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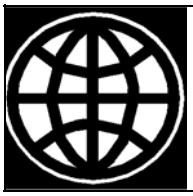

Social Protection Discussion Paper Series

A Technology White Paper on Improving the Efficiency of Social Safety Net Program Delivery in Low Income Countries
An Introduction to Available and Emerging Mobile Technologies

Mike Gallaher

May 2005

Social Protection Unit

Human Development Network

The World Bank

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Social Protection Discussion Paper Series

A Technology White Paper on Improving the Efficiency of Social Safety Net Program Delivery in Low Income Countries

An Introduction to Available and Emerging Mobile Technologies

Mike Gallaher[1]

May 2005

[1] This report was commissioned to CAL2CAL Corporation by the Social Protection Unit of the Human Development Network. It was prepared by Mike Gallaher in collaboration with the ICT Team of CAL2CAL, under the supervision and guidance of Carlo del Ninno and Margaret Grosh (cdelninno@worldbank.org). Helpful comments on an earlier draft have been provided by Susan Razzaz, Francisco Ayala and Marito Garcia. Comments are welcome, and should be directed to Carlo del Ninno (cdelninno@worldbank.org) or Mike Gallaher (mike@cal2cal.com).

Foreword

The design and implementation of safety net programs present many operational challenges related to the determination of eligibility, the maintenance of a data base of beneficiaries, the documentation of compliance, the distribution of benefits, and the verification of program efficacy. Technology can help to address these challenges as well as increase efficiency and decrease costs.

Several approaches adopted in recent years to improve the administration of cash transfer programs make use of technologies such as cash dispensers, palm pilots, smart cards and databases for better record keeping.

This paper was commissioned by the Social Protection unit of the World Bank to explore how emerging technologies can improve the efficiency of Social Safety Net Program delivery in low income countries. The objective is to outline various available and emerging Information and Communication Technologies (ICTs) and to provide a framework to assess whether and how they may be used to improve the delivery of safety net programs. The main focus is on the specific issues related to the operational challenges posed by Conditional Cash Transfer Programs, since they are more complicated and pose additional participation requirements. The lessons learned from the analysis, however, are not unique to Conditional Cash Transfer Programs and can be applied to other programs.

This paper represents the first attempt to understand how these technologies can be used in low income countries to improve program delivery. It is an excellent source of information on available ICTs and how they can be used. While the paper provides a framework for the design of an ICT based delivery system for safety nets and gives ideas on how to estimate costs under various configurations, it does not provide concrete examples on how any of the systems suggested have been implemented. There is much more work that needs to be done to learn how ICTs can be incorporated in the delivery of safety net programs along the lines described in the paper. This will require learning more from exciting and upcoming program delivery systems and from new pilot programs that can be developed.

Abstract

This document outlines various available and emerging information and communication technologies (ICTs) and provides a framework to assess how these technologies may be used to improve the efficiency of the delivery of safety net programs. These technologies include: mobile computing, biometrics, satellite communications, simple and smart cards, global positioning systems, radio frequency identification tags, automated teller machines and solar power. Their use in the administration, delivery and monitoring of SSN programs offers numerous advantages including increased accuracy, reliability and timeliness of information, performance measurement and service provider accountability. However, these new and emerging technologies typically require higher initial investment costs that benefit current and future time periods. The optimal solution to design an advanced and efficient delivery system for a safety net program may be a combination of traditional service delivery methods and new technologies that draws on a needs assessment that accounts for local conditions and program characteristics.

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1. INTRODUCTION

1.1 INTRODUCTION TO SAFETY NETS AND CONDITIONAL CASH TRANSFER PROGRAMS

Overview

A large number of developing countries manage a variety of social safety net programs to provide additional income or in-kind help to vulnerable households. A growing number of these countries are implementing, or considering whether to implement a new type of safety net program: the Conditional Cash Transfer (CCT) Programs. These programs provide payment in cash to individual families conditional upon certain actions or behaviors on the part of the recipient. Typically these conditional actions assign responsibility to parents for the following: ensuring their school aged children have attended a predefined percentage of school days; ensuring that pre-school aged children have received the prescribed number of preventive health care visits (the schedule varies by age from about monthly to twice annually); and ensuring that parents have attended required health education lectures (generally monthly or bimonthly).

Operational Challenges

A significant challenge related to CCT programs is determining of the feasibility of the payments and the most efficient and economical channel for distributing many small payments to poor households in very low-income countries. Between tens of thousands and millions of recipient households could potentially be identified for inclusion. These households might receive payments between US$5 and US$20 on a monthly, bi-monthly or quarterly basis over several years.

Other operational issues include the collection of the information to verify that the beneficiary families have complied with the conditions requisite for the cash transfers and measurement of the effectiveness of the program.

Typically the program is administered in areas that lack reliable infrastructure such as communications networks, power, transportation, and banking, and in most cases are marked with minimal literacy and low-density spread of the population. These factors not only impose an impediment to the efficient and cost-effective implementation of CCT programs relative to the challenges above, but also in assessment of the ultimate effectiveness of the programs.

1.2 OBJECTIVE

Varied organizations and projects have undertaken the exploration and implementation of Information and Communication Technologies (ICT) as viable and imperative components of initiatives expected to reduce poverty and improve the living standards of people in the developing world. These initiatives focus on such issues as healthcare, education, basic communications and even business transactions.

The objective of this document is to outline various available and emerging ICTs and provide a framework to assess whether and how these technologies may be used to improve the efficiency of the delivery of safety nets programs. The main focus of the paper is on the specific

issues related to the operational challenges posed by the Conditional Cash Transfer Program, since these programs are more complicated and pose additional participation requirements. The lessons learned from their analysis will help to find solutions that can be used in the implementation and delivery of other programs as well. In particular we are interested in the operational challenges relative to:

- Determining the Eligibility of Individuals;
- Documenting Compliance with Program Conditions;
- Distribution of Benefits; and
- Verification of Program Effectiveness.

1.3 ORGANIZATION OF DOCUMENT

The first section of this paper, ***AVAILABLE AND EMERGING TECHNOLOGIES,*** introduces and describes the features and functionality of a variety of technological appliances and services. We provide hyperlinks[1] to representative devices, service providers and real-world case studies. Further, we suggest potential applications to which the technologies might be considered in solving the operational challenges associated with the CCT Programs. Our intent is twofold: to pique and stimulate readers' respective interests and imaginations; to provide a framework in which to consider the opportunities in which these technologies might play an assistive role in their respective situations.

In ***DISCUSSION OF POTENTIAL APPLICATIONS*** we expand on the potential CCT applications of these technologies to the operational challenges. We provide overviews using pictorials and descriptive process steps to exemplify the approaches in which the technologies might be incorporated into the CCT Program structure. In ***ASSESSMENT FACTORS AND INQUIRIES*** we propose certain factors and inquiries that should be considered and ascertained in order to facilitate the assessment of whether and which technologies should be applied.

APPENDIX I summarizes, from each technology section included in ***AVAILABLE AND EMERGING TECHNOLOGIES,*** the CCT operational challenges in which the technologies discussed may apply. ***APPENDIX II*** summarizes a range of technology cost information and remarks on broad advantages, limitations and constraints.

2. AVAILABLE AND EMERGING TECHNOLOGIES

2.1 MOBILE COMPUTING

Handheld computing devices commonly referred to as Personal Digital Assistants[2] (PDA), offer a mobile environment for collecting, and more importantly, delivering information. They have enabled companies, organizations and individuals to expand the enterprise beyond the corporate computing environment out into the field. Delivering information to individuals wherever they are and whenever they need it will be the defining achievement of the new mobile environment. Recent developments in communications, the Internet, portable devices and synchronization technologies have transformed these devices into multi-dimensional information delivery systems benefiting both the personal and business marketplace.

Unlike desktop computers, operating systems[3] (OS) and software developed for these handheld computers are optimized for screen size, limited input, memory requirements, data storage and power consumption to achieve maximum efficiency, flexibility and compatibility. A user typically inputs and retrieves information from these devices utilizing a keyboard or by writing or tapping with a stylus on a touch-sensitive screen.

Mobile computing devices include notebook computers, tablet computers[4], PDAs, and Smart Phones[5] with wireless Internet connectivity. Handheld computers are commonly categorized based on the embedded operating systems on which they run:

- Palm OS based devices;
- Windows CE/Pocket PC/Windows Mobile OS based devices;
- Symbian OS based devices (popular for advanced mobile phones);
- Smart Phone devices that combine the functionality of handheld computers and mobile phones;
- Embedded Linux OS based devices.

Due to the recent rapid development of mobile computing, a large number of handheld computers and Smart Phones are available in the market to fulfill varying requirements. Handheld computers are also growing in computing power with very fast processors[6] up to 400 MHz[7], large memory capacity (up to 64MB[8]), additional memory cards[9], powerful rechargeable batteries which can continually run these devices for several hours and wireless connectivity.

Memory usage of handheld computers is generally more efficient than desktop computers: for example, an extensive electronic data capture field survey application was recently developed for the Palm OS by CAL2CAL Corporation. The survey included more than 100 questions per household and the survey software consumed only approximately 600-700 KB[10], while data for each survey consumed approximately 15-20 KB. This translates to more than 1,000 surveys on a single Palm device.

Most handheld computers also have the ability to connect to other devices such as GPS receivers, barcode scanners, smart card readers, cell phones, satellite phones, biometric fingerprint readers, portable printers and audio-video devices. Connectivity to these external devices is offered by use of Bluetooth[11] technology or expansion[12] slots. Portable memory

chips[13] (for example, Secure Digital[14] Cards, Compact Flash Cards[15], MMC Cards[16]) that can store up to 256 MB or more of data can be attached externally to some models and provide extended data storage. Backup of handheld computer data can also be accomplished by direct connection to a desktop computer and/or by wireless data transmission via the Internet or satellite.

The following are common guidelines for consideration when selecting a particular handheld computer:

- CPU / Processor speed
- Screen resolution
- Memory
- Operating System
- Software support
- Multimedia support
- Desktop connectivity
- Wireless connectivity
- Form factor[17]
- Memory expansion slots
- Power supply
- Data input methods such as keyboards and handwriting
- Weight and portability
- Simplicity
- Cost

PDA devices are generally powered either by direct electrical connection, disposable batteries, rechargeable batteries or a combination of these methods. Solar powered technology is also available as an alternative for battery recharge.

- **Links to Representative Devices:**

Palm OS based Handheld Computer:
http://www.palmsource.com/handhelds/index.html
Palm OS-based Smart Phone:
http://www.palmsource.com/smartphones/index.html

Windows Mobile Devices - Pocket PC Handheld Computer:
http://www.microsoft.com/windowsmobile/buyersguide/helpmechoose/default.mspx
Embedded Linux OS-Based Handheld Computers:
http://www.linuxdevices.com/articles/AT8728350077.html
Integrated Handheld Computers with GPS:
http://www.garmin.com/products/iQue3600/
http://www.magellangps.com/en/products/product.asp?PRODID=13
http://h10010.www1.hp.com/wwpc-JAVA/offweb/vac/us/en/sm/pocketpc/FA196A_overview.vad
http://www.pharosgps.com/products/
Linux-based Handheld Computer with Biometric Fingerprint Reader:
http://www.linuxdevices.com/articles/AT7145548309.html
Integrated Microsoft Windows CE-based Handheld Computer / Biometrics / Smart Card Reader / Wireless Communication Device:
http://www.tricubes.com/1020.pdf

Integrated Handheld Computer / Magnetic Card Reader / Smart Card Reader and Writer / Printer / Wireless Connectivity:
http://www.4p-online.com/en/products/dat500/index_d500.html

- **Links to Case Studies:**
  Integrated Palm Handheld Computer with GPS Survey Data Capture Solution:
  http://www.cal2cal.com/05B1.asp
  Use of PDAs in HealthCare Study in Africa:
  http://www.bridges.org/iicd_casestudies/satellife/
  http://news.hst.org.za/view.php3?id=20021043
  Use of Tablet PC for Mobile Data Collection:
  http://ms-answers.com/content/retail/Best%20Buy%20--%20Tablet%20PC.doc
  Integrated Handheld Computer and Smart Card Project:
  http://www.digitaldividend.org/pubs/pubs_05_sks.htm

- **Potential Applications:** *Determination of Eligibility; Documentation of Compliance; Distribution of Benefits; Verification of Program Effectiveness*

FEATURED CASE STUDY

SATELLIFE UGANDA HEALTH INFORMATION NETWORK

What Works: **Healthnet Uganda's Evolution from NGO to Sustainable Enterprise**

Executive Summary

Technology continues to be vital to the development of many African nations. The digital divide between industrial nations and the developing world represents an opportunity for many micro-enterprises to build sustainable models for profitability and growth. HealthNet Uganda (HNU), a project funded by SATELLIFE, a U.S.-based non-profit organization, was created in an effort to demonstrate the effectiveness of using personal digital assistants (PDAs) in healthcare in Africa. The project, now in its third year, is at a crossroads. HealthNet Uganda is transitioning from a grant-funded project to a self-sustaining non-profit organization. The new organization will be called Uganda Chartered HealthNet.

This report is an analysis of HealthNet Uganda's business model, including a description of challenges HealthNet Uganda is likely to face and recommendations for how to forestall those challenges. The project conducted market and profitability analyses and identified potential clients. In addition, the underlying assumptions that define HNU's business model—including the willingness and ability of consumers to spend a premium on HNU services, the effectiveness of the technology, and ongoing support of critical partners and constituents—were scrutinized and evaluated.

The use of information and communications technology (ICT) has had a significant impact on healthcare worldwide and Uganda will be no exception. In fact, the analysis shows that Uganda, and potentially other developing nations, have an urgent need for ICT in the delivery of healthcare. HealthNet Uganda's services will be used by medical professionals, students, NGOs, and other individuals and institutions involved in the Ugandan health sector. All of HNU's targeted users see the value in having readily available real-time access to information. The availability of information ensures accurate reporting and analysis of health data and provides doctors with the ultimate tool to care for patients. Health workers in remote parts of the country will now be able to consult with peers, access information from medical journals and order drugs and medical supplies in real time. This ability to share information could have far-reaching benefits for the health sector in Uganda.

The Ministry of Health in Uganda has enacted policies which demonstrate its commitment to the use of ICT in healthcare. Currently the Ministry uses technology in its Health Management Information System (HMIS) for telemedicine. However, there remains lingering concerns about the necessity, applicability, and affordability of PDAs. Policy implications of PDA adoption will have to be considered as a necessary part of HNU's model.

As HealthNet Uganda transitions to a self-sustaining organization, the most obvious challenge is the scarcity of financial and human resources. With the support of stakeholders and partners, thorough strategic planning and analysis, and dedicated leadership, it is likely that HealthNet Uganda will not only succeed in its stated objectives, but will lead the way for further innovation in the delivery of services in the health sector in Uganda through the use of ICT.

Source: http://www.digitaldividend.org/case/case_healthnet.htm

2.2 BIOMETRICS

Biometrics measure and authenticate a person's identity by capturing the uniqueness of an individual's biological characteristics and later performing a match to a database of biometric characteristics. These biological characteristics include fingerprints, hand or face geometry, retinal or iris structure, voice or vein patterns, signature dynamics and even DNA[18] sequences.

Biometric systems have two advantages over traditional identification methods. First, the person to be identified is not necessarily required to carry and present any identification document. Second, it does not depend on the user's memory for critical identification variables like passwords and PIN[19] that can be forgotten, lost or stolen. Retinal identification is the most accurate of the biometric methods used at this time, while fingerprint identification is the most popular due to its lower cost and effectiveness. Biometric systems are likely to replace traditional identification methods such as PINs for accessing automated teller machines and virtually every other electronic device used for conducting business where identification is a requirement and prerequisite.

Biometrics are superior to stand alone PIN or physical tokens like Identification Cards in the following ways:

- Superior Security: Biometric methods do not involve the danger of information exposure associated with PINs and identification cards. Unauthorized persons cannot guess or acquire biometric information.
- Increased Convenience: Biometric methods do not require an individual to remember passwords or PINs or carry identification cards, nor do they necessitate any particular literacy level or understanding of the system by the individual being identified.

Biometric systems become even more powerful and secure when utilized in conjunction with other technologies such as Smart Cards or traditional systems such as PINs or passwords. Biometric devices may be stand-alone or can be attached to handheld or desktop computers, or integrated into combinational devices.

- **Links to Representative Devices:**

  Stationary Biometric Devices:

  http://www.bioenabletech.com/standalone_fingerprint_time_attendance.htm
  http://www.bioenabletech.com/time_recorders_access_controllers.htm
  http://www.paypunch.com/paypunch_handreaders.asp
  http://www.datamaticsinc.com/inside.jsp?sub_page=sol_over&jsp=EntDataCapturingBiometrics

  Portable Handheld Integrated Biometrics / Smart Card Readers:

  http://www.datastrip.com/english/products_detail.asp?id=90
  http://www.datastrip.com/english/products_detail.asp?id=91

  Microsoft Windows CE-based Handheld Device with Biometric Fingerprint Reader:

  http://www.tricubes.com/1020.pdf

  Linux-based Handheld Computer with Biometric Fingerprint Reader:

http://www.linuxdevices.com/articles/AT7145548309.html

Attachable Biometric Fingerprint Reader for Pocket PC:
http://www.biocentricsolutions.com/mobile.html

- **Links to Case Studies:**

Biometrics Identification and Access Control Solution:
http://www.unisys.com/public_sector/solutions/defense__and__domestic__security/biometrics__identification__and__access__control__solutions/

El Salvador Smart Driver's License and Registration Card:
http://www.gemplus.com/pss/id_security/download/el_salvador.pdf

Biometric Government in the New South Africa:
http://wiserweb.wits.ac.za/PDF%20Files/state%20-%20breckenridge.PDF

- **Potential Applications:** *Documentation of Compliance; Distribution of Benefits*

FEATURED CASE STUDY

DSS's Biometric ID Project

Connecticut Department of Social Services
Replacing welfare with work

Project Overview

Connecticut's Biometric ID Project began in January 1996

The state legislature passed a law requiring that AFDC and General Assistance recipients be biometrically imaged for identification purposes.

Biometric identification refers to a technology that uses scanned graphical information from many sources for evaluation and identification purposes. This would include facial imaging, retinal scans, fingerprint scans and voice recognition among many other current technologies. For Connecticut's purposes, biometric identification will mean taking a scan of an individuals two index fingers for purposes of multiple case fraud detection. The imaging is done electronically, with a computer, rather than with an ink pad. The process is accurate, clean and takes less than five minutes. Finger imaging has emerged as one of the most widely used biometric identification application processes. Connecticut has selected this technology. The DSS Digital Imaging System became operational on January 1, 1996.

Biometric identification is being done to prevent people from receiving welfare benefits under more than one name or from receiving benefits improperly from more than one town or state program.

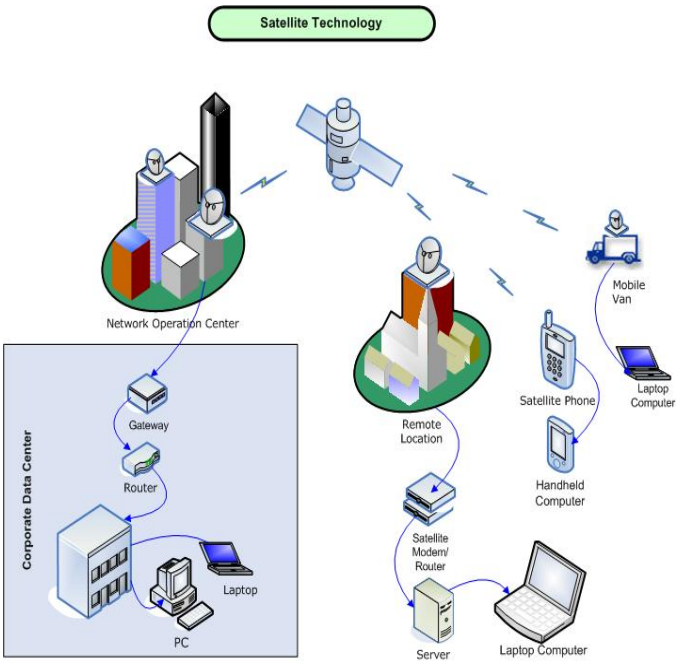
Digital images are created for every new and existing welfare recipient. These images are stored in a computer database along with a digitally captured facial portrait and signature. As each new applicant is imaged, the digital record is matched against the established database in real time. Connecticut has selected a combination of proven technologies that places it's system at the cutting edge of all human services systems in place in the US.

The equipment used in the digital imaging process include a Pentium III computer, an LCD signature tablet, a small optical fingerprint reader, a PVC card printer and a digital camera. Applicants place their two index fingers (one at a time) on the fingerprint scanner. Applicants can see their own fingerprints on the computer screen while the computer "scans" their fingerprints into the central data base. While their fingerprints are being recorded and matched, the system operator will take their photograph and record the applicant's signature. In less than five minutes, a real time match process is completed and the applicant is given a tamper proof, secure photo identification card. The card contains the applicants photo, welfare identification number, a 2D bar-code containing fingerprint minutiae data for fast 1:1 identification verification, and a ISO standard mag stripe that can carry everything from EBT financial transaction codes for use in ATM's and POS devices to medical eligibility data for medical service providers.

Information gathered through the digital imaging process is subject to DSS confidentiality rules and may not be used for purposes other than DSS program administration. Interstate matches with other human services agencies are permissible and planned.

Source: http://www.dss.state.ct.us/digital/project.htm

2.3 SATELLITE COMMUNICATIONS

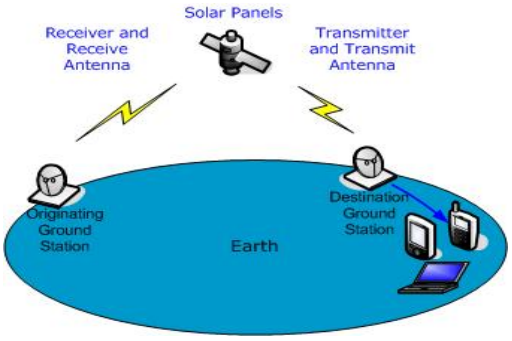


Various companies and governmental bodies have positioned satellite vehicles into Earth's orbit to facilitate data collection and communications transmission using radio or microwave[20] frequencies. Most communications satellites maintain geosynchronous[21] or near-geosynchronous orbits.

Satellite communication is a viable alternative when conventional technology is limited due to lack of infrastructure such as traditional telephone networks. Data capturing devices such as handheld or laptop computers may be connected to satellite phones or modems to transmit data "on-the-fly" or at a pre-determined time. Satellite link receiving stations and devices can be powered by portable power solutions, including solar panels and batteries, in the event of traditional power supply unavailability.

The criteria for evaluating the feasibility of use of satellite technology will be:

- Uplink and downlink devices and their respective pricing
- Communications service charges
- Service coverage



- **Links to Representative Devices and Service Providers:**

  Iridium Motorola Satellite Phone:
  http://www.outfittersatellite.com/iridium.htm
  Satellite IP Modem:
  http://www.gpsphones.com/rbgan_specs.htm
  Thrane & Thrane Capsat Mobile Inmarsat Mini-M Terminal:
  http://www.gpsphones.com/thrane.htm
  Intelsat:
  http://www.intelsat.com/resources/coveragemaps.aspx
  Inmarsat:
  http://www.outfittersatellite.com/inmarsat_equip.htm
  Service Charges and Coverage:
  http://outfittersatellite.com/adobe/GSM_ratesheet.pdf

- **Links to Case Studies:**

  Whitepaper on Rural Communication:
  http://www.fcc.gov/cgb/rural/presentations/GlobalstarFCCPresentationMaterial.pdf
  E-Learning Initiative to Tackle Information Poverty in Developing Countries:

http://about.inmarsat.com/news/00014160.aspx

- **Potential Applications:** *Determination of Eligibility; Documentation of Compliance; Distribution of Benefits*

FEATURED CASE STUDY

AfriAfya Initiative

Project Description: The AfriAfya initiative is a consortium of seven of the largest health NGOs in Kenya and the Ministry of Health that is focused on collecting health information, repackaging it, and using ICTs to disseminate it to rural and marginalized Kenyan communities. The project has set up a small coordinating hub and seven field centers selected from existing community-based health intervention sites run by each of the Partner Agencies within AfriAfya. The field centers are spread out across the country and consist of different types of facilities in a range of settings: an urban slum community-based health care project, a rural dispensary, a mission hospital, a rural community training center, a community-based child survival project, a primary school, and a District Medical Officer's office.

Each of these sites are equipped with a computer, its operating software, printer, data modem, WorldSpace receiver and PC adapter card. Three to four staff from each of these sites are trained in the use of this equipment. Solar panels have been used to power the equipment where there is no electricity. The field sites are being used as the testing ground for these new technologies, and to see how well the modern technologies integrate with the traditional health communication methods.

Project URL: http://www.afriafya.org

Locations:
- Africa/Kenya/Nairobi Area/Nairobi
- Africa/Kenya/Western/Kakamega
- Africa/Kenya/Coast/Mombasa

Organization: AfriAfya (African Network for Health Knowledge Management and Communication)

Source: http://www.digitaldividend.org/

2.4 GLOBAL POSITIONING SYSTEMS (GPS)

The Global Positioning Satellite System (GPS) is a worldwide radio navigation system based on a constellation of satellites. The GPS system can reference an accurate position on land, sea or in air through a triangulation method using signals broadcast by these satellites. The GPS system includes three primary components: a space segment, a user segment and a control segment. The space segment consists of 24 satellites, each in orbit 11,000 nautical miles above the Earth. The user segment consists of receivers, which can be handheld or vehicle mounted. The control segment consists of five worldwide ground stations that ensure the satellites are functioning properly.

An end user requires only a GPS receiver to record geographical coordinates. GPS receivers have been miniaturized to the extent that they can be embedded into devices in common use and can now be found in automobiles, marine vessels, aircraft, and even handheld computers.

Reference: US Coast Guard Navigation Center – http://www.navcen.uscg.gov/faq/gpsfaq.htm

- **Links to Representative Devices:**

Handheld GPS Devices:

http://www.garmin.com/mobile/products.html#handheld

http://www.magellangps.com/en/products/

GPS PDA Attachments:
http://www.magellangps.com/en/products/product.asp?PRODID=13
http://www.laipac.com/gps_tf30cf_eng.htm#down
http://h10010.www1.hp.com/wwpc-JAVA/offweb/vac/us/en/sm/pocketpc/FA196A_overview.vad
http://www.pharosgps.com/products/
Integrated Handheld Computers with GPS:
http://www.garmin.com/products/iQue3600/

- **Links to Case Studies:**
  Microsoft Case Study on Use of Handheld Computer with Integrated GPS:
  http://download.microsoft.com/download/8/1/2/812737f6-f1c1-4276-8f9d-35274a73fdcd/MPAC_pharos.pdf
  Integrated Palm Handheld Computer with GPS Survey Data Capture Solution:
  http://www.cal2cal.com/05B1.asp
  Wireless Tracking Solutions for First Responders Using Handheld Computers:
  http://www.mobileplanet.com/private/biz/case_studies_article.asp?selected=&article=21
  GPS Helps Locate and Mark Villages in Peru:
  http://www.garmin.com/products/gps12/testimonials.html

- **Potential Applications:** *Determination of Eligibility; Distribution of Benefits; Verification of Effectiveness*

2.5 SIMPLE AND SMART CARDS

Varying types of cards are available for identification and authentication purposes. These cards range in capability from simple unsophisticated identification cards to advanced microprocessor[22] based Smart Cards that can provide a range of functionality, including computational capability. We discuss the basic specifications and capabilities below.

Simple Card with Unique Identifier, Photograph and Signature

In areas with little or no infrastructure, a simple card with a unique identifier, photograph and signature can be used for identification purposes. This type of card is commonly used for identification in low security situations such as controlling access to a physical location. It is a low cost solution but is limited to basic visual authentication.

Plastic / Paper Card with Barcode

The card with a barcode option is similar to a simple card with the addition of a barcode printed on the card. The card may or may not have a photograph. Barcodes are routinely used in our everyday lives. They can be found in retail stores in the form of Universal Product Codes[23] (UPCs), on identification cards, in video rental stores and on other types of labels.

A barcode is a series of vertical black and white stripes that can be read by a barcode scanner. Basic identification information can be encoded by using barcodes. Cards with barcodes provide quick access to information by simply scanning the card which relays and interprets the information into the barcode scanner. Implementation of

barcodes is less expensive than Smart Cards, however they bear limited read-only data and are incapable of storing more accurate authentication information such as biometric data. Information once encoded using barcodes cannot be updated.

- **Links to Representative Devices:**
  Example Barcode Solutions:
  http://www.getphysicalsoftware.com/idcards/idcards.html
  http://www.barcodesinc.com/
  Example Handheld Computers for Barcode Reading:
  http://www.symbol.com/products/mobile_computers/mc9000.html
  http://www.barcodesinc.com/symbol/spt1550.htm

- **Links to Case Studies:**
  Hospital Patient and Records Tracking:
  http://www.zebra.com/pdf/CS13110LwristBands.pdf
  http://www.zebra.com/pdf/CS13109LhospitalAdmissions.pdf

Magnetic Stripe Card

Magnetic Stripe cards can store identification data and limited personal information on a magnetic stripe embedded within the card. The stripe usually contains identification information. The magnetic stripe is composed of tiny iron-based magnetic particles in a plastic-like film. Each particle is actually a tiny bar magnet about 20-millionths of an inch long. The magnetic stripe can be "written" by magnetizing and de-magnetizing each tiny bit. The most common application for this type of card is in credit and ATM cards. The magnetic stripe in these cases includes not only the cardholder's name, but also other pieces of information such as account number and credit limit. The card can be secured against loss or theft when combined with a PIN or password. The advantage of this type of card is its wide acceptability and the ability to update the stored information. The disadvantage is that it needs to be handled carefully to prevent loss of data.

- **Links to Representative Devices:**
  ID Card Printer System with Electronic Encoding:
  http://www.evolution-1.com/pebble.htm
  School, Government and Hospital Identification Systems:
  http://www.evolution-1.com/identification.htm
  Integrated Handheld Computer / Magnetic Card Reader / Smart Card Reader and Writer / Printer / Wireless Connectivity:
  http://www.4p-online.com/en/products/dat500/index_d500.html

- **Links to Case Studies:**
  The German Railway Card:
  http://www.datenschutz-berlin.de/sonstige/konferen/ottawa/alex3.htm
  Value Card Application:
  http://www.kal.com/Products/case4.htm

Smart Cards

The Smart Card is one of the latest additions to the world of information technology. Similar in size to today's plastic payment card, the Smart Card has a microprocessor or memory chip embedded in it that, when coupled with a reader, has the processing power to serve many

different applications. As an access-control device, smart cards make personal and business data available only to the appropriate users. Smart cards are read / write capable and extremely secure. One of the more significant advantages of smart cards is their large memory capacity. This allows each card to be "personalized" for a user by including biometric information such as a fingerprint. Another significant advantage is that multiple applications can be housed on the same device. Smart Cards provide data portability, security and convenience.

Smart cards are available for either or both contact or proximity (non-contact) reading. Contact Smart Cards are inserted into a Smart Card reader making physical contact with the reader. However, non-contact Smart Cards have an antenna embedded inside the card that enables communication with the reader without physical contact. A combination card combines the two features with a very high level of security.

Today, there are three categories of Smart Cards, all of which are evolving rapidly into new markets and applications:

Integrated Circuit[24] Memory Cards

IC memory cards can store up to 64 KB of data but have no processor on the card with which to manipulate that data. Thus, they are dependent on the smart card reader for their processing and are suitable for uses where the card performs a fixed operation.

Memory cards represent the bulk of the 600 million Smart Cards sold last year, primarily for prepaid, disposable card applications like prepaid phone cards. Memory cards are popular as high-security alternatives to magnetic stripe cards.

Integrated Circuit Microprocessor Cards

Microprocessor cards are similar to IC Memory cards but also contain an embedded microprocessor that can process data on the card. The current generation of Microprocessor Cards has the equivalent processing power of the original IBM-XT personal computer.

These Smart Cards are used for a variety of applications, especially those that have cryptography built in and require manipulation of large numbers. Thus, chip cards have been the main platform for cards that hold a secure digital identity. Some examples of these cards are:

- Cards that hold money (‘stored value cards’)
- Cards that hold money equivalents (for example, ‘affinity cards’)
- Cards that provide secure access to a network
- Cards that secure cellular phones from fraud
- Cards that allow set-top boxes on televisions to remain secure from piracy

Optical Memory Cards

An optical memory card is essentially a card with a piece of compact disc (CD) glued to its surface. Optical memory cards can store up to 4 MB of data, however data cannot be changed or removed once written. Thus, this type of card is ideal for record keeping of such information as medical files, driving records or travel histories. Today, these cards have no processor in them although this feature is coming in the near future. While the cards are comparable in price to chip cards, the card readers use non-standard protocols and are expensive.

Reference: http://didya.com/about_smart_card.asp

- **Links to Representative Devices:**

  ID Card Printer System with Electronic Encoding:
  http://www.evolution-1.com/pebble.htm
  Integrated Handheld Computer / Biometrics / Smart Card Reader / Wireless Communication Device:
  http://www.tricubes.com/1020.pdf
  Integrated Handheld Computer / Magnetic Card Reader / Smart Card Reader and Writer / Printer / Wireless Connectivity:
  http://www.4p-online.com/en/products/dat500/index_d500.html

- **Links to Case Studies:**
  El Salvador Smart Driver's License and Registration Card:
  http://www.gemplus.com/pss/id_security/download/el_salvador.pdf
  Smart Card and Biometric Integration White Paper:
  http://www.bioenabletech.com/downloads/Secure_identification_system.pdf
  White Paper on Smart Card Expansion:
  http://infosecuritymag.techtarget.com/2002/mar/cover.shtml
  Gemplus ID and Security Solutions and Case Examples:
  http://www.gemplus.com/pss/id_security/index.html
  Integrated Handheld Computer and Smart Card Project:
  http://www.digitaldividend.org/pubs/pubs_05_sks.htm

- **Potential Applications:** *Documentation of Compliance; Distribution of Benefits*

FEATURED CASE STUDY

Swayam Krishi Sangam (SKS) Handheld/Smart Card Project

In the developed world, handheld PCs seem to have become no more than fashionable organizers. What about digital "smart" cards? Just a way to tuck everything into your purse.

But in Medak, one of the poorest regions in the Indian state of Andhra Pradesh, these hi-tech devices are being explored as a cost-saving alternative in microfinance—and may thus have a central role to play in raising living standards in the area.

How can you help feed the poor with $300 handhelds?

Hear Swayam Krishi Sangam (SKS) explain. SKS is a Grameen Bank replication project that has been providing emergency and income-generating micro-loans for women in the rural villages of Medak since 1997. Following the Grameen model, five women are grouped together to form a cohesive unit, and up to eight groups form a larger cohesive called sangam (women's banking cooperative). During sangam meetings held once a week, a SKS staff member or Sangam Manager disburses new loans, manages savings withdrawals, collects due payments, and hears proposals for new loans.

Every transaction is recorded meticulously by hand. Because this is highly time and labor-intensive—and therefore costly—it inhibits the number of women and the number of sangams that the managers can serve. They have to execute all transactions and proposal-hearings within a small window of time in the early morning before the women must depart to work. Coupled with an exponential increase in membership since 1997, from 0 to 8200 women in just 5 years, the situation has forced SKS to explore new operational strategies.

The Technology and How It Works

Introducing SKS' Handheld/Smart Card pilot project. Smart cards are essentially electronic passbooks—bank-card size pieces of hard plastic that contains integrated memory chips. Each group of women is given a smart card that stores information about their loans and savings transactions with SKS.

Every morning, the sangam manager takes her handheld computer and new loans agreed upon at the previous meeting to the sangams she is responsible for. At the meeting, a representative of each women's group comes forth and inserts her smart card into the card reader of the handheld. Due loan and savings repayments are paid, new loans disbursed, and where previously the transaction was recorded by hand, the sangam manager simply has to type in the amount borrowed or repaid into the handheld and it will instantly write the new data onto both the handheld and smart card.

Once the sangam manager returns to her regional SKS office after making her round, she proceeds to synchronize and update the branch computer with the new data on her handheld. In this way, records of loan transactions can travel back to the top-level central databank automatically.

Understanding that more awareness-building needs to be done to generate total confidence in the benefits of the new system, the sangam manager now uses both the manual as well as the smart card system.

Initial Results

Initial observations are cause for cautious optimism. The new system has resulted in a 10% reduction in sangam meeting times, and eliminates the need for sangam managers to do 20,000 manual passbook entries in sangam meetings and 160,000 entries at the branch office per year. The time savings can be productively used in other activities such as conducting new sangam meetings, hearing more proposals or checking on how the loans are utilized. Automating these transactions also reduces the scope of error.

The Handheld/Smart Card design is aimed at lowering SKS's cost of operation. The financial sustainability of microfinance institutions (MFIs) like SKS has continually been under strain—not only due to their clients' generally small loan portfolios, but also due to the high transportation cost that MFI staff must bear when traveling to their clients' remote and sparsely-populated villages. Thus the system hopes to increase MFIs' profit margins such that they will continue to serve the most needy in those areas.

The Challenge

Given all the benefits, high hardware and software costs are still prohibiting rapid and full deployment of handhelds and smart cards in SKS' operation. Currently SKS is waiting for cost-analysis results from its 10-month, 10-sangam wide pilot. A critical evaluation of the results will be used to determine whether the technology can indeed dramatically increase the MFI's efficiency and give it significant returns for its investment.

SKS is confident that by thinking creatively and leveraging technology, MFIs and their clients will both benefit.

Bridging a Larger Divide

Another important learning experience from the SKS Handheld/Smart Card project is the remarkable way in which its staff—most of whom share the same socio-economic status with their borrowers as dalats (untouchables)—is able to maneuver the hi-tech devices with ease.

Not only is their ability to quickly master the technology impressive, but their willingness (and that of the women villagers) to replace the century-old method of bookkeeping by the complicated, hi-tech device is giving SKS great confidence in the feasibility of scaling up its Handheld/Smart Card operations in the near future.

The organization has set an ambitious target of reaching 100,000 women in the 100 poorest districts in India, to be fulfilled in 5 years. SKS seeks partnerships with larger banks and businesses, and challenges them to take advantage of emerging technologies to offer a greater range of services to improve the lives of these disadvantaged women.

Source: http://www.digitaldividend.org

2.6 RADIO FREQUENCY IDENTIFICATION (RFID) TAGS

Radio **F**requency **Id**entification (RFID) technology uses radio signals to identify items or individuals automatically. A common method of identification using RFID is to store an identifying serial number, and possibly other limited information, on a microchip with a coiled antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). RFID permits wireless identification, tracking and control in a non-invasive, rewritable, non-line-of-sight manner. This feature provides an advantage over conventional Barcode identification techniques.

An RFID reader sends out electromagnetic waves that form a magnetic field. A passive RFID tag draws power from this magnetic field and uses it to power the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader, and the reader converts the new waves into digital data. RFID systems generally operate up to three feet at Radio Frequency or up to 20-25 feet at Ultra High Frequency. Possible issues surround eavesdropping, encryption, security, frequency and permissible error.

Current and potential uses include person identification, security, automobile safety, building security, toll collection, supply-chain management, animal identification, airline luggage tracking and inventory control.

- **Links to Representative Devices:**
  The following websites illustrate products from Texas Instruments, Precision Dynamics Corporation and ACC Systems. A range of RFID technology platforms exist and a large variety of tags and readers. The RFID systems are available also as wireless and portable systems. The ACC System website carries information related to both high and low frequency tags.
  http://www.secureorderprocess.com/ti/products.asp
  http://www.ti.com/tiris/docs/products/products.shtml
  http://www.pdcorp.com/healthcare/rfid_solutions.html
  http://www.accsystemsinc.com/minec/

- **Links to Case Studies:**
  RFID Case Study Briefs:
  http://www.rfidjournal.com/article/archive/6/
  http://update.informationweek.com/cgi-bin4/DM/y/ehkv0GMafH0G4n0CbND0Ax
  http://www.pdcorp.com/rfid/

- **Potential Applications:** *Documentation of Compliance; Distribution of Benefits*

FEATURED CASE STUDY

Buffalo's Enterprise Charter School – Access, Assets and Apples

The more than 450 staff and students in grades K-8 at the Enterprise Charter School in Buffalo, NY, are using **TI-RFid** 13.56 MHz identification cards for access control and time and attendance. The public school will use **TI**'s smart labels to identify and secure assets such as library books, laptop computers and other items. Students will also be able to make selected purchases in the cafeteria using their identification cards.

Intuitek, based in Buffalo, implemented the RFID cards and readers, and integrated the technology with the school's existing security system to create a seamless solution. Students present an RFID identification card, printed with their name and photo, to stand-up RFID-enabled kiosks at the school entrance, bringing up their photo on the touch-screen display. To check-in, the student touches her photo, and attendance information is forwarded to the school's database, while a copy is provided in real-time to teachers in their classrooms. Staff members are also using **TI** access control cards to enter the school building at additional entrances equipped with **TI-RFid** S6420 vicinity wall plate readers.

Source: http://www.ti.com/tiris/docs/solutions/security/multicard.shtml#charter

2.7 AUTOMATED TELLER MACHINES

Automated Teller Machines (ATMs) often serve as non-human interfaces between individuals and their bank accounts, providing virtually 24 hour access in many cases to account balances, fund deposits, withdrawals and transfers. ATMs are classified into three categories: Cash dispensers, Full-fledged and Advanced. Cash dispensers, as reflected by their name, dispense cash only and do not accept deposits or supply envelopes. Full-fledged machines include additional functionality accepting deposits and dispensing envelopes. Advanced machines also include powerful processors, LCD touch screens and multimedia features.

The format of ATMs ranges from portable stand-alone units weighing several hundred pounds to steel and concrete wall-mounted units weighing several thousand pounds to mobile units that have been incorporated into varying types of vehicles. Currency capacity is stated in terms of the number of currency cassettes, how high the cassettes are stacked and how many cassettes are active at a time. For example, "4 high / 2 active" indicates an ATM with 4 currency cassettes, 2 of which are active simultaneously.

ATM machines generally authenticate a user via a magnetic or Smart card with stored information including account number and PIN, however biometric access is currently being tested. Obvious physical security issues arise when considering the implementation of stand-alone and mobile ATM units, however measures such as die packs and smoke canisters have reportedly been incorporated into some models.

Diebold and NCR are currently the two primary manufacturers of ATMs worldwide, of which Diebold has manufacturing operations in the United States, Brazil, France, China and India, and support centers Worldwide.

∞ **Links to Representative Devices:**
Diebold ATM Models and Features:
http://www2.diebold.com/solutions/atms/models/default.htm
Built-in Vehicle and Trailer ATMs:
http://www.matts.com/
http://www.moneymobile.net/

Potential Applications: *Distribution of Benefits*

2.8 SOLAR POWER TECHNOLOGY

Solar power is the process in which energy from the sun is converted into electricity. It is reliable, environmentally friendly and has low operating and construction costs. In remote rural areas use of solar power is more economical than other conventional power systems. Solar power systems consist of two primary components:

Solar Panel

The process of creating electricity from sunlight using solar cells is known as photovoltaics. The output of a solar panel (a collective of solar cells) is often stated in watts. In a sunny climate, just one square meter of solar panel can generate enough power to run a 100-watt light bulb continally.

Battery

Batteries are used for continuous supply of power and are designed to be discharged and then recharged hundreds or thousands of times. These batteries are rated in amp hours (ah), typically at 20 hours and 100 hours.

The battery selected needs sufficient amp hour capacity to supply required power during the longest expected period of "no sun" or extremely cloudy conditions. The size of the battery bank required depends on the storage capacity required, the maximum charge rate, the maximum discharge rate and the minimum temperature at which the batteries will be used. During planning, all of these factors are considered and the one requiring the largest capacity will dictate the battery size.

A variety of portable solar panels and batteries are available for powering and charging PDAs / handheld computers, laptop computers, satellite and mobile phones, and GPS devices.

References: http://www.jatsgreenpower.com/solar-basics.html
http://www.solar4power.com/solar-power-basics.html

∞ **Links to Representative Devices:**
The following websites provide various types and suppliers of solar panels, solar battery packs and backup devices, and integrated portable power sources:

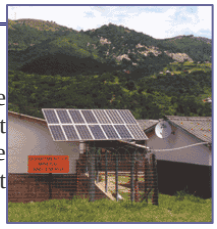
http://www.outfittersatellite.com/solar.htm
http://www.solar4power.com/solar-power-devices.html
http://www.southernce.com/cgi-bin/SoftCart.exe/solarport.htm?L+scstore+qshs1880+1086914725
http://www.productsforanywhere.com/gear/details/ic_isun.html
http://www.qvc.com/asp/frameset.asp?aol_refer=false&msn_refer=false&nest=http://www.qvc.com/scripts/detail.dll?item=E19626!tpl=DETAIL!ref=CJ4&ref=CJ4
http://www.icpsolar.com/
http://www.brunton.com/ (Choose "Portable Power" Category and "Solar Chargers" Subcategory)
http://www.cetsolar.com/solar.htm
http://www.cetsolar.com/backup.htm
http://www.cetsolar.com/marine1.htm

Links to Case Studies:
Rural Electrification in Namibia:
http://www.german-renewable-energy.com/www/main.php?tplid=15&PHPSESSID=e03e35b66bffb621e870428a5e407cbe
Rural Electrification in Zambia:
http://www.sei.se/energy/pvesco/download_reports/kalum_werc.pdf
E-Choupal Initiative Analysis with Best Practices:
http://www.cio.com/archive/101502/netgains.html

Potential Applications: *Determination of Eligibility; Documentation of Compliance; Distribution of Benefits; Verification of Effectiveness*

FEATURED CASE STUDY

Solar Schools in KwaZulu/Natal



Project Description: The Solar Electric Light Fund (SELF), a non-profit founded to promote the use of solar energy in the developing world, has wired Myeka High School in South Africa. The project demonstrates how solar electricity, when combined with wireless communications, can facilitate dramatic improvements in the overall health, education, and local economy of rural villages throughout the world.

The school has been equipped with a solar-powered satellite dish that beams in high-quality educational material from the Learning Channel, in addition to providing the students with full Internet access. Building on its success, SELF is replicating the project in two other KwaZulu-Natal schools. Enabled by solar energy, each will receive lighting, TVs and VCRs, computer labs of 25-30 workstations, Internet access, and links to high quality distance learning resources.

Organization: Solar Electric Light Fund (SELF)
Project URL: http://www.self.org/myeka.asp
Source: http://www.digitaldividend.org and Project URL

2.9 SOFTWARE DEVELOPMENT

Integration of a single or multiple technologies for any solution requires some degree of software development effort. The solution could range from a fairly simple Excel spreadsheet for entering and analyzing data to a complex central database application such as SQL Server or Oracle with software modules for desktops, servers and mobile devices. Depending upon the type of solution, the software development project could range from a couple of weeks to many months. The degree of cost involved for this software development also varies depending upon the sophistication of the system desired.

Many choices must be cleared when determining an appropriate solution, from operating system platform to database engine to front and back end software technologies to, last but not the least, the programming language. Some of these key options include but are not limited to the following examples:

Operating Systems:
1. Microsoft Windows Desktop & Server
2. UNIX or Linux
3. Palm OS
4. Microsoft Pocket PC
5. Microsoft Tablet PC
6. Symbian OS

Databases:
1. Proprietary flat files
2. Oracle
3. SQL Server
4. Informix
5. iAnywhere
6. Microsoft Access
7. My SQL

Interface:
1. Desktop
2. Internet
3. Mobile

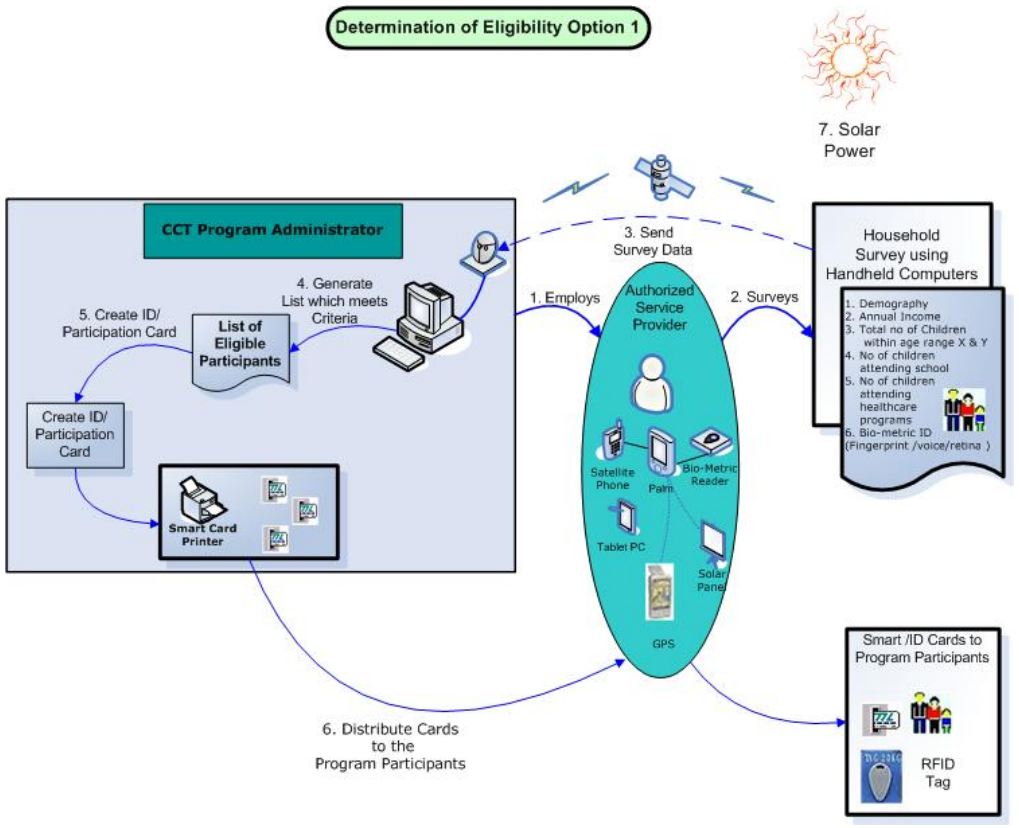
The most important phase in the software development cycle is "Requirements Analysis." Research during this phase provides strategic information about the required software complexity, the degree of necessary effort and associated cost estimations. It is highly difficult to estimate costs or efforts in general terms. Rather, when seeking an ICT solution using technologies described in this paper, we recommend consideration of diverse alternatives as described in the next section, ***Discussion of Potential Applications*** as well as the ***Assessment Factors and Inquiries*** presented in the section thereafter. After these factors and requirements are enumerated and the complexity of the solution desired is determined, qualified software development companies can provide appropriate estimations of the associated efforts and costs.

3. DISCUSSION OF POTENTIAL APPLICATIONS

Before implementing any system and particularly any technological system, it is necessary to step back, identify the scope of the problem or challenge, understand the existing processes and methods and assess whether they are functioning adequately. Only after fully identifying and understanding the scope of the problem and needs and biases of all involved actors can an adequate assessment be made, so that the system developed will be accepted and successful. Technology should not be the end but rather the means unto a better end.

In this section, we present functional overviews, pictorials, associated process steps and additional information to demonstrate the schemes in which the technologies discussed previously may be applied in the CCT program process. Although this information is described as it pertains to CCT programs, the prospect of applying the technologies and processes presented to other Safety Net programs is certainly viable. Further, the pictorials represent a fairly centralized system, but varying levels of decentralization are also possible. The applications are presented not as the absolute solution but rather as a guide, to provide readers with a framework and options to decide which components might work in their respective situations. Varying scales of specified technologies can be implemented either in part, as a complete solution or in association with existing service delivery systems. The level of technology implementation generally corresponds to the levels of program reliability, accountability and security required and expected.

3.1 DETERMINATION OF ELIGIBILITY



Pictorial Overview – Application of Technology

The key focus in ***Determination of Eligibility Option 1*** above illustrates that technology may be implemented in the form of electronic survey tools to speed the identification of those individuals who are eligible participants in a CCT program.

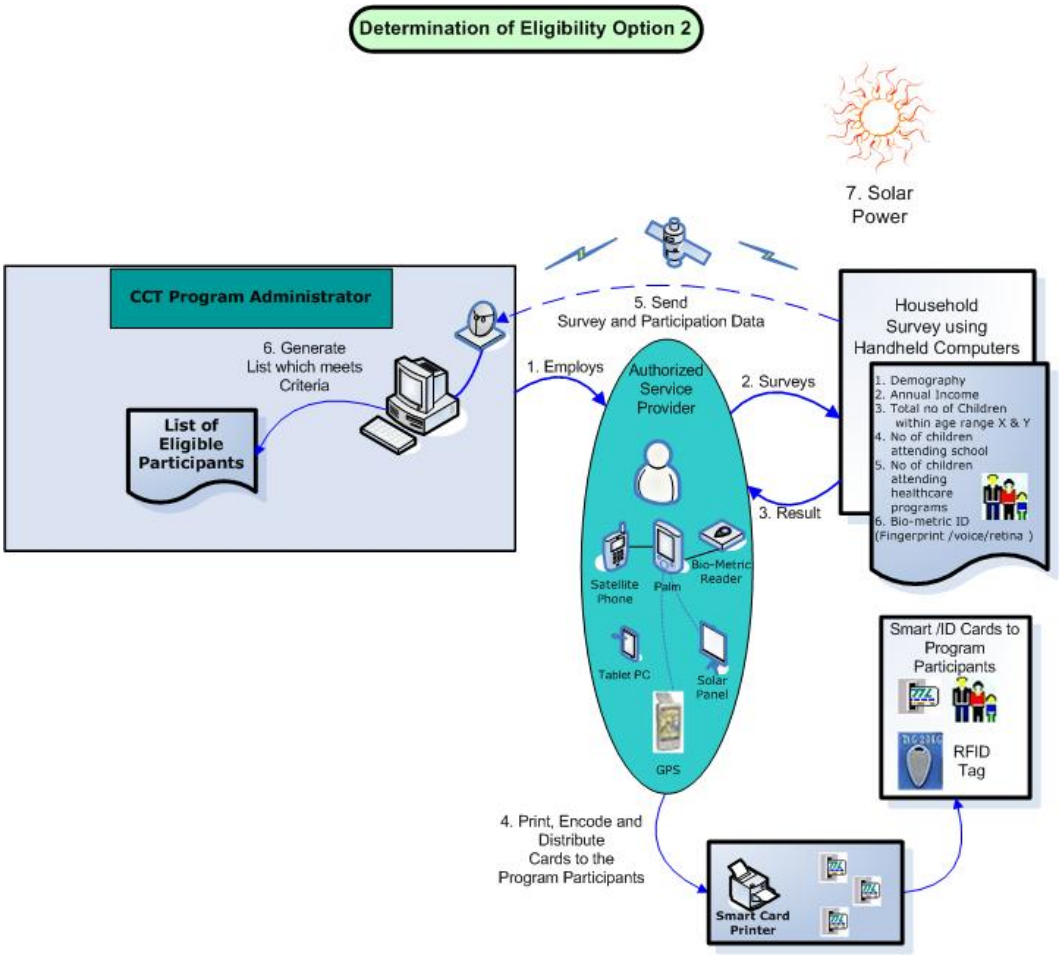
For example, with customized programming of a PDA and attached GPS device, the efficiency, speed, accuracy, reliability and security of data collection, compilation and study is greater than that of traditional paper-based survey methods. Biometrics of individuals surveyed may be collected at the time of survey for added efficiency in later identification and program compliance. Where telecommunications and power infrastructure are inadequate, Satellite connectivity may be added to speed the transfer of information to the Program Administrator for action and backup, and solar power may be employed.

Process Steps

1. Program Administrator employs and authorizes personnel / service provider to determine eligibility of 'households' / individuals for CCT program.
2. Authorized personnel / service provider surveys target 'households' / individuals using Handheld Computer and/or Smart Phone. Integrated or external GPS captures location coordinates of 'households' / individuals. Integrated or external biometric device captures and stores biometric (e.g. fingerprint) for future identification. (See **Survey Tools** below for Electronic Survey Case Study and additional Survey information).
3. Authorized personnel / service provider sends survey data / report to Program Administrator via wired or wireless communication (i.e. phone or internet), satellite communication or SD-type storage card.
4. Program Administrator generates program participant list of 'households' / individuals meeting CCT program criteria.
5. Program Administrator creates program participation ID cards (i.e. Smart Card, Simple Card, RFID) for eligible program participants with relevant participant participation (e.g. ID number, name, location).
6. Program Administrator or authorized personnel / service provider distributes participation ID cards to program participants.
7. Solar power may be used to power and/or recharge mobile devices.

Alternatives

The previous pictorial and process steps depict a rather centralized and ubiquitous application of technology. In contrast, regional, division or other local 'administrative' offices within a country may perform the role(s) of Program Administrator or Service Provider to varying degrees with a more decentralized program implementation. Further, the "household survey" process described above does not necessarily imply or require surveyors travel to each home to gain necessary information. Local offices may solicit potentially eligible households to come to them for inclusion in the program. The key point to consider is that choices are available and may vary from one situation to the next.



Pictorial Overview – Application of Technology

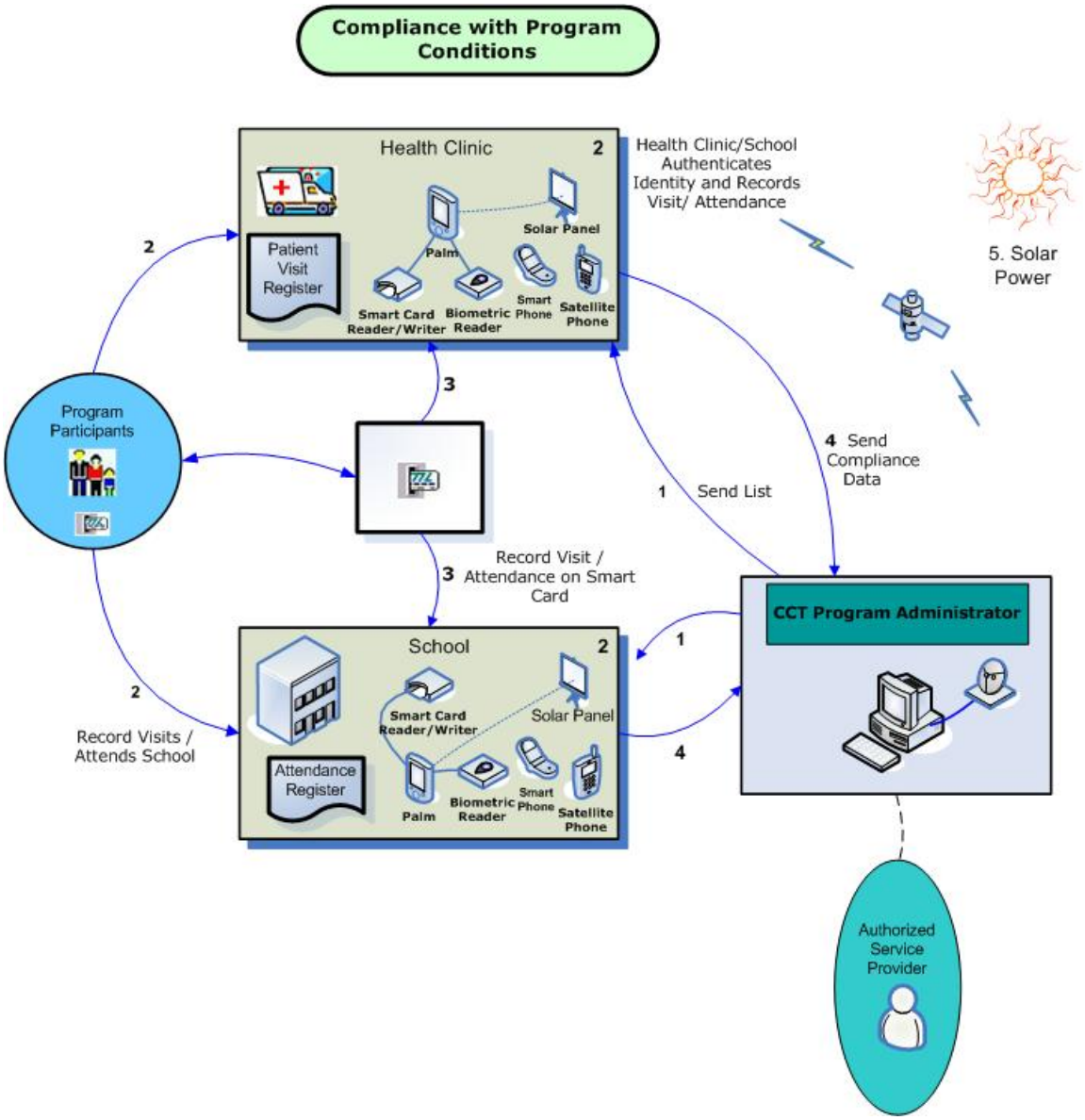
As shown in ***Determination of Eligibility Option 1,*** the key focus in ***Determination of Eligibility Option 2*** above illustrates that technology may be implemented in the form of electronic survey tools to speed the identification of those individuals who are eligible participants in a CCT program. The added feature presented in Option 2 is the possibility that surveyors might immediately receive and inform those surveyed of eligibility results and distribute some type of participant identification token at that time.

Process Steps

1. Program Administrator defines criteria for eligibility of 'households' / individuals and employs and authorizes personnel / service provider to identify 'households' / individuals meeting criteria for CCT program.
2. Authorized personnel / service provider surveys target 'households' / individuals using Handheld Computer and/or Smart Phone. Integrated or external GPS captures location coordinates of 'households' / individuals. Integrated or external Biometric device captures and stores biometric (e.g. fingerprint) for future identification. (See **Survey Tools** below for Electronic Survey Case Study and additional Survey information).

3. Based on results of Handheld Computer survey programming, authorized personnel / service provider is advised whether 'household' / individual meets criteria for eligibility.
4. Authorized personnel / service provider creates program participation ID cards (i.e. Smart Card, Simple Card, RFID) for eligible program participants.
5. Authorized personnel / service provider sends survey data / report and program participant data to Program Administrator via wired or wireless communication (i.e. phone or internet), Satellite communication or SD-type storage card.
6. Program Administrator generates and maintains list of eligible participants.
7. Solar power may be used to power and/or recharge mobile devices.

3.2 DOCUMENTATION OF COMPLIANCE WITH PROGRAM CONDITIONS



Pictorial Overview – Application of Technology

The key focus in ***Documentation of Compliance with Program Conditions*** above illustrates that technology may be implemented in varying forms and to varying degrees to determine, verify and/or document compliance with CCT program conditions on the part of the program participants.

For example, as described in the previous ***DETERMINATION OF ELIGIBILITY*** section, program participants may have received an identification token (e.g. Smart Card, Magnetic or other Simple Card or RFID device). A PDA programmed to identify and track attendance or visits might be positioned in schools and health clinics. Teachers and health clinicians would require some training on the use of these devices for inputting attendance and visit data, however deployment of the proper device and programming could make this process fairly intuitive.

Further, a Biometric device, Smart Card or RFID reader could be added to this type of system to improve reliability of participant identification and authentication and to minimize the amount of user interaction required. Plan participants might also realize some level of empowerment if Smart Cards are employed and they are aware that their compliance with program conditions is stored with them. Where telecommunications and power infrastructure are inadequate, Satellite connectivity may be added to speed the transfer of information to the Program Administrator for backup, and solar power may be employed.

More traditional non-technology procedures may also be combined with the technology options above to improve the timeliness and reliability of information. For example, teachers or health clinicians might track attendance and visits using paper and pen or pencil. This information might be combined and input into a handheld computer at a to-be-determined 'regional center' location accessible to multiple schools and clinics. The 'regional center' might then transmit the data via available communications channels to the Program Administrator for ultimate benefit payments to the plan participants. Once again, where telecommunications and power infrastructure are inadequate, Satellite connectivity may be added to speed the transfer of information to the Program Administrator, and solar power may be employed.

Process Steps

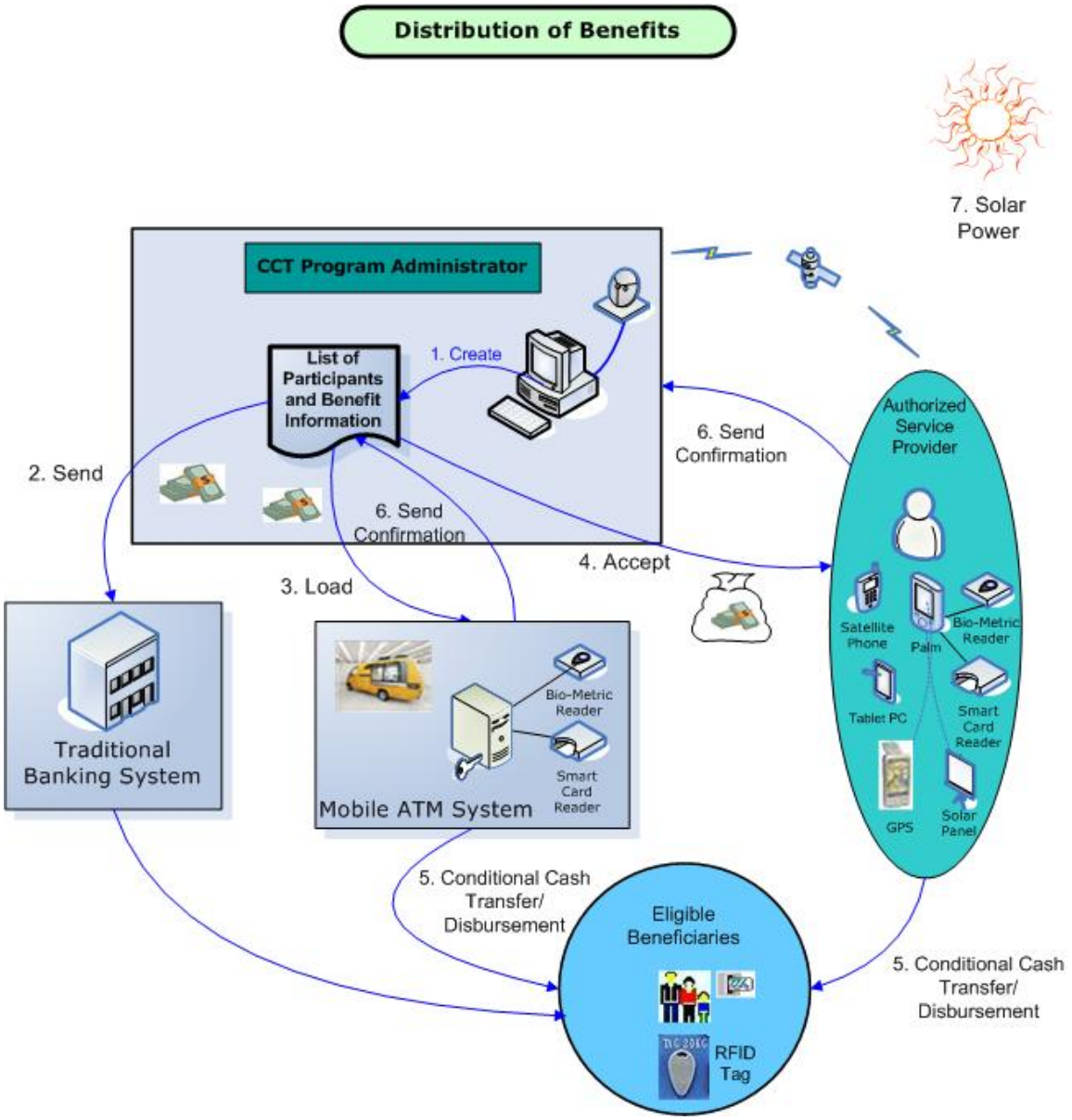
1. Program Administrator or authorized personnel / service provider provides program participant lists to Health Clinics and Schools.
2. Participant attends school or visits health clinic. Attendance / visit is recorded using mobile computer attached with Smart Card reader, RFID or biometric reader. Biometric reader may also be used to authenticate identity.
3. Attendance / visit information may be recorded on Smart Card and returned to participant.
4. Authorized personnel / service provider sends compliance data to Program Administrator via wired or wireless communication (i.e. phone or internet), Satellite communication or SD-type storage card.
5. Solar power may be used to power and/or recharge mobile devices.

Alternatives

As with Determination of Eligibility, regional, division or other local 'administrative' offices may also play a significant role in the program compliance process. As discussed

in the pictorial overview above, local offices might serve as a collection point for compliance data or the data might be transmitted directly to a centralized Program Administrator. In contrast, compliance data could be recorded only by the School / Health Clinic and on a participant Smart Card. This data might be later collected from the Smart Card and verified by the local office if and when benefit distribution is made by them, or at other varying time intervals. This method could eliminate the need for communication equipment (and related cost) between local entities and a centralized Program Administrator. Again the key point to consider is that choices are available and may vary in different situations.

3.3 DISTRIBUTION OF BENEFITS



Pictorial Overview – Application of Technology

The key focus in ***Distribution of Benefits*** above illustrates three schemes in which technology may be implemented to assist in the distribution of benefits: by a more traditional service delivery method (Step #2), more innovative systems (Step #4) or a combination of both (Step #3).

Although the use of traditional banking systems in the CCT benefit distribution process would possess its own set of conditions, requirements and challenges, for the purposes of this discussion we consider it a luxury that is generally not available. However, these systems could certainly integrate well with the technology approaches presented herein.

Mobile ATMs are one method that could be employed to distribute funds. Depending on the ATM format (e.g. built-into a trailer or van stand-alone versus a unit carried in the back of a truck), a limited amount of security might be provided. The ATM computer could be programmed to distribute funds using previously distributed Magnetic Stripe or Smart Cards with preloaded participant and benefit information from the Program Administrator. The ATM computer could conceivably be programmed to determine eligibility of the plan participant at the time a Smart Card is swiped through the terminal if compliance data has been stored onto the Smart Card. Benefit payment data could be transmitted back to the Program Administrator via direct link from the ATM computer or via satellite or wireless communication. Implementation would be contingent on a power source such as a vehicle generator and the range of possible land and participant coverage could be limited.

More likely, technology can provide efficient solutions in combination with traditional service delivery methods. Existing or authorized service providers could be provided with customized programming on a PDA device that indicates eligible participant information (e.g. ID, name, location, benefit amount). GPS might be added to assist in acquiring the participant location. An RFID scanner could provide quick and accurate identification referencing. A Biometric and appropriate biometric device might be added instead of RFID, either for fast primary identification or more accurate authentication of the participant. A Smart Card reader (particularly with Biometric) integrated with the PDA would provide superior ID, authentication, confirmation of benefit receipt and backup of information. The participant's Biometric capture (e.g. fingerprint or signature) at the time of benefit receipt could provide some level of confirmation that funds were actually received. Implementation would require training (however, programming can simplify the identification and distribution process) of the service providers and perhaps payment for services rendered.

Process Steps

1. Program Administrator creates an eligible beneficiary listing based on compliance data that has been received from the field.
2. Program Administrator transmits relevant information through traditional banking channels for acceptance by eligible beneficiaries. Although we will not discuss this method further due to higher infrastructure requirements, please refer to "Transferring Cash Benefits through the Banking System in Colombia"; Maria Teresa Lafaurie V. and Claudia A. Velasquez Leiva; World Bank Institute: *Social Safety Net Primer Series;* March 2004 for relevant information.
3. Program Administrator loads eligible beneficiary data (ID details, amount of benefit) and funds into Mobile ATM system. (Although not specifically represented in the

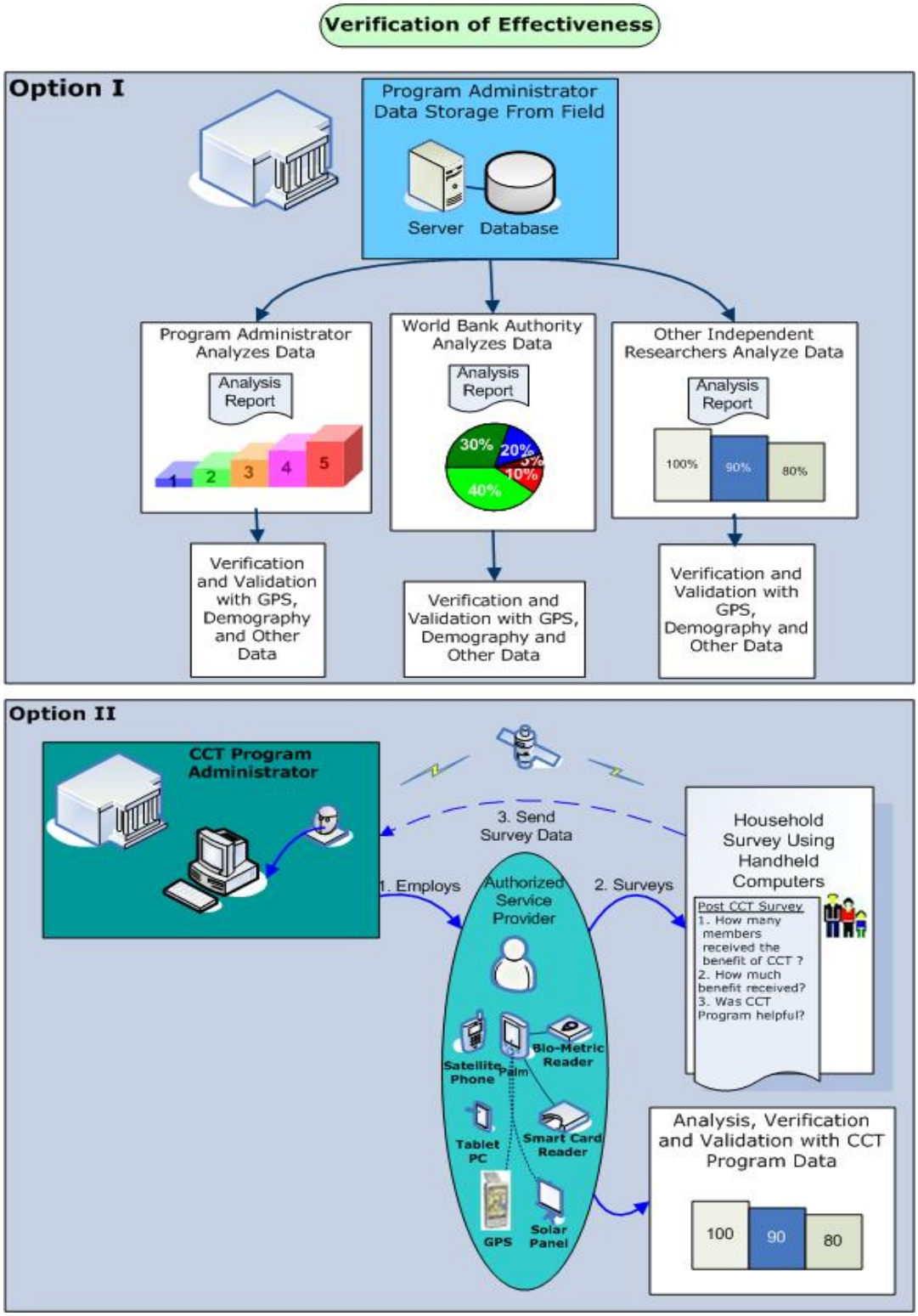
pictorial, it is conceivable that through customized ATM system programming or accompanying Handheld Computers, beneficiary eligibility could be determined in the field with a Smart Card solution).

4. Authorized personnel / service provider loads beneficiary data (location, personal details, amount of benefit) into Handheld Computer and accepts funds from Program Administrator.
5. Mobile ATM or authorized personnel / service provider travels to common access point for eligible beneficiaries to receive funds. Location may be determined by previous collected GPS coordinates. Smart / ID cards, Biometrics and / or RFID may be utilized with ATM or Handheld Computers for identification and authentication of eligible beneficiaries. If the benefit transfer takes place using traditional service delivery mechanisms, a handheld computer integrated with the above devices may be utilized to document benefit payment.
6. Mobile ATM and authorized personnel / service provider returns physically to Program Administrator and / or transmits benefit confirmation data (including date, amount, biometric, GPS) wired or wireless communication (i.e. phone or internet) or Satellite link.
7. Solar power may be used to power and/or recharge mobile devices (other than mobile ATM).

Alternatives

Regional, division or other local 'administrative' offices may also play a significant role in a more decentralized benefit distribution process. One possibility could empower the local office, after verifying participant compliance, to 'charge' a Smart Card with the benefit due that period that could then be used to obtain the benefit from an ATM. Another possibility could find the local office distributing funds based on identification of present participants and comparison to compliance data previously accumulated from schools and health clinics. Again the key point to consider is that choices are available and may vary in different situations.

3.4 VERIFICATION OF PROGRAM EFFECTIVENESS



Pictorial Overview – Application of Technology

Two alternatives are presented to assist in assessing the effectiveness of the implemented CCT program. These reviews and assessments may include independent evaluations of eligibility and identification procedures and results, timeliness of benefit payments and the amount of benefits actually reaching the beneficiaries. They can provide a level of accountability to service providers as well as measure performance.

Option I illustrates that data previously centralized by the Program Administrator from the field as part of the participant eligibility, compliance and benefit distribution processes may be analyzed. For example, if a biometric (e.g. fingerprint or signature) was collected at the time of the program eligibility survey and the time of benefit payment, a post-payment comparison might be performed by the Program Administrator to verify that the two biometrics actually exist and match. GPS coordinates captured at the time of benefit disbursement might also be compared for proximity to a known participant location. Further, compliance information may be reviewed post-payment to confirm a recipient actually complied with the program conditions.

Option II illustrates that an independent survey of program beneficiaries may be conducted, similar to the process described above under *Determination of Program Eligibility*. Program participants might provide direct feedback to independent surveyors as to the timeliness and amount of benefit payments actually received from service providers.

Each option would by its nature possess its own set of benefits, constraints and costs that would need to be considered prior to implementation. If data has been assembled and retained centrally, Option I would be much more cost effective. Note that the two options are not mutually exclusive as meters of program effectiveness.

4. ASSESSMENT FACTORS AND INQUIRIES

What should be the determining factors when deciding on the best system to use in the implementation of Safety Net programs like the CCT program? Various specific circumstances and characteristics of program components will determine the feasibility of alternative implementation systems. Implementation scenarios that contain some of the emerging mobile ICT elements illustrated in this document should offer more reliable and accurate information, enhance the timeliness of data for decision-making purposes and provide accountability to existing and new service delivery sources. However, one of the overriding issues remains the associated cost factor and, particularly with CCT program implementation, the cost-benefit comparison.

Some key information is required to design the most efficient system. These considerations include but are not limited to those matters presented below.

4.1 KEY CONSIDERATIONS

Program Characteristics

Who are the population for eligibility consideration and their location spread and density?
What are the number and spread of participants (beneficiaries)?
What will be the implementation schedule – gradual or widespread?
What are the eligibility criteria?
What is the amount and frequency of disbursements?
Are varying languages an issue?

Program Implementation

Will program administration and database(s) be centralized or regionalized?
What concentration points can be identified for administration and monitoring of the program?
Will a centralized entity or regional service centers be established to monitor eligibility, participant complaints or disputes?
What method is used to identify and determine eligibility?
How will program information be distributed to eligible program participants?
What levels of compliance documentation and recording will be required?
How often will data be transmitted? To whom?
How are benefits distributed?
What is the method of payment?
What distribution system is used or envisaged?

Infrastructure

What existing service delivery systems are in place and may be utilized to execute different facets of the program?
What is the existing communication infrastructure?
Are electricity and telephones readily available?
Can existing wireless communications systems and Internet connections be utilized?
What is the level of sophistication and coverage of available financial institutions?

Administrative Capacity - Personnel

Are personnel currently available with relevant skills to implement and manage the technologies used; or how long is required to hire and train appropriate levels?
Do schools and health clinics have the human capital resources to assist in program compliance documentation or are they currently overworked and under funded? What will be their motivation to make these programs successes?
Use of technology presumes literacy on the part of teachers and health clinicians; literacy on the part of plan participants is not as critical depending on the level of technology implemented, but they need to understand the overall purpose of the program and the associated conditions.

Implementation of Technologies

Will technology and existing manual systems be used in tandem? What level of technology will be implemented, or will it be used in conjunction with existing service delivery methods (i.e. "pencil and paper" methods)?
How will technology devices be powered?
Where will data backups be maintained, who will supervise, and what level of contingency plan will be implemented?
What levels of security are required?
Use of technology presumes literacy on the part of teachers and health clinicians; literacy on the part of plan participants is not as critical depending on the level of technology implemented, but they need to understand the overall purpose of the program and the associated conditions.
What is the planned program life for purposes of assessing useful life and cost amortization of hardware?
Will issues exist with technology acceptance by the general population; how will these issues be overcome?
One obvious downside of mobile technology is the potential risk of loss and breakage.

Financial Constraints

What amount of funding is available?
Can technology implementation and cost outlay for this program be combined with other programs such as education and health / medicine and related ICT initiatives to maximize the benefit relative to the cost?
Can major implementation steps such as identification of eligible participants and costs be shared with other important country initiatives like a National population ID (similar to the El Salvador Smart Card program)?

In some cases, predetermined notions seem to have developed that implementation of specific new technologies, particularly such as Smart Cards, will solve current Safety Net program challenges and weaknesses. In fact, Smart Cards may not be the specific solution given a particular assessment, or a combination of old methods (and delivery systems) and new technologies may be more appropriate. We have included in this Paper various emerging technologies, including Smart Cards, an Introduction to their purpose and functionality, a Discussion of Potential Applications (pertaining to SSN Programs) and Key Considerations. As we point out in Discussion of Potential Applications, the pictorials and descriptions are presented in a broad manner such that varying applications of the technologies can be envisioned where most needed.

4.2 HYPOTHETICAL SOCIAL SAFETY NET ICT COSTING

How much will it cost to incorporate mobile ICT elements in the implementation and delivery of safety net programs? The answer depends on a number of factors such as the type of country (high or low income), the size of the programs, the frequency and the value of benefit disbursement and the applications which are selected.

To provide some idea of the magnitude and range of possible costs, hypothetical estimates were calculated based on alternative scenarios for the five main program components. The scenarios presented include a low income and a higher income country setting, and a "Lower" and "Higher" estimate for each country type based on differing levels of ICT implementation. These estimates are for illustrative purposes to aid a program designer in selecting system features at varied levels of complexity and density and in estimating the costs of a range of options. We do not intend to imply that the process is as simple as plugging in a few criteria in order to determine the optimal solution; the process is not that straightforward. Nor is it assumed that every item listed will be required for every CCT program. It is probable that designers will pick and choose from among the options listed.

Only after completing a thorough needs assessment can a reliable requirements analysis and solution be formulated. As previously stated, the optimal solution to design an advanced and efficient delivery system for a CCT program may be a combination of traditional service delivery methods and new technologies. The needs assessment must take a number of factors into consideration such as environmental conditions, available infrastructure, backup & contingency, post-deployment support and cost. Pilot implementations of these technologies, the related investigation, needs and requirements analyses, deployment and results will provide valuable information in the creation of a more detailed roadmap for future Safety Net ICT implementations. While such assessments might be expensive, this must be set against the costs associated with continuing to implement safety net programs characterized by significant leakages and inefficiencies.

The two summary tables presented here are based on preliminary estimates provided in more detail in the appendix. The first set of estimates is for a hypothetical program set in a high income country and the second is for a program set in a lower income country setting. The program objective and characteristics (such as number of beneficiaries and size and frequency of benefit disbursement) are at the top of each table. The costing estimates are divided into Core Components (which are common to all programs), Determination (identification and registration of beneficiaries), Compliance, Distribution and Verification/Analysis.

The first two columns contain a high and a low estimate of the set up costs for the first year of the program (Year 1). The following two columns contain the recurring costs for years 2-5. The last four columns cover the same time periods and "Lower" and "Higher" ranges but give it on a "Per $100 of Benefits" basis. These ratios facilitate a cost/benefit comparison of the alternative instruments. The low and high range estimates are driven by the number of service points and administrative units: the greater the number of service points, the larger the number of technology devices required. Explanatory notes are included to clarify certain features, assumptions and limitations inherent in these hypothetical cost estimates. Certain costs, such as Software Development and Training, are subjective.

To illustrate how to use these tables take, for example, the low income country setting where there is a program for 5 million beneficiaries who receive 2 USD a month. Assume to

implement a system in which a centralized database is maintained at the Union level but all other activities requiring ICTs are administrated at the Upazilla level. An implementation scenario which uses a centralized database at Union level ($212,000), smart cards ($6,610,000) for Compliance purposes, and mobile computing ($562,500) and smart cards ($410,000) for Distribution at the Upazilla level, will cost a total of $7,794,500 which is equal to $7.79 per $100 of benefits. Since the recurrent cost will be $784,000 per year for the following four years, then if the program will be in place for five years the total cost will be less than $11 per $100 of benefits which is equivalent to 11 percent of the cost of the benefit.

Higher Income Country Scenario

THEORETICAL SAFETY NET ICT COSTING

Program Name	Social Risk Mitigation Project (SRMP)
Setting	Higher Income Country
Amounts shown in US$	

Program Characteristics (data rounded for presentation purposes):

Size of target population	4,200,000
Number of beneficiaries	833,000
Amount of benefit disbursement (monthly)	12
Frequency of benefit disbursement (times per year)	4
Number of service points (SYDVs) [Higher Range]	931
Number of administrative Provinces [Lower Range]	81
Number of Regions	7
Program cycle (in months)	36
Total benefit over program cycle	359,856,000
Number of benefit disbursements over program cycle	9,996,000

	Year 1 Implementation Period Cost Ranges		Years 2-3 Annual Recurring Cost Ranges		Year 1 Implementation Cost Ranges Per $100 of Benefits		Years 2-3 Annual Cost Ranges Per $100 of Benefits	
	Lower (Provinces)	Higher (SYDVs)	Lower (Provinces)	Higher (SYDVs)	Lower (Provinces)	Higher (SYDVs)	Lower (Provinces)	Higher (SYDVs)
Core Components								
Basic System	81,825	969,900	16,365	272,153	0.8186	9.7029	0.1637	2.7226
Incremental System Functionality:								
Back office & administrative systems (centralized database)	35,500	235,500	7,100	28,200	0.3551	2.3559	0.0710	0.2821
Satellite modems / phones with centralized database	124,800	1,084,600	12,480	270,380	1.2485	10.8503	0.1248	2.7049
Determination (Beneficiary Identification & Recordation)								
Basic System	160,000	605,000	32,000	76,500	1.6006	6.0524	0.3201	0.7653
Incremental System Functionality:								
GPS Devices	76,200	682,400	7,620	108,720	0.7623	6.8267	0.0762	1.0876
Compliance								
Basic System	160,000	605,000	32,000	76,500	1.6006	6.0524	0.3201	0.7653
Incremental System Functionality:								
GPS Devices	31,200	252,400	3,120	65,720	0.3121	2.5250	0.0312	0.6575
Smart Cards	1,186,300	7,407,500	118,630	2,181,250	11.8677	74.1046	1.1868	21.8212
RFID	1,008,100	5,181,100	100,810	1,513,330	10.0850	51.8317	1.0085	15.1394
Biometrics	150,500	711,000	15,050	172,300	1.5056	7.1128	0.1506	1.7237
Distribution of Funds								
Basic System	110,000	145,000	22,000	25,500	1.1004	1.4506	0.2201	0.2551
Incremental System Functionality:								
Mobile ATMs	160,000	505,000	16,000	92,500	1.6006	5.0520	0.1601	0.9254
Mobile Computers (in addition to Core Components)	216,825	1,359,900	21,683	302,970	2.1691	13.6044	0.2169	3.0309
Satellite modems / phones	94,800	879,600	9,480	249,880	0.9484	8.7995	0.0948	2.4998
GPS Devices	31,200	252,400	3,120	65,720	0.3121	2.5250	0.0312	0.6575
Smart Cards	200,500	1,111,000	20,050	212,300	2.0058	11.1144	0.2006	2.1238
Biometrics	131,200	447,400	13,120	85,220	1.3125	4.4758	0.1313	0.8525
Verification and Analysis								
Incremental System Functionality:								
Business Intelligence	135,000	280,000	13,500	28,000	1.3505	2.8011	0.1351	0.2801

Replacement Factor	20%
Maintenance Support Rate	20%
Incremental Functionality Support Rate	10%

See detailed costing breakdown and explanatory notes at Appendix III

THEORETICAL SAFETY NET ICT COSTING

Program Name	Primary Education Stipend Program
Setting	Lower Income Country
Amounts shown in US$	

Program Characteristics (data rounded for presentation purposes):

Size of target population	10,000,000
Number of beneficiaries	5,000,000
Amount of benefit disbursement (monthly)	2
Frequency of benefit disbursement (times per year)	4
Number of service points (Unions) [Higher Range]	5,000
Number of administrative units (Upazilas) [Lower Range]	500
Number of administrative Divisions	6
Program cycle (in months)	60
Total benefit over program cycle	600,000,000
Number of benefit disbursements over program cycle	100,000,000

	Year 1 Implementation Period Cost Ranges		*Years 2-5* Annual Recurring Cost Ranges		*Year 1* Implementation Cost Ranges Per $100 of Benefits		*Years 2-5* Annual Cost Ranges Per $100 of Benefits	
	Lower (Upazilas)	Higher (Unions)	Lower (Upazilas)	Higher (Unions)	Lower (Upazilas)	Higher (Unions)	Lower (Upazilas)	Higher (Unions)
Core Components								
Basic System	427,500	4,657,500	85,500	1,416,000	0.4275	4.6575	0.0855	1.4160
Incremental System Functionality:								
Back office & administrative systems (centralized database)	35,500	212,000	7,100	25,750	0.0355	0.2120	0.0071	0.0258
Satellite modems / phones with centralized database	460,000	4,655,000	46,000	1,345,500	0.4600	4.6550	0.0460	1.3455
Determination (Beneficiary Identification & Recordation)								
Basic System	160,000	545,000	32,000	70,500	0.1600	0.5450	0.0320	0.0705
Incremental System Functionality:								
GPS Devices	160,000	1,520,000	16,000	372,000	0.1600	1.5200	0.0160	0.3720
Compliance								
Basic System	160,000	545,000	32,000	70,500	0.1600	0.5450	0.0320	0.0705
Incremental System Functionality:								
GPS Devices	115,000	1,145,000	11,500	334,500	0.1150	1.1450	0.0115	0.3345
Smart Cards	6,610,000	41,695,000	661,000	12,469,500	6.6100	41.6950	0.6610	12.4695
RFID	5,510,000	29,595,000	551,000	8,839,500	5.5100	29.5950	0.5510	8.8395
Biometrics	360,000	2,945,000	36,000	844,500	0.3600	2.9450	0.0360	0.8445
Distribution of Funds								
Basic System	110,000	145,000	22,000	25,500	0.1100	0.1450	0.0220	0.0255
Incremental System Functionality:								
Mobile ATMs	155,000	465,000	15,500	82,500	0.1550	0.4650	0.0155	0.0825
Mobile Computers (in addition to Core Components)	562,500	5,012,500	56,250	1,408,750	0.5625	5.0125	0.0563	1.4088
Satellite modems / phones	430,000	4,465,000	43,000	1,326,500	0.4300	4.4650	0.0430	1.3265
GPS Devices	115,000	1,145,000	11,500	334,500	0.1150	1.1450	0.0115	0.3345
Smart Cards	410,000	3,295,000	41,000	879,500	0.4100	3.2950	0.0410	0.8795
Biometrics	215,000	1,330,000	21,500	353,000	0.2150	1.3300	0.0215	0.3530
Verification and Analysis								
Incremental System Functionality:								
Business Intelligence	135,000	270,000	13,500	27,000	0.1350	0.2700	0.0135	0.0270

Replacement Factor	20%
Maintenance Support Rate	20%
Incremental Functionality Support Rate	10%

See detailed costing breakdown and explanatory notes at Appendix III

APPENDIX

Appendix I: Matrix Summarizing Technology Categories and Suitability

Program Challenge Category ► / Technology ▼	Eligibility	Compliance	Distribution	Effectiveness
Mobile Computing	√	√	√	√
Biometrics	X	√	√	X
Satellite	√	√	√	X
GPS	√		√	√
Simple and Smart Card	X	√	√	
RFID		√	√	
ATM			√	
Solar Power	√	√	√	√

Legend:

√ Primary Application of Technology

X Not Primary Application, but Potential Implementation / Usage in this Challenge

Appendix 2: Comparative Study of Technology Devices

Categories and Sub Categories ▼ / Parameters ►		Optimal Unit Price in US$ (A)	Remarks
Handheld (or Mobile) Computing Devices	Notebook	1,500	**Advantages:** Handheld computers allow electronic capturing of field data at the point of source, easy data storage and fast transmission compared to conventional paper based methods. Can be attached with other devices like GPS, barcode readers and biometric fingerprint readers for complete solution. Programmable for customized solutions. **Disadvantages:** Depending on device implemented, may require intensive training at user level. **Constraints:** Requires power for charging, wireless / satellite network for communication. Data storage capacity varies depending on the device used.
	Tablet PC	2,000	
	PDA	200+	
	Smart Phone	500	
Biometric Devices	Stand alone	1,600-3,320 (a)	**Advantages:** Accurate authentication and authorization. **Disadvantages:** Process may be time intensive and expensive. **Constraints:** Stand-alone biometric devices require power supply, electronic data storage and processing device for matching biometric identity.
	Portable	550 (b)	
	Insertable/ Attachable	200	
Satellite	Phone	400-600 to purchase + $200 data kit; 340 for pre-owned purchase; or 39 per week rental; 1,500 for high-end phone purchase (c)	**Advantages:** Easy and fast communication from almost any place on earth; works in rural areas; allows data as well as voice transmission. **Disadvantages:** Service cost may be high depending on geographical location. **Constraint:** Coverage areas depend on provider.
	Modem	1,000 to purchase (d); or 77 per week rental	
	Service	Voice: 70 per week plus 1.40-1.50 per minute; Voice and Data: 2.95 - 8.25 per minute (e)	
GPS	Handheld	150-500 (f)	**Advantages:** Captures physical location accurately; can be used with GIS for geographical representation. **Constraints:** GPS signal may be weak indoors.
	PDA Attachment	100-300 (g)	
	Integrated with Handheld Computer	500 (h)	
Simple and Magnetic Cards	Simple ID	(i)	**Advantages:** Fast and simple authentication and authorization; potential lower implementation cost than Smart Cards. **Disadvantages:** Loss or transfer of card may lead to unauthorized use or delay of service. **Constraints:** Need card reader / writer and power supply.
	Photo ID w/ Barcode	Total System: 900-2,600 (Printer, Camera & Software) (j)	
	Barcode Scanner	75–700 (k)	
	Magnetic Stripe Printer	700-2,400 (l)	
	Magnetic Stripe Cards	$260 per 1,000 (m)	
	Magnetic Stripe Reader	100 (n)	

Categories and Sub Categories ▼ / Parameters ►		Optimal Unit Price in US$ (A)	Remarks
	PDA Magnetic Card Reader	195 (u)	
Smart Cards	IC Memory	Cards: 1-2.50 per card; Reader and Connection: 500 (o)	**Advantages:** Fast and simple authentication and authorization; data can be stored on card itself; can be used for storing biometric information. **Disadvantages:** Higher cost of implementation than simple cards. **Constraints:** Need card reader / writer and power supply.
	IC Microprocessor	Cards: 7-15 per card; Reader and Connection: 500 (p)	
	Optical Memory	Cards: 7-12 per card; Reader and Connection: 3,500-4,000 (q)	
	PDA Smart Card Reader	150 (v)	
	Smart Card Writer / Printer with Contact Station	2,400+ (y)	
RFID	Writer	500 (est.)	**Advantages:** Non-contact, non line-of-sight authentication and tracking. **Disadvantages:** Contains limited data storage. **Constraint:** Functions a limited distance from base station.
	Reader	300 (x)	
	Tags for Integration	$40 per 1,000 (x)	
	Heavy Duty Disk Transponder	$5 (w)	
ATM	Mobile	5,000-8,000 (r)	**Advantages:** Secured, authenticated and possibly unattended cash disbursement. **Disadvantages:** System can be difficult to implement. **Constraint:** Static ATM requires power as well as communication infrastructure.
	Static	10,000-20,000+	
Solar Power	Portable	145 (4.2 watts); 1,295 (48 watts) (s)	**Advantages:** Can be used in rural areas as portable power source; provides alternative economical power source in areas with no traditional power infrastructure; pollution free and requires no running cost. **Disadvantages:** Does not support very high power requirements. **Constraints:** Usually requires adequate amounts of sun.
	Static	170 – 250 (20 to 30 watts); 280–380 (50 to 100 watts) (t)	
Other Combinational	Integrated Handheld Computer/ Biometrics/ Wireless Communication Device	Not available	**Advantages:** Integrated devices provide complete solution. **Disadvantages:** Higher cost of these devices.
	Integrated Handheld Computer/ Magnetic Card Reader/Smart Card Reader and Writer/Printer/ Wireless Connectivity	Not available	

Legend:

A. Costs shown are general estimations, either through cost reference links shown below or by the author's discussions with vendors or general knowledge, based on subjective assumptions of optimal hardware types for applications mentioned in this paper. They are not intended to promote a specific vendor or brand, but rather a range of representative costs that may vary by vendor, brand, country of implementation and other factors. They do not include costs associated with customized software consulting and programming, centralized computing systems, shipping, breakage or loss. More accurate costing can be achieved with additional research based on specific scopes of implementation.

Cost References:

Biometric Devices:

(a) http://www.paypunch.com/paypunch_handreaders.asp

(b) http://shop.store.yahoo.com/quantumshoppes/lolo250spr10.html

Satellite:

(c) http://www.globalcomsatphone.com/?engine=adwords!1090&keyword=%28satellite+phone%29
http://www.outfittersatellite.com/globalstar.htm
http://www.telestial.com/products/m_9505.htm
http://www.globalstarusa.com/phones/handheld/
http://shop.infosat.com/Merchant2/merchant.mv?Screen=PROD&Product_Code=SS9505B&Category_Code=iridiumhandheld
http://www.satellitediscountstore.com/iridium.htm
http://www.satellitediscountstore.com/Thuraya.htm

(d) http://www.outfittersatellite.com/rbgan.htm

(e) Phone Service
http://www.outfittersatellite.com/adobe/rental_M4.pdf
http://www.globalstarusa.com/pricing/roam_rates.shtml
http://www.satellitediscountstore.com/Iridium%20Prepaid.pdf

Voice & Data Service
http://www.outfittersatellite.com/adobe/rental_M4.pdf

GPS:

(f) http://www.consumersearch.com/www/sports_and_leisure/handheld_gps/
http://www.garmin.com/mobile/products.html#handheld

(g) http://www.garmin.com/mobile/products.html#handheld

(h) http://www.skywalkergps.com/skywalkergps.html
http://www.handango.com/PlatformProductDetail.jsp?productType=2&optionId=1_11_2&jid=FE7ABX94DE24237282EB3CCC2F24829D&platformId=11&siteId=1&productId=116680&sectionId=0&catalog=110&txtSearch=pocket+streets
http://www.mapopolis.com/home.jsp?v=5&pg=su&s=1087676781187662&p=&q=5

Simple and Magnetic Cards:

(i) Simple ID: Costs not shown would likely include such equipment and materials as printer(s), heavy duty plastic cardsor paper and laminating machine(s), ink cartridges / ribbons, camera(s) and computer hardware.

(j) ID w/ Barcode
http://www.alphacard.com/gt.html
http://www.cardprinterwarehouse.com/items.asp?cc=systemsinglesid
http://www.cardprinterwarehouse.com/items.asp?cc=systemsinglesid
http://www.avantinc.com/photo_id/instant_id_cameras.html

(k) Barcode Scanner
http://www.idautomation.com/scanners/
http://www.hallogram.com/barcodes/scanners/

(l) Magnetic Strip Printer

http://evolution-1.com/pebbpo.htm
http://www.hackershomepage.com/section6.htm

(m) Magnetic Strip Cards
http://www.officedepot.com/ddSKU.do?level=SK&id=142830
http://www.evolution-1.com/magnetic_stripe.htm

(n) Magnetic Strip Reader
http://www.hackershomepage.com/section6.htm
http://66.40.78.100/Products/Books/Credit_Finances_Scams/
http://www.kanecal.net/mag-stripe-reader-scanner.html

(u) https://www.oc2net.net/ecshopLink/Prodselect.asp?CategoryID=184&BasketID=&MerchantID=12206

Smart Cards:
(o) http://java.sun.com/products/javacard/smartcards.html
(p) http://java.sun.com/products/javacard/smartcards.html
(q) http://java.sun.com/products/javacard/smartcards.html
(v) http://www.didya.com/PalmSmartCardreader.asp
(y) http://www.evolution-1.com/pebble.htm

RFID
(w) http://www.secureorderprocess.com/ti/products.asp?sub_id=59#Low%20Frequency%20Transponders

(x) Pervasive Computing, April-June 2004; *RFID Monitors Help Trim Health Costs*

ATM (excludes cost to transport unit to users):
(r) http://www.atmmachine.com/atm-pricing.html

Solar Power:
(s)http://www.satelliteoutfitters.com/solar.htm

(t)http://shop.altenergystore.com/items.asp?CartId=9432548BNFBZ4-EVEREST-28&CC=SOLPAN&tpc=

Appendix 3: Detailed ICT Costing and Explanatory Notes

Lower Income Country Setting

THEORETICAL SAFETY NET ICT COSTING
Program Name: Primary Education Stipend Program
Setting: Lower Income Country
Amounts shown in US$

Program Characteristics (data rounded for presentation purposes):

Size of target population	10,000,000
Number of beneficiaries	5,000,000
Amount of disbursement (monthly)	2
Frequency of disbursement (times per year)	4
Number of service points (Unions)	5,000
Number of administrative units (Upazilas)	500
Number of administrative Divisions	6
Program cycle (in months)	60
Total benefit over program cycle	600,000,000
Number of disbursements over program cycle	100,000,000

	Year 1						*Years 2-5*	
				(Incremental Deployment)			Annual	Incremental
		Unit			Unit		Recurring	Recurring
	No.	Amount	Total	No.	Amount	Total	Amount	Amount
Core Components								
Hardware:								
Field and Mobile Data Systems:								
Mobile computers	500	300	150,000	5,000	300	1,500,000	30,000	300,000
SD cards	500	25	12,500	5,000	25	125,000	2,500	25,000
Solar rechargers & batteries	500	500	250,000	5,000	500	2,500,000	50,000	500,000
Technical support & training	1	15,000	15,000	7	15,000	105,000	85,500	423,000
			427,500			4,230,000	168,000	1,248,000
Incremental System Functionality:								
Back office & administrative systems:								
Servers	2	10,000	20,000	8	10,000	80,000		
Desktop computers	2	1,500	3,000	8	1,500	12,000		
Printers	2	500	1,000	8	500	4,000	200	800
Backup systems	1	1,500	1,500	7	1,500	10,500		
Technical support & training	1	10,000	10,000	7	10,000	70,000	7,100	17,650
			35,500			176,500	7,300	18,450
Satellite modems / phones:								
Hardware	500	800	400,000	5,000	800	4,000,000	80,000	800,000
Software development	1	25,000	25,000					
Technical support & training	1	5,000	5,000	7	5,000	35,000	43,000	403,500
Back office web modem/switch:								
Hardware	2	5,000	10,000	8	5,000	40,000		
Software development	1	10,000	10,000	1	50,000	50,000		
Technical support & training	1	10,000	10,000	7	10,000	70,000	3,000	16,000
			460,000			4,195,000	126,000	1,219,500

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THEORETICAL SAFETY NET ICT COSTING

Program Name: Primary Education Stipend Program
Setting: Lower Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-5	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Determination (Beneficiary Identification & Recordation)								
Hardware: (Included in Core Components)								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	6	60,000	360,000	32,000	38,500
			160,000			385,000	32,000	38,500
Incremental System Functionality:								
GPS Devices:								
Hardware	500	200	100,000	5,000	200	1,000,000	20,000	200,000
Software development	1	10,000	10,000					
Technical support & training	1	50,000	50,000	6	60,000	360,000	16,000	136,000
			160,000			1,360,000	36,000	336,000

THEORETICAL SAFETY NET ICT COSTING

Program Name: Primary Education Stipend Program
Setting: Lower Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-5	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Compliance								
Hardware: (Included in Core Components)								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	6	60,000	360,000	32,000	38,500
			160,000			385,000	32,000	38,500
Incremental System Functionality:								
GPS Devices:								
Hardware	500	200	100,000	5,000	200	1,000,000	20,000	200,000
Software development	1	10,000	10,000					
Technical support & training	1	5,000	5,000	6	5,000	30,000	11,500	103,000
			115,000			1,030,000	31,500	303,000
Smart Cards:								
Hardware-Readers	500	500	250,000	5,000	500	2,500,000	50,000	500,000
Writer/Printer with Contact Station	500	2,500	1,250,000	5,000	2,500	12,500,000	250,000	2,500,000
Software development	1	100,000	100,000	1	25,000	25,000		
Cards	5,000,000	1	5,000,000	5,000,000	4	20,000,000	1,000,000	4,000,000
Technical support & training	1	10,000	10,000	6	10,000	60,000	661,000	3,508,500
			6,610,000			35,085,000	1,961,000	10,508,500
RFID:								
Hardware-Readers	500	300	150,000	5,000	300	1,500,000	30,000	300,000
Writers	500	500	250,000	5,000	500	2,500,000	50,000	500,000
Software development	1	100,000	100,000	1	25,000	25,000		
Tags/Transponders	5,000,000	1	5,000,000	5,000,000	4	20,000,000	1,000,000	4,000,000
Technical support & training	1	10,000	10,000	6	10,000	60,000	551,000	2,408,500
			5,510,000			24,085,000	1,631,000	7,208,500
Biometrics:								
Hardware	500	500	250,000	5,000	500	2,500,000	50,000	500,000
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	10,000	10,000	6	10,000	60,000	36,000	258,500
			360,000			2,585,000	86,000	758,500

THEORETICAL SAFETY NET ICT COSTING

Program Name: Primary Education Stipend Program
Setting: Lower Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-5	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Distribution of Funds								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	10,000	10,000	1	10,000	10,000	22,000	3,500
			110,000			35,000	22,000	3,500
Incremental System Functionality:								
Mobile ATMs:								
Hardware	6	5,000	30,000	30	5,000	150,000	6,000	30,000
Software development	1	100,000	100,000	1	100,000	100,000		
Technical support & training	1	25,000	25,000	6	10,000	60,000	15,500	31,000
			155,000			310,000	21,500	61,000
Mobile Computers:								
Hardware (in addition to Core Components)	500	825	412,500	5,000	825	4,125,000	82,500	825,000
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	50,000	50,000	6	50,000	300,000	56,250	445,000
			562,500			4,450,000	138,750	1,270,000
Satellite modems / phones:								
Hardware	500	800	400,000	5,000	800	4,000,000	80,000	800,000
Software development	1	25,000	25,000					
Technical support & training	1	5,000	5,000	7	5,000	35,000	43,000	403,500
			430,000			4,035,000	123,000	1,203,500
GPS Devices:								
Hardware	500	200	100,000	5,000	200	1,000,000	20,000	200,000
Software development	1	10,000	10,000					
Technical support & training	1	5,000	5,000	6	5,000	30,000	11,500	103,000
			115,000			1,030,000	31,500	303,000
Smart Cards:								
Hardware-Readers	500	500	250,000	5,000	500	2,500,000	50,000	500,000
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	6	60,000	360,000	41,000	288,500
			410,000			2,885,000	91,000	788,500
Biometrics:								
Hardware	500	200	100,000	5,000	200	1,000,000	20,000	200,000
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	15,000	15,000	6	15,000	90,000	21,500	111,500
			215,000			1,115,000	41,500	311,500

THEORETICAL SAFETY NET ICT COSTING

Program Name: Primary Education Stipend Program
Setting: Lower Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-5	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Verification and Analysis								
Incremental System Functionality:								
Business Intelligence:								
Hardware: (Included in Core Components/Back Office & Admin)								
Software development	1	75,000	75,000	1	25,000	25,000		
3rd Party Licenses	1	50,000	50,000	1	50,000	50,000		
Technical support & training	1	10,000	10,000	6	10,000	60,000	13,500	13,500
			135,000			135,000	13,500	13,500

Replacement Factor	20%
Maintenance Support Rate	20%
Incremental Functionality Support Rate	10%

THEORETICAL SAFETY NET ICT COSTING

Program Name: Social Risk Mitigation Project (SRMP)
Setting: Higher Income Country
Amounts shown in US$

Program Characteristics (data rounded for presentation purposes):

Size of target population	4,200,000
Number of beneficiaries	833,300
Amount of disbursement (monthly)	12
Frequency of disbursement (times per year)	4
Number of service points (SYDVs)	931
Number of administrative Provinces	81
Number of Regions	7
Program cycle (in months)	36
Total benefit over program cycle	359,985,600
Number of disbursements over program cycle	9,999,600

	Year 1			(Incremental Deployment)			*Years 2-3*	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Core Components								
Hardware:								
Field and Mobile Data Systems:								
Mobile computers	81	300	24,300	931	300	279,300	4,860	55,860
SD cards	81	25	2,025	931	25	23,275	405	4,655
Solar rechargers & batteries	81	500	40,500	931	500	465,500	8,100	93,100
Technical support & training	1	15,000	15,000	8	15,000	120,000	16,365	88,808
			81,825			888,075	29,730	242,423
Incremental System Functionality:								
Back office & administrative systems:								
Servers	2	10,000	20,000	9	10,000	90,000		
Desktop computers	2	1,500	3,000	9	1,500	13,500		
Printers	2	500	1,000	9	500	4,500	200	900
Backup systems	1	1,500	1,500	8	1,500	12,000		
Technical support & training	1	10,000	10,000	8	10,000	80,000	7,100	20,000
			35,500			200,000	7,300	20,900
Satellite modems / phones:								
Hardware	81	800	64,800	931	800	744,800	12,960	148,960
Software development	1	25,000	25,000					
Technical support & training	1	5,000	5,000	8	5,000	40,000	9,480	78,480
Back office web modem/switch:								
Hardware	2	5,000	10,000	9	5,000	45,000		
Software development	1	10,000	10,000	1	50,000	50,000		
Technical support & training	1	10,000	10,000	8	10,000	80,000	3,000	17,500
			124,800			959,800	25,440	244,940

THEORETICAL SAFETY NET ICT COSTING

Program Name: Social Risk Mitigation Project (SRMP)
Setting: Higher Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-3	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Determination (Beneficiary Identification & Recordation)								
Hardware: (Included in Core Components)								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	7	60,000	420,000	32,000	44,500
			160,000			445,000	32,000	44,500
Incremental System Functionality:								
GPS Devices:								
Hardware	81	200	16,200	931	200	186,200	3,240	37,240
Software development	1	10,000	10,000					
Technical support & training	1	50,000	50,000	7	60,000	420,000	7,620	60,620
			76,200			606,200	10,860	97,860

THEORETICAL SAFETY NET ICT COSTING

Program Name: Social Risk Mitigation Project (SRMP)
Setting: Higher Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-3	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Compliance								
Hardware: (Included in Core Components)								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	7	60,000	420,000	32,000	44,500
			160,000			445,000	32,000	44,500
Incremental System Functionality:								
GPS Devices:								
Hardware	81	200	16,200	931	200	186,200	3,240	37,240
Software development	1	10,000	10,000					
Technical support & training	1	5,000	5,000	7	5,000	35,000	3,120	22,120
			31,200			221,200	6,360	59,360
Smart Cards:								
Hardware-Readers	81	500	40,500	931	500	465,500	8,100	93,100
Writer/Printer with Contact Station	81	2,500	202,500	931	2,500	2,327,500	40,500	465,500
Software development	1	100,000	100,000	1	25,000	25,000		
Cards	833,300	1	833,300	833,300	4	3,333,200	166,660	666,640
Technical support & training	1	10,000	10,000	7	10,000	70,000	118,630	622,120
			1,186,300			6,221,200	333,890	1,847,360
RFID:								
Hardware-Readers	81	300	24,300	931	300	279,300	4,860	55,860
Writers	81	500	40,500	931	500	465,500	8,100	93,100
Software development	1	100,000	100,000	1	25,000	25,000		
Tags/Transponders	833,300	1	833,300	833,300	4	3,333,200	166,660	666,640
Technical support & training	1	10,000	10,000	7	10,000	70,000	100,810	417,300
			1,008,100			4,173,000	280,430	1,232,900
Biometrics:								
Hardware	81	500	40,500	931	500	465,500	8,100	93,100
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	10,000	10,000	7	10,000	70,000	15,050	56,050
			150,500			560,500	23,150	149,150

THEORETICAL SAFETY NET ICT COSTING

Program Name: Social Risk Mitigation Project (SRMP)
Setting: Higher Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-3	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Distribution of Funds								
Software:								
Development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	10,000	10,000	1	10,000	10,000	22,000	3,500
			110,000			35,000	22,000	3,500
Incremental System Functionality:								
Mobile ATMs:								
Hardware	7	5,000	35,000	35	5,000	175,000	7,000	35,000
Software development	1	100,000	100,000	1	100,000	100,000		
Technical support & training	1	25,000	25,000	7	10,000	70,000	16,000	34,500
			160,000			345,000	23,000	69,500
Mobile Computers:								
Hardware (in addition to Core Components)	81	825	66,825	931	825	768,075	13,365	153,615
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	50,000	50,000	7	50,000	350,000	21,683	114,308
			216,825			1,143,075	35,048	267,923
Satellite modems / phones:								
Hardware	81	800	64,800	931	800	744,800	12,960	148,960
Software development	1	25,000	25,000					
Technical support & training	1	5,000	5,000	8	5,000	40,000	9,480	78,480
			94,800			784,800	22,440	227,440
GPS Devices:								
Hardware	81	200	16,200	931	200	186,200	3,240	37,240
Software development	1	10,000	10,000					
Technical support & training	1	5,000	5,000	7	5,000	35,000	3,120	22,120
			31,200			221,200	6,360	59,360
Smart Cards:								
Hardware-Readers	81	500	40,500	931	500	465,500	8,100	93,100
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	60,000	60,000	7	60,000	420,000	20,050	91,050
			200,500			910,500	28,150	184,150
Biometrics:								
Hardware	81	200	16,200	931	200	186,200	3,240	37,240
Software development	1	100,000	100,000	1	25,000	25,000		
Technical support & training	1	15,000	15,000	7	15,000	105,000	13,120	31,620
			131,200			316,200	16,360	68,860

THEORETICAL SAFETY NET ICT COSTING

Program Name: Social Risk Mitigation Project (SRMP)
Setting: Higher Income Country
Amounts shown in US$

	Year 1			(Incremental Deployment)			Years 2-3	
	No.	Unit Amount	Total	No.	Unit Amount	Total	Annual Recurring Amount	Incremental Recurring Amount
Verification and Analysis								
Incremental System Functionality:								
Business Intelligence:								
Hardware: (Included in Core Components/Back Office & Admin)								
Software development	1	75,000	75,000	1	25,000	25,000		
3rd Party Licenses	1	50,000	50,000	1	50,000	50,000		
Technical support & training	1	10,000	10,000	7	10,000	70,000	13,500	14,500
			135,000			145,000	13,500	14,500

Replacement Factor	20%
Maintenance Support Rate	20%
Incremental Functionality Support Rate	10%

Explanatory Notes

- "Year 1" designation represents year of full implementation; "Years 2-5" represent estimated recurring costs after year of full implementation. Actual implementation would likely occur in a graduated manner.
- Incremental Deployment deploys ICT beyond broader administrative units to local service point; servers are deployed to each of the broader Administrative Divisions. An assumption is made that Administrative Division / Region deployment location has reliable power source; if not, supplemental power requirements may be required.
- "Core Components" Basic System reflects minimum hardware and support requirements for scenario encompassing all objectives (i.e. one unit count per Administrative Unit).
- "Core Components / Technical support & training" includes costs for hardware integration and hardware/OS software basic training.
- "Core Components" Incremental System Functionality reflects hardware and software interface for basic communications between Field & Mobile Data Systems and Back Office Server(s)
- "Core Components" solar and communications components - although power and communications infrastructure may exist, solar components are indicated as Core while Satellite communications components are indicated as Incremental System Functionality (for backup system at a minimum).
- "Compliance" Basic System represents minimum software and support requirement utilizing core components.
- "Distribution of Funds" Basic System costing scenario includes continuation of banking system usage for funds distribution.
- "Verification and Analysis" includes Business Intelligence and database analytics tools.
- Communication usage fees are excluded.
- Smart Card "Cards" incremental deployment reflects more technologically sophisticated smart cards.
- Potential software license fees are unknown for "Distribution of Funds"; software development includes interface between country banking system (i.e. banks) and CCT central system database.
- Important to note that some hardware costs may overlap functions.
- Recurring technical support & training costs may potentially be reduced by internal assumption of responsibilities and/or implementation of long-term service contracts.
- Contingency factor has not been included in these hypothetical costing examples.
- Replacement Factor is assumed for sample costing purposes to be 100%; actual replacement experience will likely vary.
- Replacement Factor is not applied to Back office hardware as it is considered to be longer lasting than field hardware.
- Low range recurring costs include technical support only as level of hardware replacement is considered uncertain.
- Incremental Deployment and Incremental System Functionality Technical Support utilize Incremental Functionality Support Rate.
- Equipment shipping costs, sales, duty and use taxes, and certain setup costs are excluded.

Sample Costing Example

PRELIMINARY ICT COSTING ESTIMATES FOR COUNTRY CENSUS

Amounts shown in US$

Assumptions (blue numeric indicates input required):

a	Number of Communities	300
b	Number of Households per Community	150
c	Number of Census Questionnaires (a x b)	45,000
d	Estimated Duration of Census in Years	0.50
e	Work Days per Week	5
f	Work Weeks per Year	50
g	Estimated Duration of Census in Work Days (d x e x f)	125
h	Number of Census Questionnaires per Day (c / g)	360
i	Number of Enumerators per Supervisor	8
j	Number of Census Questionnaires per Enumerator per Day	12
	Palm Reserve Factor	25%
	Contingency Factor	15%

Estimated Costs:		No.	Unit Amount	Total Amount
	Headcount:			
k	Enumerators (h / j)	30		
	Supervisors (k / i)	4		
	Technical Lead(s)	1		
	Project Director	1		
	Hardware and Software:			57,975
	Desktop / Laptop Computers (Project Director & Technical Lead)	2	2,000	4,000
	Palm Devices (Enumerators& Supervisors)	34	300	10,200
	SD Cards to Back Up Palm Units	34	25	850
	Palm Reserves	9	325	2,925
	Laptop Computers (Supervisors)	4	2,000	8,000
	Server Hardware and Licenses	1	7,000	7,000
	Software Development / Licenses	1	25,000	25,000
	Other:			
	Technical Support & Training (No. = months)	6	10,000	60,000
	Miscellaneous and Contingency	15%	117,975	17,696
	TOTALS			135,671

Other Factors:

Reduced overall census cost.

Automated skip and branching logic; snapshot feature shows completion status of individual questions.

Dramatic improvement in timeliness of survey data for analysis and action; near real-time.

Enhanced survey validity with GPS integration.

Superior data reliability; decreased errors due to efficient, customized data entry reponses and elimination of post-survey transcription.

Flexible and efficient questionnaire updates.

Appendix 4: References

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We have referred to various manufacturers and vendors throughout this paper to illustrate a range of technologies. Our intention is not to necessarily advocate any specific brand, manufacturer or vendor. All Trademarks, etc. are held by their respective owners.

APPENDIX 5: Glossary

[1] **Hyperlink:** An element such as text or a picture in an electronic document that links to another place in the same document or to an Internet web page.

[2] **PDA:** Is a small hand-held device that provides computing and data storage abilities. Usually the user interacts with the PDA by writing or tapping the screen with a stylus. The term handheld is a synonym. Examples of PDAs include the Palm Pilot and the Pocket PC.

[3] **Operating System:** The core program that runs on a computer. This provides the foundation for all other programs and activities on the computer. E.g. Windows XP, Palm OS etc.

[4] **Tablet Computer:** These are usually portable wireless computers slightly bigger than PDAs. These also use a touch-sensitive screen for data input and manipulation.

[5] **Smart Phone:** Combination of a mobile phone and a PDA, smart phones allow users to converse as well as perform tasks, such as accessing the Internet wirelessly and storing contacts in databases. Smart phones have a PDA-like screen.

[6] **Processor:** See Micro-processor (20).

[7] **MHz:** Megahertz, is a unit typically used to measure the processor speed of computers. The higher the megahertz rating, the faster a computer will perform. It is used to compare performance of processors.

[8] **MB:** 1 Megabyte = 1024 kilobytes (KB) is a unit of computer memory, data storage capacity, or data. This unit is typically used to measure random access memory (RAM) and hard drive space in computers.

[9] **Memory Cards:** A card that can be added to a PDA or other electronic devices like digital cameras to store data.

[10] **KB:** Kilobyte. A unit of computer memory, data storage capacity, or data, smaller than a MB. This unit is typically used to measure the size of computer files (i.e. files created in Word, WordPerfect, Adobe Acrobat, and other computer applications).

[11] **Bluetooth:** System for short-range wireless communications among computers, printers, telephones and PDAs using the 2.4 GHz frequency.

[12] **Expansion Slots**: Allows additional memory cards and similar devices to be added to a computer to increase the capability of the computer.

[13] **Memory Chip:** A semiconductor device that is attached to a memory board and stores information in the computer; RAM chips can be for temporary (working) storage needs, and ROM chips are for permanent data storage.

[14] **Secure Digital Card:** Is a memory device about the size of postage stamp and can be attached to PDAs to store additional data and increase storage capacity of the PDAs.

[15] **Compact Flash Card:** A memory card similar to SD cards to store data.

[16] **MMC Card:** A memory card similar to SD cards to store multimedia data like music, video etc.

[17] **Form Factor:** The size, configuration, and other physical specifications used to describe hardware. Examples of memory form factors are: SIMM, DIMM, RIMM, 30-pin, 72-pin, and 168-pin.

[18] **DNA:** Deoxyribonucleic Acid: DNA molecules carry the genetic information necessary for the organization and functioning of most living cells and control the inheritance of characteristics.

[19] **PIN:** Personal Identification Number.

[20] **Microwave**: Electromagnetic radiation that is used to provide remote communication links.

[21] **Geosynchronous:** Term applied to any equatorial satellite with an orbital velocity equal to the rotational velocity of the Earth. The net effect is that the satellite appears to be virtually motionless with respect to an observer on the ground.

[22] **Microprocessor:** A circuit of transistors and other electrical components on a chip that can process programs, remember information, or perform calculations.

[23] **UPC:** Universal Product Code; the bar code symbol that is the standard in the retail marketplace. It uniquely identifies a product and the manufacturer.

[24] **Integrated Circuits:** An electronic circuit consisting of many individual circuit elements, such as transistors, diodes, resistors and capacitors etched on a single chip of semi-conducting material.