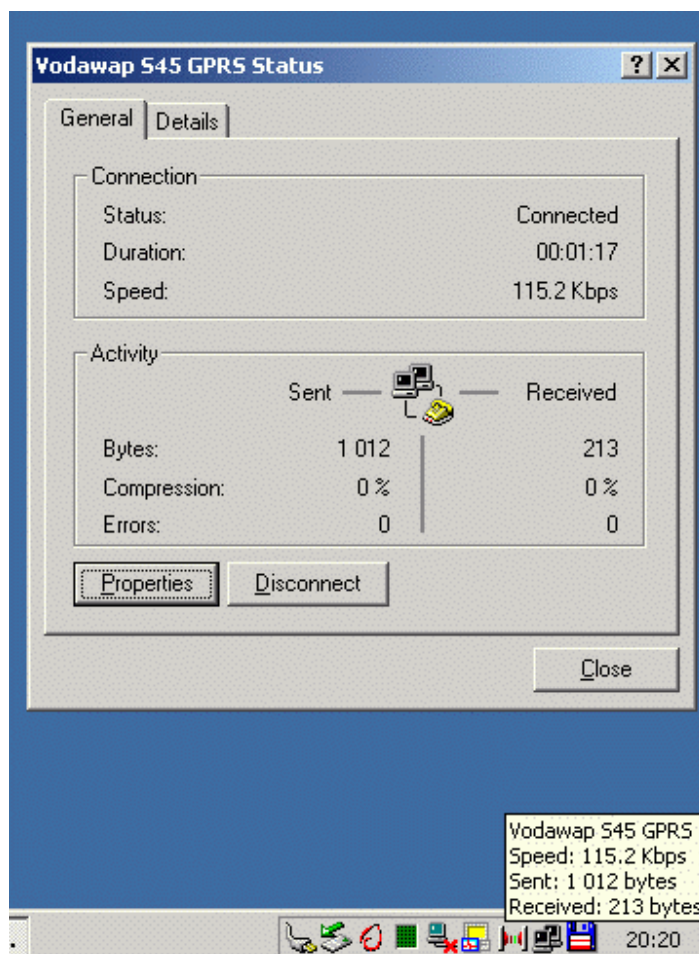


Figure 3. Window shows GPRS status

4.2 Direct satellite plus Wi-Fi technology

In most cases, there is neither GSM nor CDMA network available in rural areas of developing countries. In such scenario, access to Internet requires more investment.

Direct satellite connection is available everywhere in the world. Thus, there is no problem of access Internet via direct satellite connection but the cost is normally very high. Moreover, most of the satellite receiver is very heavy and cannot be installed on Dualler.

However, by using the newly developed Wi-Fi technology, it is possible to solve the problem. Here is a communication network proposed by Dualler ICT team.

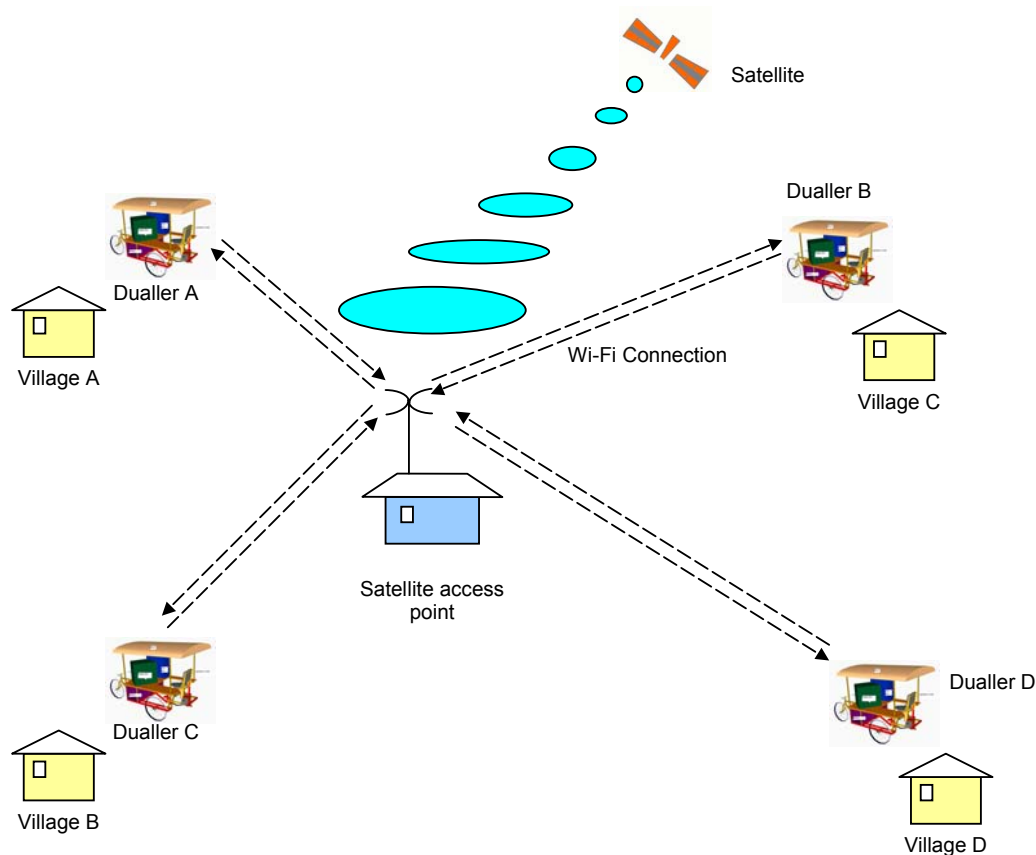


Figure 4. Communication infrastructure

In this infrastructure, a satellite access point will be set up among several villages. All the Duallers near this access point can share the Internet access via Wi-Fi connection. Nowadays, the maximum range of a Wi-Fi connection is about 1 kilometer. However, this range largely depends on the terrains. If the terrain is flat and there are not many objects blocking the wireless communication, it is possible to extend Wi-Fi connection to a few kilometers. In this infrastructure, the high cost of satellite access can be evened out by the number of Duallers around.

The price of direct satellite communication in developing countries depends greatly on service providers. Here is a typical Satellite Broadband System used in US. The price is US\$6,495 installation fee plus US\$99 monthly fee.



Figure 5 Satellite Broadband System

In order to build a Wi-Fi network described in Figure 4, we need Wi-Fi Access Point and USB Adapters, which is necessary for desktops as they normally do not have built-in PC card. Figure 6 shows these equipments.

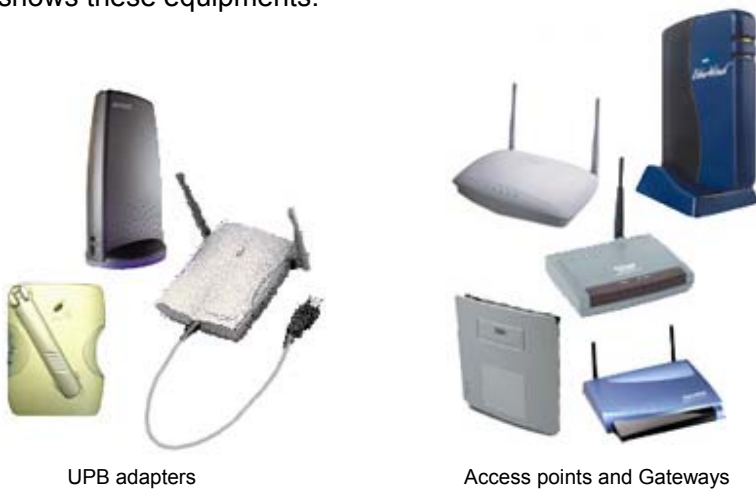


Figure 6 Wi-Fi equipments

The setup of a small Wi-Fi network is not complicated and many websites provide step-by-step instructions. Refer to [4] for details.

5. IMPLEMENTATION OF PROJECT

Technically, the project can be divided into 2 phases from now.

5.1 Phase 1 – Prototype under GSM network

Currently, it is not known that where Dualler will be used. Thus, it is difficult to decide the communication portion of project. Moreover, the satellite plus Wi-Fi network requires more investment and can be put as phase 2 of the project. In phase 1, the prototype will use GSM communication equipment, which is described in section 4.1. Here is a plan for phase 1.

Project group number	Number of students	Task	Item	Budget (S\$)	Time
1	2	Refit a tricycle to meet Dualler's requirement. Install a PV panel on top of the tricycle.	a) 2nd-hand tricycle b) 120W PV panel (optional)	400 (1,400 if PV panel used)	6 months
2	2	Install pedal-powered generator and supply stable output to desktop. Install desktop on tricycle and ensure anti-vibration capability	a) Pedal power generator b) 2nd hand Desktop c) Infrared port for desktop	3,000	6 months

5.2 Phase 2 – Prototype by using satellite plus Wi-Fi connection

To setup a network described in section 4.2 has exceeded the capability of Engineering students and requires full-time professionals. The cost is difficult to estimate but will be definitely higher than S\$20,000.

REFERENCE

- [1] http://www.foxpop.co.uk/pc/wap_01.htm
- [2] <http://www.windstreampower.com/humanpower/hpg.html>
- [3] <http://www.tiaonline.org/policy/regional/asia/atn/archive.cfm?ID=90>
- [4] www.weca.net
- [5] <http://www.techtv.com/screensavers/answerstips/story/0,24330,2593841,00.html>
- [6] http://www.mec.com.jo/satellite_pc_access%20.html
- [7] <http://www.linksys.com/Products/product.asp?grid=22&prid=157>
- [8] <http://www.satworld.biz/>