RIO TINTO
SHARED SERVICES

$100 Buck Laptops

CAT – Rio Tinto Fellowship

4th – 15th September 2006

Outcomes[1]

- A list and assessment of low cost computing solutions currently available or under development for developing communities.
- A short report on the feasibility of low cost computer solutions for private purchase by consumers living in remote Indigenous settlements in Australia, setting out the advantages and disadvantages of each option - especially including consideration for the quality of product that Indigenous people would find acceptable.
- If low cost computing is found to be feasible, a *Bush Tech* formatted as a buying guide, for households wishing to purchase a low cost computer.

Context[2]

Internationally there are high profile initiatives to manufacture low cost computer systems that are within the economic range of poor households in developing communities. The most popular of these are known as *hundred dollar laptops* (http://laptop.media.mit.edu/). Whilst this particular configuration may not be appropriate in remote Indigenous settings, there is merit in an investigation of the feasibility of low cost computers for Indigenous households to purchase privately, which can operate reliably and cheaply in remote settings.

A reasonable balance must be found between cost and reliability. Computer hardware must be sufficiently robust to withstand the spiking power supplies, dusty environment and heavy usage likely in Indigenous households. Indigenous people are also likely to resent any notion of a lower standard to that available in the mainstream; they may respond positively to innovative solutions that are distinctly local and unique.

Cost considerations will need to include the cost of software and internet access. Combined with the use of voice over internet protocol (VOIP) technologies, there is also a potential for Aboriginal households to access low cost communication options. This fellowship project has relevance to the fellowship project titled *Remote Internet Services*, and hence it is envisaged that there will be some close collaboration between each of these fellows.

Preamble

Computing costs have dropped dramatically over the past few years as technology and manufacturing processes have become increasingly refined.

Subsequently, there is a push to make computing and the Internet available to 50% of the world's population by 2015. Whilst this initiative is ambitious, the majority of the world's population is within easy access to basic utilities that will allow this to happen with minimal effort.

For those who live outside of this area, such as remote central Australia, this is going to be quite a challenge if we're to be part of the 50%.

Research[3] shows that remote Indigenous communities have the same computing and Internet requirements as do city dwelling people. As they are generally creative people, they do have the need to access multi-media applications in order to express themselves. Having these applications, and the computing power required to run them, in every residence would be costly and require a high level of support.

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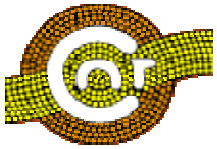

Assessment of current technologies available for remote communities

1. Thin-client based computing - Wyse

Advantages	Disadvantages
Reasonably cheap for basic models <$800	Requires central administration point i.e server based
Easy to support remotely	Requires stable power supply
No moving parts	Only rated to 40^0C
Works well over low bandwidth	No wireless capability at this stage

Thin-client based computing, of which Wyse are the leaders, is designed more for corporate type environments where each user does not need the functions of a PC, in that applications such as Microsoft Office, Adobe Acrobat and Internet Explorer are hosted on a central server. The Wyse terminal simply acts as a dumb terminal to access these resources from the central server. Terminals that have core applications installed locally increase the purchase cost significantly and add another layer of support such as patches and hot fixes which require large bandwidth and resources to install. A central point of administration is required which can be locally within the community or back at a regional centre, though the communications link speed is the key factor in deciding this. As there is no wireless capability (yet), these devices require fixed infrastructure (Ethernet cabling) which may be inappropriate for remote communities and adds to the overall cost and support requirements.

Suggested example - http://www.wyse.com.au

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Assessment of current technologies available for remote communities

2. Cut-down PC computing – Intel, AMD

Advantages	Disadvantages
Provides similar experience to normal PC	Operating system installed locally
Reasonably priced <$800	Contains moving parts similar to normal PC
Wide range available from various manufactures	Not designed for remote conditions i.e. heat, dust
	Requires reasonable bandwidth to operate
	Requires similar support levels to normal PC

Cut-down PC computing takes a normal PC and strips it down to a 'bare bones' level to enable it to fit into a smaller form factor. Essentially it still utilises the same technology as a PC i.e. motherboard, CPU, hard drive etc although usually of a lower specification than a normal PC. These units are primarily designed for schooling, educational or kiosk environments where normal PC's are overkill. They require the same level of support as a normal PC i.e. OS patches, device drivers etc and are not designed for remote conditions in terms of heat and dust. Most manufacturers of these devices have marketed themselves towards developing countries where over-population problems, not remoteness, is an issue i.e. India.

Suggested examples

http://www.amd.com/us-en/ConnectivitySolutions/ProductInformation/0,,50_2330_12264_12262,00.html

http://www.intel.com/pressroom/archive/releases/20060329corp.htm

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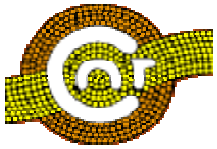


Assessment of current technologies available for remote communities

3. Purpose built remote computing - Inveneo

Advantages	Disadvantages
Purposely designed for remote environments	Would need to be implemented as a community project
Based on open source software	Requires central administration point
Reasonably priced <$800	
Works on wireless technology	
Combines VoIP and LAN to provide complete package	
Simple one-touch restore providing easy support	
Works on 12v DC from various power supplies i.e. solar	
Battery backup for power outages available	

Purpose built remote computing has been designed with remote communities in mind. It is robust in design, based on thin-client technology (no moving parts), but runs on open source software which reduces costs. It uses wireless technology to connect to a central administration point which also serves as the communications hub. It can support VoIP telephones using open source PBX software and can act as a LAN for the local community. Designed for environments with dirty power supplies, it can be run from various power sources, including solar and wind, and is 12v DC. For times of power outages, it draws power from backup batteries. One-touch recovery is provided which simplifies support and central administration point provides error recovery and is designed to be tolerant of network outages.

Suggested example - http://www.inveneo.org

Recommendations

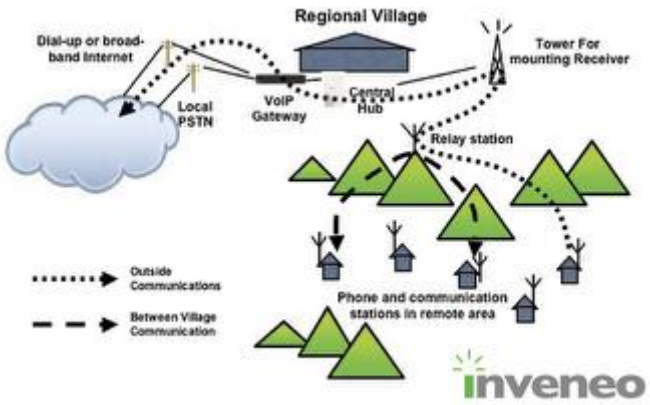
Taking into account the numerous requirements for computing in remote communities, it appears the approach may need to be divided into two parts. The requirement and needs of personal computing is clearly different to that of community-based computing needs, and thus they have to be addressed accordingly. During our visit to Arltarlpilta community, it was highlighted that the newly built RTC centre had an intended purpose as an Internet Café, amongst other roles. This has not eventuated however the need is still there for community-based centralised computing. The main uses of this type of computing would be for Internet applications (banking, Centrelink) and multi-media type work (music, artwork), as there is a real need for these applications in the general community. Basic training in computing and software applications was also highlighted by the council as a requirement, which would help promote the capabilities of just what can be achieved with computers connected to a suitable Internet connection. The setup of this location could be achieved in several ways; however a separate, detailed project would best outline the most appropriate way. It could also be that this setup may be different for each community. A 'one size fits all' approach would not work in this case and it is quite apparent that flexibility is key to any approach for computing in remote communities.

With regard to personal computing, it was questioned as to whether there was in fact a need to have devices in homes if there was a functioning community-based centre. In order to address the outcomes of the project, a neutral view is best adopted even though there are many and varied opinions out there.

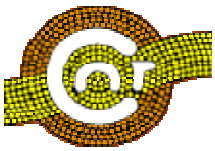
The Inveneo system[4] of purpose built remote computing devices appears to best address (at this point in time) the requirements of personal computing in remote communities. This system uses technology from

various sectors (thin-client, wireless and open-source) and combines them to create a unique approach to remote computing.

Using base stations on wireless technology, the Inveneo system can be used centrally at a community or extended via relay stations to locations up to 100kms away (with line of sight). Made up of a Hub Station (central location and focus point) and numerous Communication Stations (personal computing devices), the Inveneo system is modular and can grow with the addition of further Communication Stations. It runs on various power supplies including solar, wind and battery. VoIP is supported through an open-source soft PBX, and can also act as a LAN within the community. Support is addressed through a one-touch recovery system which simply re-images the Communication Station in case of an error, from a base image stored on the Hub Station.



As cost is a major component of this project, it must be remembered that the old adage “you get what you pay for” couldn’t be more relevant in this project. Considering the unique requirements and conditions that go with remote communities, few solutions can address the situation adequately. There is no one solution that fits the bill perfectly – the recommendation of the Inveneo system is the most suitable option when balancing cost, practicality and functionality as outlined in the project brief.



Pilot

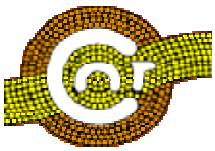
Below are the minimum requirements to run a community based Inveneo system (all prices are in $US).

One (1) Hub Station - $859 without VoIP, $959 with VoIP
Two (2) or more Communications Stations - $659 without VoIP, $759 with VoIP.
Two (2) or more Access Points - $469 single radio, $659 dual radio.
Switch - if more than one Communication Station is present in any single location.

It is suggested that in order to evaluate the Inveneo system for remote communities, a pilot test be implemented at a typical community in conjunction with the recommended outcomes from the *Remote Internet Services* project in order to test the feasibility of the total solution. This model could then be expanded upon and adopted at other communities once it is deemed suitable.

Conclusion

It is apparent that whatever approach is taken, the driving force needs to come from the community as a whole due to the unique infrastructure requirements for purpose built remote computing. The Inveneo system works holistically and dependently of each component; adding foreign components to the system would not work. With that in mind, producing a *Bush Tech* for household use would not serve any relevant purpose – a community overview outlining the requirements to implement the system would be far more useful.



In the past there have been several projects aimed at putting computing into remote communities using different approaches. The end result of many of these projects was slow failure due to lack of uptake. This was mainly due to the approach taken; 'one size fits all' solution designed with the best of intentions for several communities. Where communities did not want this type of solution or any solution at all, the project failed. Optus's 'Networking the Nation' is a prime example of this.

The recommendations given in this report are very general and will help somewhat to pointing further research in the right direction. Any serious attempt at putting computing into remote communities will require updated and in depth research before implementation.

Attachments

Inveneo Communications System Datasheet April 2006

Inveneo Detailed Datasheet April 2006

Time Magazine article - 29/05/2006

References

www.google.com

www.inveneo.org

www.intel.com

www.amd.com

www.wikipedia.org

Personal discussions with:

- Deadly Mob
- Arltarlpilta Council
- NT Library Services

[1] Taken from CAT project brief
[2] Taken from CAT project brief
[3] Discussion with Deadly Mob, Arltarlpilta Council and NT Library Services
[4] See page 6.

Inveneo

Inveneo creates ICT solutions that meet the needs of organizations (NGOs, local governments, private companies) and the rural communities they serve

A new way to serve remote and rural organizations and people with ICT

How Inveneo is changing the way ICT solutions are designed and supported for rural areas

More that 2.5 Billion people live in rural and remote areas of developing countries where access to communications is severely limited due to availability or affordability. For these rural communities, access to Information and Communications Technologies (ICTs) can transform people's lives in simple yet, profound ways.

Non-government organizations (NGOs), local governments and private entities that provide communities vital development, education and services are also in need of ICT tools such as low power computing, telephony and Internet access.

Until now, there were few alternatives for these organizations to acquire and deploy ICTs for their projects and programs. They could develop their own solution, they could engage expensive consultants, or they could take what little was available. In many cases the ICT was not sustainable due to cost, complexity, lack of ruggedness, lack of in-region technical support and countless other issues.

Inveneo, a US-based non-profit social enterprise, offers a new alternative through its open, decentralized, sustainable approach to ICT systems. Inveneo focuses on designing, integrating and supporting affordable technology systems that match the needs of people and organizations in underserved areas worldwide.

Introducing the Inveneo Communications System

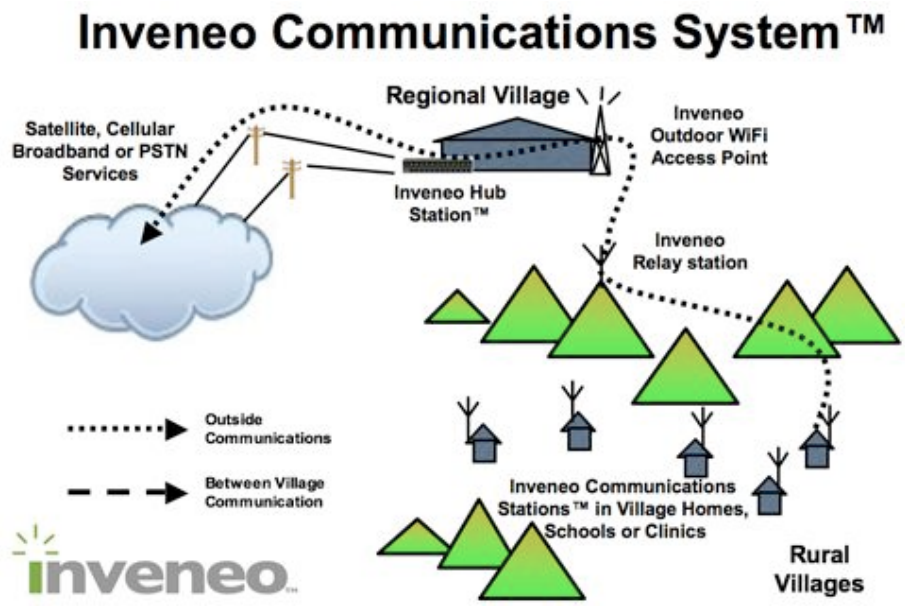
The Inveneo Communications System(tm) is designed to provide computing, VoIP telephony and Internet access for rural, remote and often challenging environments. It can be used for a wide range of applications including economic and community development, microfinance, telehealth, education, humanitarian aid and emergency relief.

NGOs and other organizations operating in rural environments need ICT solutions that fit their unique situation. Inveneo's innovative solution integrates proven hardware, open-source software and 12-volt DCpower options to create a rugged and resilient yet, simple to operate system. Inveneo partners with Inveneo certified local IT professionals to provide cost effective local support.

Below: The Communications Station

Below: Jane Nabwire of ActionAid shows Ugandan villager how to use email

Inveneo
760 Market Street, Suite 859
San Francisco, CA 94102 USA
info@inveneo.org



Product Overview

The Inveneo Communications System consists of two components - the Communications Station- and the Hub Station - that combine to provide a complete ready to use ICT solution:

- The Communications Station is designed for use by end-users in a village school or office, home or clinic setting. It provides computing, telephony and Internet access.
- The Hub Station is designed for use by a network administrator and is placed in a regional location. It manages the network and provides connectivity to data and voice services.

Communications Station Detail

The Communications Station is designed for end-users. It includes:

- Ultra-low power Wyse S50 computer and 14 inch LCD Monitor
- Standard telephone handset and Linksys Analog Telephone Adaptor (ATA)
- Custom-built open-source desktop with web browsing, messaging and office software
- Outdoor wireless access point designed for long distance networking to the Hub Station

The Communication Station draws only 20-22 watts of power when in full use. It is available in different configurations to meet end-user needs. For example, a school may need several computer set-ups but only one phone and access point.

Hub Station Detail

The Hub Station is designed for easy system administration. It includes:

- Network central server
- 40 - 100 GB data storage
- Content sharing applications
- Standard telephone handset
- Call management with voicemail via Asterisk, an open-source IP-PBX
- Outdoor wireless access point designed to connect to Communications Stations

The Hub Station connects on the back end to satellite, cellular or analog lines for data and PSTN services.

Operating Environment

Inveneo's System is designed to operate in environments where computing has traditionally not been found:

- Limited or no access to electricity
- Limited or no access to Internet connectivity and/or telephony
- Dusty environments, high humidity and long periods of hot weather
- Limited access to on-site or local technical service and support

Feature overview

1. A Fully Integrated System

A fully engineered and integrated system which addresses computing, telephony, connectivity to the Internet and telephone network, local area networking and software applications, all ready to use after installation.

2. Low Power Consumption

Power is a costly resource. The system's components have been chosen for low power consumption so that it can run on virtually any power source (solar, wind, micro-hydro, bicycle generator) making it less costly to operate.

3. Flexible Power Management

In remote areas, grid power is undependable. The system is designed to run during a typical outage using a battery power system.

4. Customized Software

The open-source software has been carefully chosen and adapted for use in rural and remote environments. User level software is simple, yet robust with all current features: office software, chat, e-mail, forums and audio/video. The system has a one-button recovery feature. The administrative software provides simple network management and error recovery, but also has advanced features available. Altogether, the system is designed to be tolerant of network outages.

5. Made for Challenging Environments

Each component of the system is encased in appropriate enclosures. The computer has no moving parts and is mounted on the monitor to resist dust and pests.

Open Source

Often, systems for networks are proprietary and inflexible. Inveneo uses no-cost, proven open-source software in all aspects of the system. Our hardware designs and software are available to the public so that so that any organization, community or individual can build, change and/or improve upon the system.

Inveneo Communications Station

Overview

Inveneo's Communications Station is a low-power, easy to use communications unit designed for use in rural locations such as clinics, schools, and villagers' homes. It provides end-users with computing, telephony, and networking capabilities when deployed as a part of the Inveneo PC and Communications System. The Communications Station includes the following components:

- Computing Unit with keyboard and mouse
- Liquid Crystal Display (monitor)
- Communications Unit for telephony and LAN
- Outdoor Wireless Unit
- Basic open source software applications

The Communications Station is designed for use in challenging environments. Existing off-the-shelf products from leading manufacturers have been carefully selected and integrated into a single compact unit to meet the requirements of organizations operating in rural areas of the world. Key design features are:

- No fans, hard disks, or moving parts of any kind that would easily break in hot, dusty environments
- Very low power consumption, allowing the units to operate efficiently from solar or other power sources
- Operates on 12 Volts DC
- Ease of use enables novice users to be productive with a minimum of training
- Flexibility to add and localize applications
- An affordable and sustainable cost model, with low purchase price and low ongoing operating expenses

Inveneo's Communications Station can be used for a variety of development applications, such as community development, health care, education, and small business entrepreneurship. Inveneo's Communications Station is an open source hardware design that operates using open source software (Linux, OpenOffice and more). All plans and software are published through Inveneo's web site, and developers are encouraged to improve and customize solutions for their own needs. Inveneo can provide customization services for organizations who need specialized configurations of hardware (e.g. for classrooms) or software.

Inveneo Communications Station

Computing Unit

Hardware Computing Unit	Processor	AMD Geode GX	bases on Wyse S50
	IO/Peripheral Support	One serial port Four USB 2.0 ports (two in front, two in back) Keyboard: enhanced USB with Windows keys (104 keys) included Mouse: PS/2 optical wheel mouse	VGA-type video output (DB-15) Local printers via USB, serial or LAN Built-in Kensington security slot (cable lock sold separately)
	Networking	10/100Base-T Fast Ethernet, twisted pair (RJ-45)	USB WiFi adaptor 802.11b (optional)
	Display support	VESA monitor support, with Display Data Control for automatic setting and resolution and refresh rate	Max. resolution and refresh rates (Hz) 64k colors: 1280x1024 @ 100Hz 1600x1200 @ 90 Hz 16.7M colors: 1280x1024 @ 85 Hz
	Audio	Output: 1/8 inch mini, full 16-bit stereo, 48 Khz sample rate	Input: 1/8 inch 8-bit mini microphone
	Environmental	Powered on: 32° to 104°F (0° to 40°C) Powered off: -14° to 140°F (-10° to 60°C) Convection cooling, fanless design	Humidity 20% to 80% noncondensing Operating altitude range 0 to 10,000 feet (0 to 3,050 meters)
	Power	Auto sensing 100-240v VAC, 50/60 Hz with included power adaptor or 12 Volt DC direct to unit	Average power usage: 5.6 Watt (set-up: device connected with 1 USB keyboard, 1 PS/2 mouse, and monitor)
	Regulatory compliance	German EKI-ITB 2000, ISO 9241-3/-8, cULus 60950, TÜV-GS, EN60950, FCC Class B, CE, VCCI, C-Tick	

Inveneo Communications Station

Liquid Crystal Display (LCD)

Hardware LCD	Panel Type	Anti-glare, active TFT-LCD	
	Size	14.1" diagonal	
	Pixel Pitch	0.279 (W) ×0.279 (H) mm	
	Brightness	150 cd/㎡ (typical)	
	Contrast Ratio	300:1 (typical)	
	Response Time	23 ms (typical)	
	Viewing Angle(H / V)	80° / 50°	
	Max. Resolution	1024 (W) x 768 (H) @ 60 Hz (non-interlace)	
	Display Color	262 K	
	Maximum Viewable Size	14.1 inch (35.8 cm)	
	Video Input	Analog:15-pin, D-sub connector	
	Display area	11.2 (W) x 8.4 (H) inch	[286(W) x 214 (H) mm]
	Power Supply	Input voltage:100-240V /60-50Hz	Output rating:12V DC, 3.0A
	Power Consumption	25 watts (maximum), 11 watts (typical), 3 watts (standby)	
	Audio	2 watts x 2 built-in speakers	
	Frequency	Horizontal:30-48KHz; Vertical: 50-60Hz	
	Operating Conditions	41°F to 95°F (5°C to 35°C)	20%-80% Non-Condensing humidity
	Storage Conditions	-4°F to 140°F (-20°C to 60°C)	10%-90% Non-Condensing humidity
	Dimensions(set size)	13.8(W) x 13.6(H) x 5.5(D) inch	350(W) x 345(H) x 140(D) mm
	Safety & EMI	UL, CUL, FCC-B, CE, TUV/GS	

Inveneo Communications Station

Communications Unit for Phone and Lan (option)

Hardware VoIP and LAN	Ports	Two 10/100 RJ-45 Network ports One LAN (connects to PC unit) and one WAN (connects to wireless unit)	Two standard phone ports (FXS)
	Network protocols	TCP/IP	
	Voice protocols	Session Initiation Protocol (SIP) Version 2	
	Voice codecs	G.711 a-law, G.711 u-law, G.729a, G.726, G.723.1	
	Ringer equivalence no.	5 REN per RJ11 port	
	Ring frequency	10 Hz - 40 Hz	
	FXS port impedance	Eight configurable settings including North America 600 Ohms, European CTR21	
	Ring Voltage	60 - 90 Vrms configurable	
	Operating Conditions	41°F to 113°F (5°C to 45°C)	10% to 85% Non-Condensing humidity
	Storage Conditions	-13°F to 185°F (-25°C to 85°C)	5% to 90% Non-Condensing humidity
	Certificates	FCC, CE, cUL	

Inveneo Communications Station

Outdoor Wireless Unit

Hardware Outdoor Wifi Unit	Ports	One 10/100 RJ-45 Network port	One (or two, optional) wireless interfaces One or two N-Type antenna connector
	Wireless standards	IEEE 802.11b	
	Transmit Power	23dBm / 200 mW	
	Power	8 - 17V DC (through RJ-45 / LAN connection)	5 Watts average typical power consumption
	Enclosure Characteristics	Industrial Die-Cast Aluminum Design Supports masts up to 3 inch (75 mm) diameter 3 point silicone-rubber gasket	NEMA-67 rated
	Dimensions	8.5(W) x 2(H) x 7(D) inch	216(W) x 51(H) x 178(D) mm
	Weight	TDB	TDB

Inveneo Hub Station

Hub Server Unit

Hardware	Processor	VIA 1 Ghz	
Hub Station	IO/Peripheral Support	One serial port (DB-9) Four USB ports (two in front, two in back) Keyboard: enhanced USB with Windows keys (104 keys) included Mouse: PS/2 optical wheel mouse	VGA-type video output (DB-15) Local printers via USB, serial or LAN Bi-directional Centronics-compatible parallel port (DB-25)
	Networking	10/100 Base-T Fast Ethernet, twisted pair (RJ-45)	
	Display support	VESA monitor support, with Display Data Control for automatic setting and resolution and refresh rate	Max. resolution and refresh rates (Hz) 64k colors: 1280x1024 @ 85Hz 1600x1200 @ 60 Hz 16.7M colors: 1024x768 @ 85 Hz
	Audio	Output: 1/8 inch mini, full 16-bit stereo, 48 Khz sample rate	Input: 1/8 inch 8-bit mini microphone
	Dimensions	2.7(H) x 11.9(W) x 11.4(D) inches Shipping weight: 12.8 lbs (5.8 kg)	60(D) x 300(W) x 290(D) mm
	Environmental	Powered on: 50° to 104°F (10° to 40°C) Powered off: -14° to 140°F (-10° to 60°C) Convection cooling, fanless design	Humidity 20% to 80% noncondensing Operating altitude range 0 to 10,000 feet (0 to 3050 meters)
	Power	Auto sensing 100-240 VAC, 60/60 Hz Power supply	12 VDC
	Regulatory compliance	UL 60950, TUV-GS, CSA 60950, FCC Class B, CE, VCCI, C-Tick	

Cool Tools For the Third World

From Internet antennas bolted to trees to pedal-powered laptops, they are bringing 21st century advances to those who need them most

BOB MARSH, MARK SUMMER and KRISTIN PETERSON

Life in four African villages was transformed after these San Franciscans installed a wi-fi system. "The farmers learned on the Internet how to prevent diseases, control pests and increase plantain production," says Summer

(Open gatefold to continue)

ROBYN TWOMEY FOR TIME

(Continued from previous page)

VILLAGEWIDE WI-FI

WIRELESS INTERNET IN AFRICA

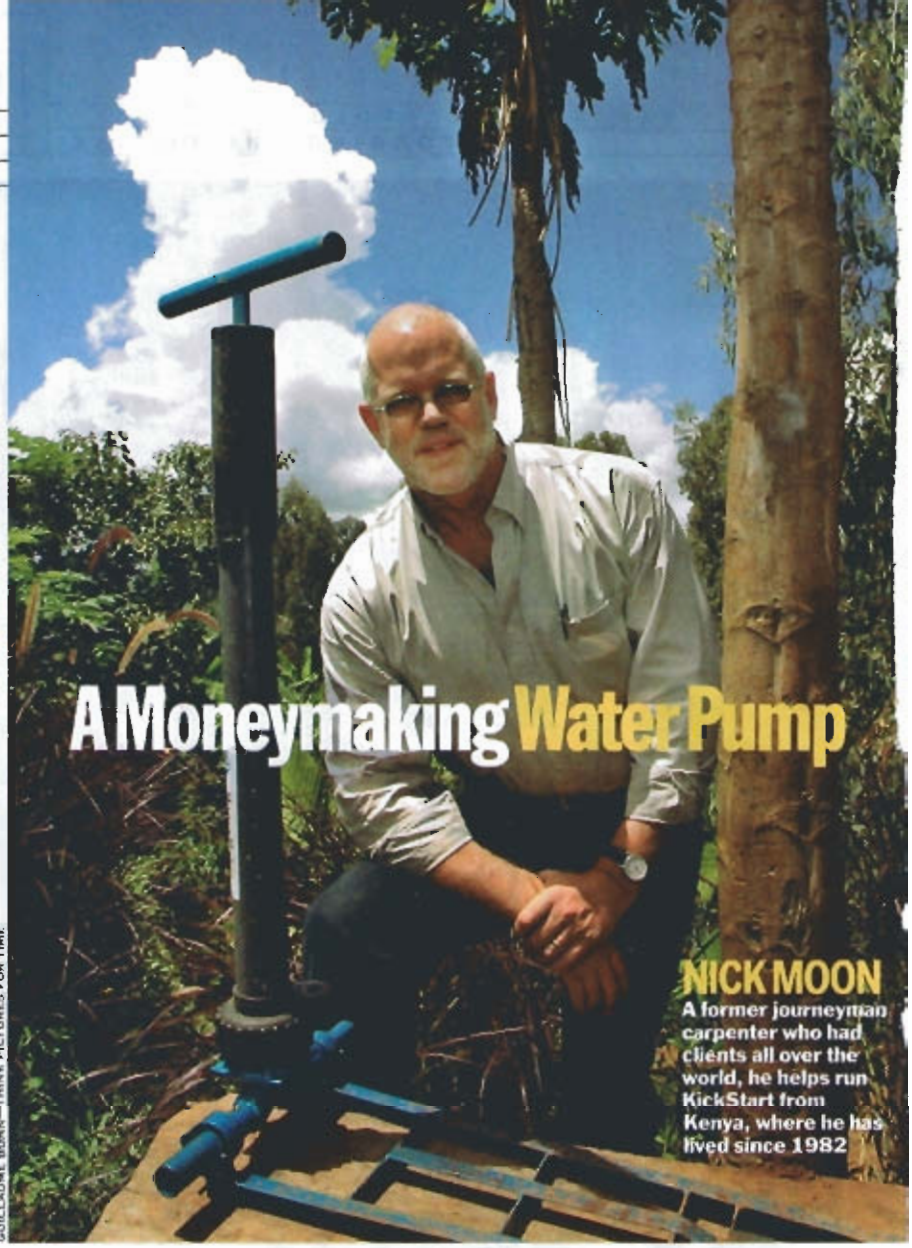
TO REACH THE VILLAGE OF Nyarukamba in western Uganda, visitors have to clamber up a thin, almost vertical dirt track. It's not the kind of place you would expect to find subsistence farmers surfing the Web with wi-fi computers or making VOIP (voice over Internet protocol) phone calls. But that's exactly what the village's 800 or so inhabitants have been doing—thanks to a wireless, solar-powered communications system installed in the Ruwenzori mountains by Inveneo, a San Francisco nonprofit.

Inveneo was launched in 2004 by three Silicon Valley veterans—Mark Sumner, 36; Kristin Peterson, 45; and Bob Marsh, 59—who share a passion for high tech and an interest in the developing world. They had done enough volunteer work overseas to see how wireless communications might improve and save lives—through phone calls to health clinics, fast reporting of natural disasters, support for trading co-ops and better educational opportunities.

So they designed a solar-powered Internet network that is inexpensive, easy to install and nearly maintenance free. At its heart is a regional hub from which wireless relay stations—some bolted to trees—fan out for up to four miles and connect a network of PCs. Total cost, including solar panels and relay stations: $1,995.

One year later, Nyarukamba is already reaping the benefits. Village income is rising, thanks to improved access to market prices for crops and co-ops formed with other villages. Buying power has increased, health outcomes are improving, and more people are learning to read.

Next month Inveneo will deploy systems to schools and colleges in Uganda, and Ghana and hopes to expand over the next year to Swaziland, Senegal and the Philippines. And just in case the sun doesn't shine, Inveneo has worked out how to power up the system with a retrofitted bicycle. *—By Amanda Bower*



GUILLAUME BONN—THINK PICTURES FOR TIME

A Moneymaking Water Pump

NICK MOON
A former journeyman carpenter who had clients all over the world, he helps run KickStart from Kenya, where he has lived since 1982

ORBITING OVER NIGERIA

THE FRONTIER OF SPACE

What does launching satellites have to do with lifting Africans out of poverty? Just ask Robert Boroffice. He's the head of the space agency of Nigeria—yes, Nigeria—and he is convinced that space programs can succeed where Earth-bound projects have failed. Though blessed with vast oil reserves, Africa's most populous nation has been crippled by years of military rule and mismanagement.

According to the World Bank, 70% of Nigerians live on less than $1 a day.

But three years ago Nigeria became only the second country in sub-Saharan Africa (after South Africa) to launch its own satellite. NigeriaSat-1 took off from Russia but is controlled by Nigerian scientists and engineers from a ground station in Abuja. The satellite, which was built in Britain, is

TOOLS FOR POOR FARMERS

TO MARTIN FISHer, 48, and Nick Moon, 51, a simple pump could be the solution to poverty for millions of Africans. They're the co-founders of KickStart, a San Francisco–based nonprofit that encourages rural entrepreneurship by providing tools that Africa's poor can afford. Since the group was founded in Nairobi in 1991 under the name ApproTEC, it has developed a machine to make building blocks, a press that extracts cooking oil from seeds, a hay baler and a series of hand-operated micro-irrigation pumps. Their latest, the Money-Maker Hip Pump, retails in Africa for $34.

MARTIN FISHER An engineer, he met Moon in Kenya in the '80s

For someone like Felix Mururi, a Kenyan in his early 30s, the hip pump made small-scale farming more profitable than working in a city. Recovering his investment within three months (the goal for every KickStart product), he felt confident enough to rent more land. But Fisher and Moon are doing more than selling a pump. They're trying to market a new model of development. Their aim, says Fisher, is "to create dignity rather than dependency and to leave in place a sustainable and dynamic private sector."

Moon says KickStart operates on a simple maxim: "The greatest good to the largest number in the shortest time at the least cost." It seems to be working. The company has sold 63,000 pumps in Kenya, Tanzania and Mali and estimates that $45 million in profits and wages has been generated by new, "kick-started" businesses.

Over the next three years, KickStart plans to expand into three more countries, sell 125,000 more pumps, roll out a "deep-lift irrigation pump" that can pull water from 60 ft. underground and bring 400,000 more people out of poverty.

—By Ross Perlin

GRAHAM TROTT FOR TIME

part of a network called the Disaster Monitoring Constellation. Its job includes keeping an orbiting eye on Nigeria's vanishing forest resources and often vandalized oil pipelines. It also watches for impending disasters such as fires and floods and shares the information with a consortium that includes Algeria, China, Thailand, Turkey, Vietnam and Britain.

That's only the start of Boroffice's ambitious plans. A communications satellite designed to give even remote villagers access to the Internet is scheduled to be launched next year, and a second observation satellite is planned for 2009. To make the space program self-sustaining, Nigeria wants to sell excess bandwidth to other nations; a United Arab Emirates–based company reportedly has already signed a $250 million deal. "I'm very passionate about space technology, says Boroffice, 57, a former biology professor. "I see what it has done in India, and I want to do the same in Nigeria." He is already working on plans for the first all-African satellite, with a launch window around 2025.

ROBERT BOROFFICE "Africa has a lot of problems and some of them can be solved from space," says the former biology professor

—By Simon Robinson with Gilbert da Costa/Abuja

PIUS UTOMI EKPEI—AFP FOR TIME

MICHAEL CRESSWELL

LIGHTING OFF THE GRID

The New El

Sitting in a brightly lit classroom at the Stanford Business School three years ago, Matt Scott got to wondering what it would take to light the rest of the world. Artificial lighting may not seem a necessity like food or shelter, but 1.6 billion people around the globe lack access to electricity and the on-off switches we take for granted. Inspired by the Light Up the World Foundation, which promotes the use of energy-efficient light-emitting diodes (LEDs), Scott, now 31, traveled to India and in 2004 partnered with Amit Chugh to devise a market strategy for replacing the kerosene lamp.

The result is the Mightylight, a waterproof, shockproof, LED lamp that can be used as a flashlight, reading lamp or ceiling fixture. Solar powered, capable of holding an eight-hour charge and designed to last 100,000 hours, the Mightylight is safer and more cost effective than kerosene lamps, which are expensive to maintain and dangerous to use. (Not only

AMIT CHUGH As managing director of Cosmos Ignite, he's on the ground, making it happen

RAKESH SAHAI

MATT SCOTT
This solar-powered light is only one part of Cosmos' innovation. The other is a company designed to serve the needs of people at the bottom of the pyramid

ctric Lamp

o they start a lot of accidental fires but they e also a primary source of indoor air pollution, major killer in developing countries.)

Scott and Chugh's other innovation is osmos Ignite, the company they founded to arket Mightylight, inspired by C.K. Prahalad's e *Fortune at the Bottom of the Pyramid*, bout the collective buying power of people rning a few dollars a day, they believe that pitalism—not charity—is the best way to ddress the needs of the Third World. So in ovember they began selling Mightylights for 45 each. The LED technology is so advanced, ys Chugh, that "anyone in New York or Delhi ould love one of these." Chugh, 38, hopes to lease a $30 model soon and even cheaper hts thereafter. With help from foundations, osmos Ignite has sold and distributed more an 4,000 Mightylights for earthquake relief Pakistan and to the poor in Afghanistan, uatemala and Kashmir. In India, fishermen d weavers are already using the lights to xtend their work hours. Says Scott: "The xciting thing—more than just the light itself—the model of using a sustainable approach effect social change." **—By Jeremy Caplan**

THE $100 LAPTOP

A COMPUTER FOR EVERY CHILD

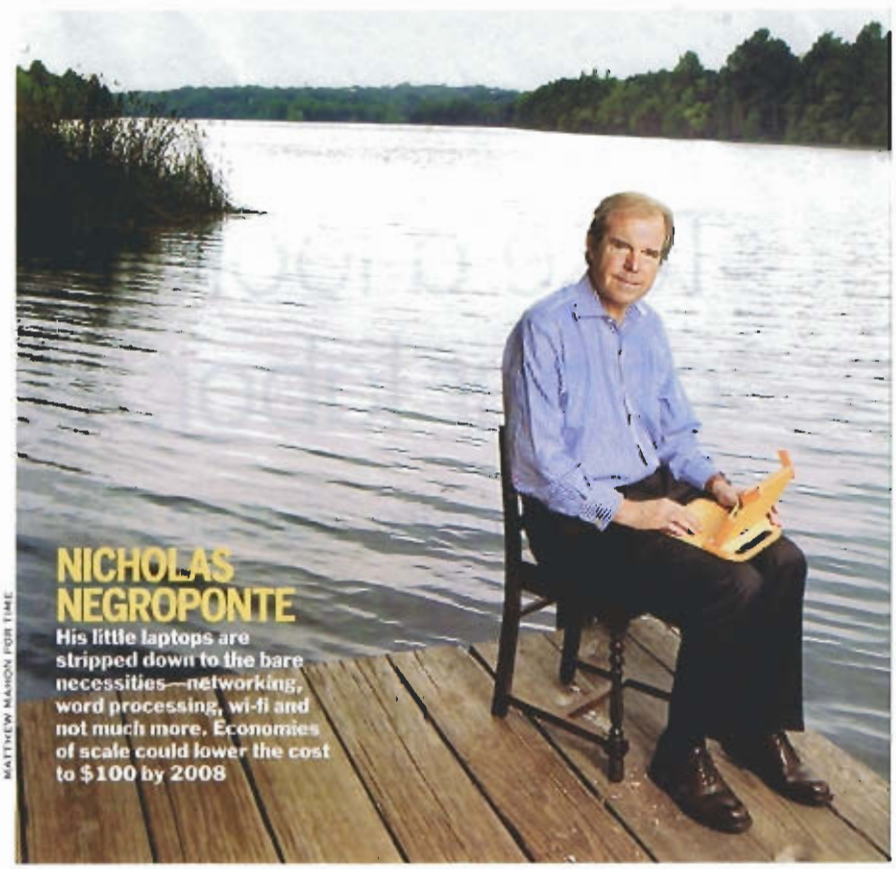
O.K., SO HIS BIG BROTHER JOHN IS DIRECTOR OF NATIONAL INtelligence and delivers daily briefings to the President. But Nicholas Negroponte, 62, is trying to reach a far more challenging audience: the world's poorest children. The co-founder of M.I.T.'s Media Lab and former *Wired* columnist took a leave from academia last year to build a computer—a laptop so cheap that developing countries could buy them by the millions to help their kids leapfrog into the 21st century.

It's an ambitious project, but the charismatic Negroponte has a persuasive pitch and a knack for fund raising. With the support of the U.N., his so-called $100 laptop quickly found backing from, among others, Google, Red Hat, Advanced Micro Devices and Nortel. His team is still making prototypes, but a finished motherboard was delivered in April. A wind-up crank has been replaced by a new foot pedal to supply power in areas lacking electricity.

"The actual decision to make millions of laptops will happen sometime in December or January," he says, predicting that finished machines could be ready by next spring. He hopes to start in seven countries—Nigeria, India, China, Thailand, Brazil, Argentina and Egypt—with a combined total of at least 5 million orders. For the first year or so, however, the $100 laptop will probably cost $140.

Negroponte has his skeptics (including Bill Gates) but is undismayed. "The cynics can be as cynical as they want," he says. "If this makes the industry address low-power, low-cost laptops that can be used in very remote places, that's perfect."

And has big brother John opened any doors? "Nepotism does help," he says, chuckling, and adds that he has met with the State Department and the U.S. Agency for International Development. "But we're trying to make this less of an American project and more of a global one." **—By Jeffrey Ressner**



MATTHEW MAHON FOR TIME

NICHOLAS NEGROPONTE
His little laptops are stripped down to the bare necessities—networking, word processing, wi-fi and not much more. Economies of scale could lower the cost to $100 by 2008