REPORT ON THE FEASIBILITY OF USING MOBILE TECHNOLOGY

TO STRENGTHEN DATA COLLECTION AND MANAGEMENT IN ZAMBIA AT THE SCHOOL AND DISTRICT LEVELS

Strengthening Educational Performance-Up (STEP-Up) Zambia Project
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CONTENTS

ACRONYMS

2G	2nd Generation Mobile Data Service
3G	3rd Generation Mobile Data Service
4G	4th Generation Mobile Data Service
ADSL	Asymmetric Digital Subscriber Line
ESB	Education Statistical Bulletin
GMS	Global System for Mobile Communications (Originally Groupe Spécial Mobile)
ICT	Information and Communications Technology
ISP	Internet Service Provider
KB	Kilobyte: 1,000 bytes
LLPT	Local Learner Performance Tracker
MB	Megabyte: 1,000,000 bytes
MOGE	Ministry of General Education
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
SIM	Subscriber Identity Module
SMS	Short Message Service (also known as text messages)
USAID	United States Agency for International Development
USD	U.S. Dollar
USSD	Unstructured Supplementary Service Data
WiMax	Worldwide Interoperability for Microwave Access
ZICTA	Zambia Information and Communications Technology Authority
ZMW	Zambian Kwacha

EXECUTIVE SUMMARY

Zambia faces a number of challenges when it comes to deploying solutions based on mobile technologies. These challenges stem from the lack of basic infrastructure due to low population density and limited access to reliable electricity. Less than 25 percent of Zambian schools have access to electricity and fewer still have computers. According to the Zambia Information and Communications Technology Authority (ZICTA), as of May 6, 2016, 74 percent of the population is covered by cellular networks.[1] Of those covered, only those who live in the largest urban centers have access to any form of high speed data (3G or above).

Zambia has made significant progress in connecting to high speed networks, and it now has fiber optic connections to South Africa, Tanzania, and Namibia. This has brought increased speeds and lower prices to urban areas but leaves rural areas mostly unchanged. Rural areas are largely dependent on cellular networks for connectivity but this connectivity comes with a high price tag due to the costs of constructing and maintaining rural cell towers (which must be powered by solar and/or diesel) given the low population density. This means that further improvements to rural connectivity are largely in the hands of ZICTA with its universal access charter[2]. Unfortunately, it is no longer economically viable to build out the connectivity to the remaining uncovered areas, so without significant investment from the government, the connectivity situation for rural Zambia will most likely remain unchanged.

Despite the challenges, mobile technology can still be used to both gather information from schools and to provide information to local and district level decision makers. For any project requiring broad reach across the country, the best option is to use the phones that administrators carry with them every day, which are generally basic cell phones that, in addition to voice, can also use Short Message Service (SMS) and Unstructured Supplementary Service Data (USSD) to communicate information. Such phones are a proven solution that can even be used in areas without coverage as the administrators regularly travel to larger urban areas with coverage to collect their monthly salaries. Such a situation does limit the frequency and immediacy of information transfer but it is quite adequate for the needs of the STEP-UP project.

While it is unclear exactly how soon the situation will change for rural areas, Zambia like its neighbors continues to urbanize. Therefore, a large and growing percentage of the population will have access to intermittent electricity and high speed data networks, which in conjunction with decreasing smart device costs means a growing number of smartphones will be in the hands of decision makers. While solutions involving the basic

[1] "Over 6 million Zambians accessing the internet – ZICTA," *Lusaka Times*, May 6, 2016. Available at https://www.lusakatimes.com/2016/05/06/6-million-zambia-accessing-internet-zicta/.
[2] Part VIII *Universal Access and Service.* Pg 49. Available at http://www.zicta.zm/Downloads/The%20Acts%20and%20SIs/ict_act_2009.pdf

phone can provide broad reach, the growth of smart devices is key to more effective data use.

To create the recommendations summarized below, this study used three working methods:

- desk research into statistics, reports, and policy development resources,
- interviews with approximately 15 stakeholders involved in mobile projects in Zambia (see Annex A), and
- direct experience gained in spending time in rural Zambia and visiting rural and urban schools.

The recommendations are intended to guide the project in both the use of basic phones and preparation for the growth of smartphones. Equally important are recommendations to (1) increase the capacity of the government and local ICT sector and (2) lay the foundation for government data collection/dissemination using zero-rating to increase information access and better control costs.

It is also important to note the strong role that paper plays in the Zambian work culture and to understand that any technology solution needs to be tested to ensure that information is communicated effectively to the decision makers.

Here is a summary of the recommendations:

- Data Collection Recommendations

    — For discreet and quick data collection, use SMS and USSD technologies for reaching the broadest number of schools.
    — Pilot an Android-based application for the Local Learner Performance Tracker (LLPT), which enables both online and offline access.
    — Integrate automated SMS reminders/alerts into existing data collection tools (the LLPT and Education Statistical Bulletin).
    — Work with mobile operators to ensure all services are offered at no cost to schools/teachers but that fees are billed by the system on the backend (which would ultimately be the paid by the Ministry of General Education or MOGE).

- Data Dissemination Recommendations

    — Survey district office infrastructure to obtain a full understanding of their capabilities (reliable electricity, reliable cellular service, reliable internet, computer and printer hardware, etc.).
    — Pilot SMS reporting to decision makers to better understand how best to communicate actionable reports to school administration.

- As part of the LLPT Android pilot, provide offline access to relevant reports within the application.
- Avoid providing air time for data access beyond pilot stage for any project as it is difficult to monitor and control and can be easily abused (explore zero-rating for data collection/dissemination below).

- Capacity Building/Sustainability Recommendations

  - Create a mobile technology working group within government ministries with goal of sharing best practices and standardizing mobile technology across the government.
  - Work with Zambian ICT community to build the technical capacity to bring mobile services (hosting, SMS/USSD gateways, etc.) inside Zambia as little capacity exists today and building the capacity within the government will be problematic due to the nature of compensation.
  - Work with key stakeholders (mobile operators and ZICTA) to get zero-rating in place for data collection/reporting site.

SECTION 1
OVERVIEW

DEMOGRAPHIC OVERVIEW

Zambia is a large, landlocked country in southern Africa. According to the World Bank, as of 2014, Zambia had a population of 15.72 million and a population density of 21 persons per square kilometer compared to 35 persons per square kilometer in the United States or 45 persons per square kilometer in South Africa. While Zambia's population is urbanizing as is much of the rest of sub- Saharan Africa, Zambia continues to have a significant portion of its population living in sparsely populated rural areas, which makes implementing mobile technologies challenging.

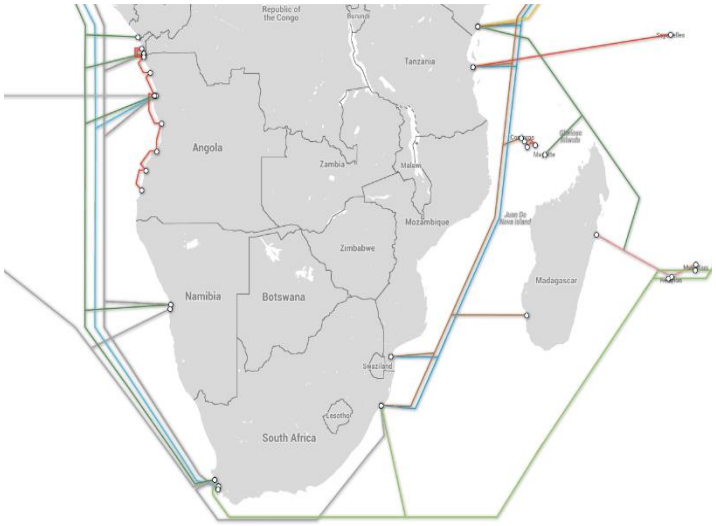
COMMUNICATIONS OVERVIEW

In comparison to other southern African countries, Zambia has a fairly competitive communications industry with three mobile operators (Airtel, MTN, and Zamtel) and several other providers of WiMax and fiber-based internet access. One provider, Zamtel, is wholly owned by the Zambian government. Despite some government projects promoting universal access (their construction of new towers is discussed below), much of Zambia's telecommunications capacity is centered in the larger urban areas and along major lines of rail and road highways, which also corresponds to the areas with the highest population density.

CONNECTIVITY TO THE OUTSIDE WORLD

Being landlocked, Zambia has historically used expensive and relatively slow satellite links to the outside world. However, there has been significant progress in the last five years in the form of fiber optic connections to undersea cables in Namibia, Tanzania, and South Africa. This has dramatically increased speeds and has reduced costs despite being primarily driven by the government of Zambia which owns two of the three fiber optic providers: Zamtel (government owned), Zambia Electricity Supply

Figure 1. Submarine cable map for Southern Africa



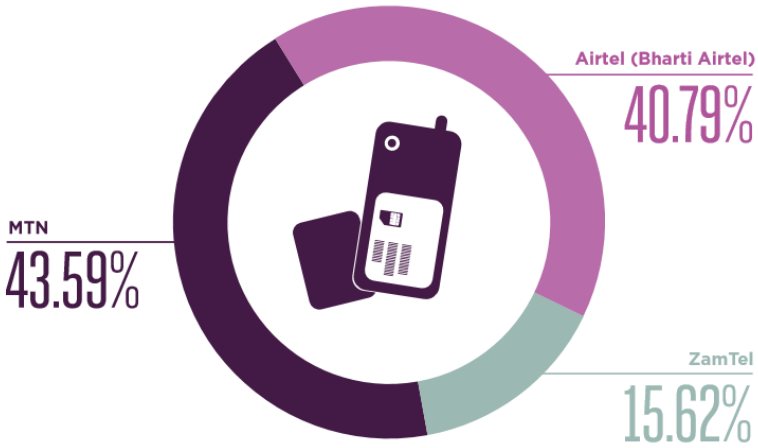
Source: http://submarinecablemap.com

Company (ZESCO, government owned), and Copperbelt Energy Corporation (privately owned).

CELLULAR CONNECTIVITY WITHIN ZAMBIA

There are three mobile operators in Zambia today (Airtel, MTN, and Zamtel) serving 11.1 million connections. However, as in many other developing countries, many customers have either multiple phones or dual SIM phones that allow them to save money by using the same network as the person they are trying to reach. For example, it is cheaper to call/text someone on the same network so many will call a friend on MTN from their MTN line and an Airtel friend on their Airtel line. There is no exact data on how many of these 11.1 million subscribers are unique but it is estimated that at least 26 percent[3] of connections are duplicate SIMs. By this estimate there are some 8.2 million unique mobile subscribers in Zambia.

Figure 2. Market Share by Mobile Operator in Zambia



Source:
Zambia.gsmamhealthfeasibility.com/GSMA_mHealth_Country_Feasibility_Report_Zambia_2015.pdf

DEFINING SERVICE

Basic cellular service. Basic service includes making/receiving calls, sending/receiving SMS text messages, and accessing USSD.

3 infoDev. 2014. Mobile at the Base of the Pyramid: Zambia. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0. Available at http://www.infodev.org/infodev-files/mobile_apps_at_the_base_of_the_pyramid_zambia.pdf.

USSD (unstructured supplementary service data). While most readers are familiar with voice calls and SMS messages, they are probably less familiar with USSD. USSD is a protocol used by Global System for Mobile Communications (GSM)[4]cellular telephones to communicate with the service provider's computers. In contrast to SMS messages, USSD creates a real time connection and allows for a two way exchange of data. A good example of USSD being used across Africa is for access to mobile money services. Another local example of USSD is the menu system in which Zambians purchase data bundles from their phones.

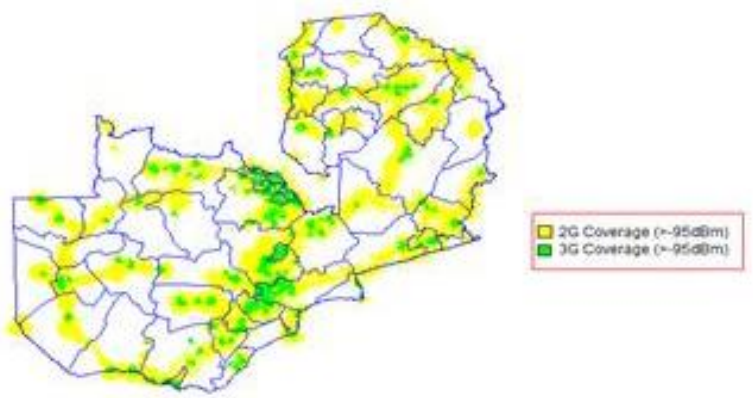
Figure 3. Example of an USSD application

DATA CELLULAR SERVICE

Although data can be sent and received using SMS and USSD, from a mobile network perspective, these services can send data over the voice channel on a cellular network. More advanced services that require internet access, such as email or web browsing, require a data channel. Mobile data services are normally categorized into "generations," for example 3G or 4G indicating third generation or fourth generation technology. Each of the three mobile operators in Zambia advertise 3G or higher speeds but these speeds are only available in limited urban areas (see Figure 4 below with 3G areas visible in green). Outside of these areas, the networks provide only 2G data service which is quite slow and unreliable.

[4] A standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones, first deployed in Finland in July 1991.

Figure 4. MTN coverage map



PAYING FOR SERVICE (SMS AND DATA)

According to Global System Mobile Association (GSMA) Intelligence (www.gsmaintelligence.com), 97 percent of mobile phone users in Zambia are prepaid customers, i.e., users purchase credits that are applied to their account. These credits can be used for voice, text, or data. In the case of data, the customer has the choice of just paying for what they use or purchasing daily, weekly, or monthly data bundles. For example, a prepaid customer is normally charged about $0.10 per megabyte without a bundle but the same megabyte as part of a bundle can be cost as little as $0.01. Data bundles are by far the most cost effective way to access the internet from a mobile phone in Zambia.

Unlike the United States and other countries, in Zambia, only the sender (in the case of SMS) or caller pays for the call. The cost to send a single SMS text message in Zambia is about 0.02 USD (using an exchange rate of 1 USD to 10 ZMW) (per https://www.twilio.com/sms/pricing/zm). For mass distribution of SMS messages (such as may be used for a project), the mobile operators offer bundles that can bring the cost down to as low as $.006 USD per message[5].

COVERAGE

Historically, much of Zambia's development occurred in urban areas and along major rail lines and roadways. The telecommunication infrastructure has followed this same pattern. According to ZICTA, 74 percent of Zambians currently have mobile phone coverage. However, the remaining 22 percent represent the poorest, hard to reach communities in the least populated areas of the country such as Northern and Muchinga provinces. Figure 5 shows the cellular coverage in Zambia from all service providers.

[5] ZICTA Stats. Available at http://onlinesystems.zicta.zm:8585/statsfinal/

Figure 5. Cellular phone coverage map provided by ZICTA showing a consolidated coverage map of all providers in Zambia

Until around 2014-2015, each mobile operator would build and maintain their own cellular towers, which in rural areas also included solar panels and/or diesel generators (further raising the cost of reaching rural areas). Historically, mobile operators have differentiated themselves in the market by their coverage (i.e., "choose mobile operator X because they cover more of the areas where you travel"). However, MTN and Airtel (the two privately owned operators) sold their towers to the international company, IHS Holding Limited in 2014 and 2015 respectively. These sales suggest that they do not plan to invest further in coverage, and that operators' coverage will begin to converge as IHS can now support multiple mobile operators on a single tower, thus reducing the cost of providing service.

FIXED-CONNECTIVITY WITHIN ZAMBIA

With the new fiber optic connections available in Zambia since 2009, the old satellite connectivity has been replaced with either cellular, radio, or fixed-connectivity. There are three main providers in the fixed-connectivity market: iConnect, Liquid Telecom, and Zamtel.

- *iConnect* (www.iconnect.zm). Owned by Vodacom, iConnect provides high-speed internet access in many of major urban areas across Zambia. They provide fiber service but the majority of their coverage uses WiMax.

- *Liquid Telecom* (http://liquidtelecom.com). In partnership with Copperbelt Energy Corporation, Liquid Telecom provides wholesale data to mobile operators. In early 2015, Liquid Telecom acquired Realtime (which was the second largest ISP in Zambia) and now sells enterprise and residential services under the brand Hai. Through Hai, they offer both fiber optic connections and WiMax primarily. In areas not served by either, they offer satellite-based internet access.

- *Zamtel* (http://www.zamtel.zm). Zamtel provides ADSL (based on landline phone connection) internet connectivity for residential and business customers. It also

provides fiber optic connections for business customers. Zamtel is 100 percent owned by the Zambian government.

OTHER CONNECTIVITY OPTIONS

There are other connectivity options available in Zambia. Satellite internet service used to be one of the primary mechanisms for internet access but its use is rapidly declining primarily due to the cost and latency (delays in sending/receiving). It may make sense to provide satellite connectivity to a remote district office with no other options, though it certainly is not a cost-effective option for schools, especially for those without access to electricity.

There are new technologies on the horizon but they have yet to be proven. For example, Google has Project Loon (http://www.google.com/loon), which it hopes will provide balloon-based internet access. Balloon-based internet is a network of balloons traveling on the edge of space, designed to connect people in rural and remote areas, help fill coverage gaps, and bring people back online after disasters.[6] However, it has yet to be deployed beyond test cases. Another attempt to bring information to rural areas without coverage is Outernet (https://outernet.is). Outernet is a one-way satelite delivery of content normally found online; it does not provide the ability to send data and, like all other solutions, requires electricity and communication devices, which raises challenges for rural areas of Zambia.

MINISTRY'S DATA NEEDS

The MOGE's data needs fall into two basic categories: simple and complex.

Simple data is data that can be created or consumed on a basic feature phone such as data that:

- Consists of short, often numerical, content of less than 25 characters
- Consists of text and numbers only (no images or photographs)
- Is less than 30 total items

Examples of simple data include days school are open, basic learner performance data, attendance by class, number of latrines at a school, etc.

Complex data is data that can be created or consumed on smart devices (smartphone, tablet, or computer). Generally, it:

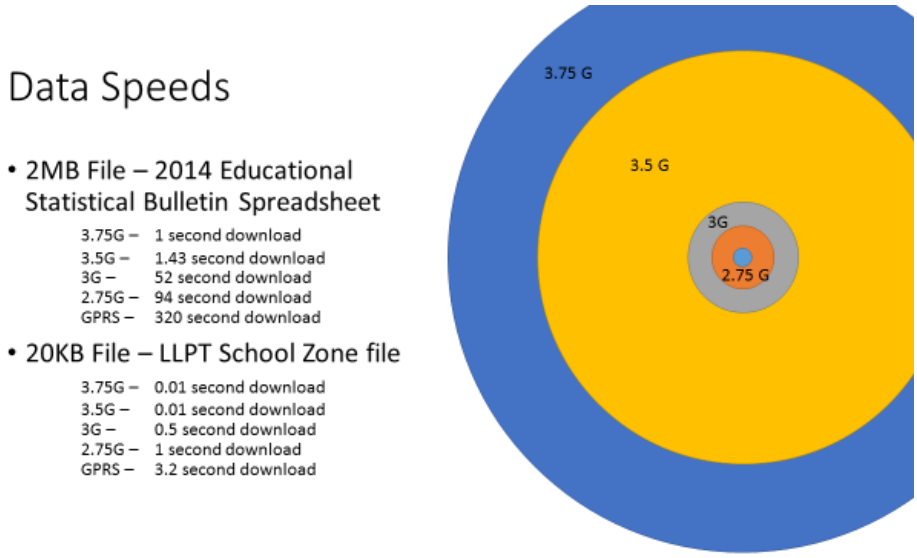
- Consists of open ended or very lengthy text and numeric content
- Uses the features of smart devices such as GPS location, images/photographs, etc.
- Consists of more than 30 items

[6] Project Loon (www.google.com/loon/)

Examples of complex data include GPS coordinates of a well or school, photographs of facilities, reports consisting of charts or graphs, etc.

Figure 6 shows the general size of the data used by the STEP-UP project along with the time required to download something over the various networks available. The size of the circle represents the relative speed of the network technology. The Educational Statistical

Figure 6. Project data download times



Bulletin would fall under the category of complex data, while the LLPT School Zone file could be considered simple data.

The progress of mobile data speeds (as the generations of technology advance from 1G to 2G to 3G, etc.) does not follow a linear path. Therefore as illustrated in Figure 6, the generations beyond 3G show dramatically increased data speeds. As a general rule, 3G or later is more than capable of providing the necessary bandwidth for STEP-Up's data needs. The challenge is that 3G speeds are only available in limited areas as indicated by this coverage map from MTN (see Figure 4, the green areas are 3G or higher).

SECTION 2
ANALYSIS OF CONNECTIVITY OPTIONS

PROJECT CONNECTIVITY REQUIREMENTS AND LOCATION

PROJECT DATA REQUIREMENTS

The LLPT is currently a Microsoft Excel worksheet that allows school data to be entered into the sheet. Reports and charts can be generated by the sheet and the information can be exported and sent to a consolidation point like a school zone, district, province, or national office. This exported file is extraordinarily compact. Using the sheet provided, the resulting export file was 20 KB. This could easily be sent even over the slowest data network. As the data is consolidated, the size of the file will, of course, grow but so will the network as district and provincial capitals are covered by higher speed networks.

Distribution of and access to the LLPT spreadsheet is a different challenge. The spreadsheet itself is approximately 800 KB, which could be transmitted by the slower data networks provided a strong cellular signal is available (which is not common in rural areas). The challenge here is not the network but the availability of electricity and a computer for entering data into the LLPT. According to a May 2013 presentation by ZICTA,[7] only 2,500 schools have access to any form of electricity (including solar and diesel generators which are both difficult to maintain in rural schools). Even fewer schools — about 2,000 — have a computer. As a result, it is not currently possible for schools to collect and distribute data broadly using the current spreadsheet-based model.

However, because the data collected is simple data (as defined on page 9), school administrators can collect and distribute data via USSD using their mobile phones.

URBAN CONNECTIVITY

With the new fiber networks in Zambia, connectivity in urban areas has changed dramatically. There is increased competition between mobile operators and traditional ISPs, which has resulted in increased choice and decreased costs. All large urban centers have a combination of cellular networks and fixed networks available to them. In these urban areas, there is ample bandwidth available to send and receive even complex data.

[7] Gertrude Mwangala Akapelwa-Ehueni (ZICTA), 2013. "Strengthening telecommunications infrastructure for economic growth and security: A case for Zambia." Presented at the India Global ICT Forum: Innovations to Drive Economies 6-8 May 2013, New Delhi. Available at http://slideplayer.com/slide/6874993/ or http://bit.ly/25aH05R.

RURAL CONNECTIVITY

> "Reliance on power and mobile network availability, respectively, were major reported challenges to service usage. 22 of the 31 pilot sites commented on poor mobile network coverage."
>
> – A member of Project Mwana (an mHealth project in Zambia)

The situation is different in rural areas, which are dependent on cellular networks. In these areas, it is no longer economically viable to build new towers in order to expand coverage because the low population density and the high cost of constructing and maintaining a tower leave little room for market-based growth. ZICTA does collect a universal access tax and is charged with bringing connectivity to rural areas.[8] Indeed, ZICTA just finished a project which saw the construction of 169 new towers at a cost of 24 million USD, bringing cellular coverage to some 200,000 Zambians (120 USD per person served). According to ZICTA's estimates, 74 percent of the population has cellular coverage. Reaching the remaining 3.5 million citizens would cost more than 420 million USD. Without sustained and costly government investment, it is unlikely the current coverage will change significantly in the coming years.

Fortunately, the success of any mobile project in rural Zambia is not completely dependent upon mobile coverage. While rural coverage is spotty, people in the rural areas know where to go in order to get coverage to make calls or send/receive text messages. In the education sector, teachers travel monthly to collect their pay which brings them into areas with coverage and allows them to submit or receive data (for example, in the case of the School Gateway System). Therefore, while coverage is not universal, it is within reach for the vast majority and can be used for data collection and dissemination via SMS and USSD systems on a periodic basis.

DEVICE OPTIONS

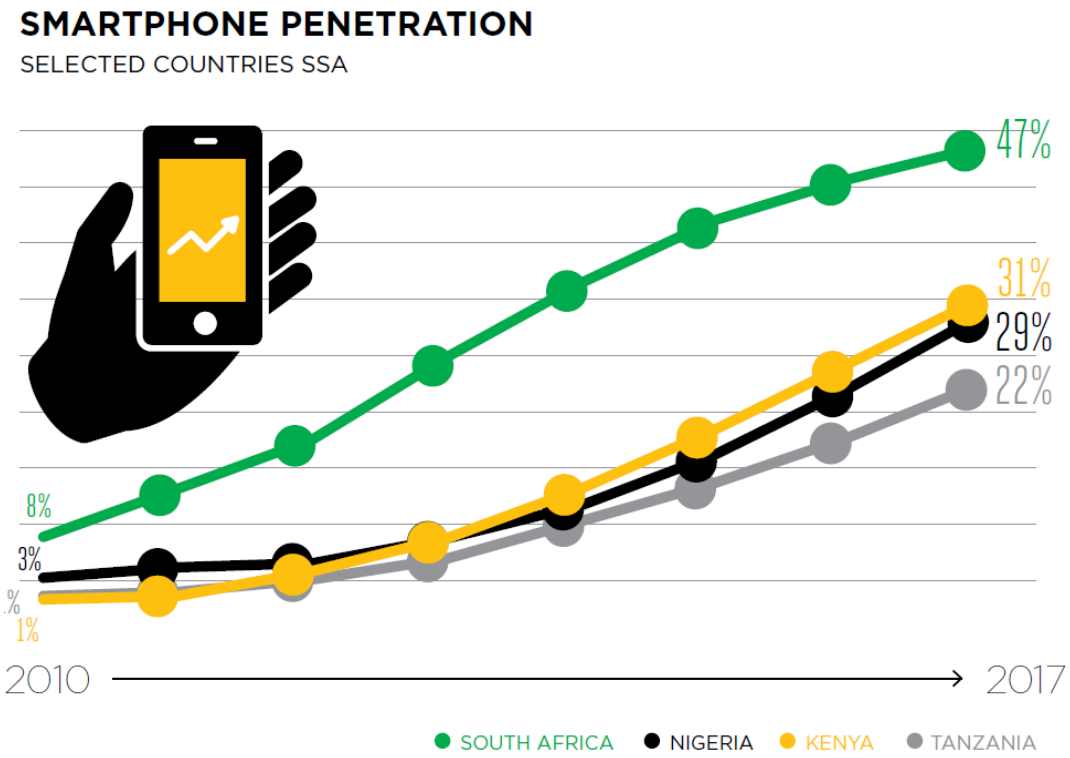
There are three categories of devices that can be used for data collection and information access: basic phone, smart device (smartphone or tablet), and traditional computers.

Basic cellular phone. The basic phone is by far the most prevalent device in Zambia. It is low cost, can last days on a single charge, and provides the basic services customers want: voice and SMS. In addition, it supports USSD, which can be used for both simple data collection and information access. The other advantage of basic phones is that they are familiar to users so users quickly become proficient in entering and accessing information. One project funded by UNICEF had initially begun a rural data collection project with smartphones but reverted to basic phones for the reasons stated above.

[8] Government of Zambia. "ICT Act of 2009 – Part VIII – Universal Access & Service." Available at http://www.zicta.zm/Downloads/The%20Acts%20and%20SIs/ict_act_2009.pdf

Smart devices. According to GSMA Intelligence, smartphone penetration in sub-Saharan Africa is growing rapidly. Of the four countries included in Figure 7 (next page), Tanzania — the most similar to Zambia — is expected to reach 22 percent penetration by 2017.[9] Smartphone penetration is highest where income is high and electricity and data services are readily available. In Zambia, smartphones are much more likely to be found in urban than in rural areas. Zambia has access to a range of mobile phones from companies like Samsung or low-cost smartphones from China. Android is the dominant smartphone platform in the country.

Figure 7. Smartphone Penetration in Sub-Saharan African Countries



Source: http://www.gsmamobileeconomy.com/GSMA%20Mobile%20Economy%202013.pdf

Tablets. Tablets are available in Zambia for a wide range of prices and qualities. Due to their larger screens, battery life, and Android operating system, many data collection applications are intended for use on tablets. Tablets are ideally suited for complex data gathering and for accessing reports containing images, graphs, or charts.

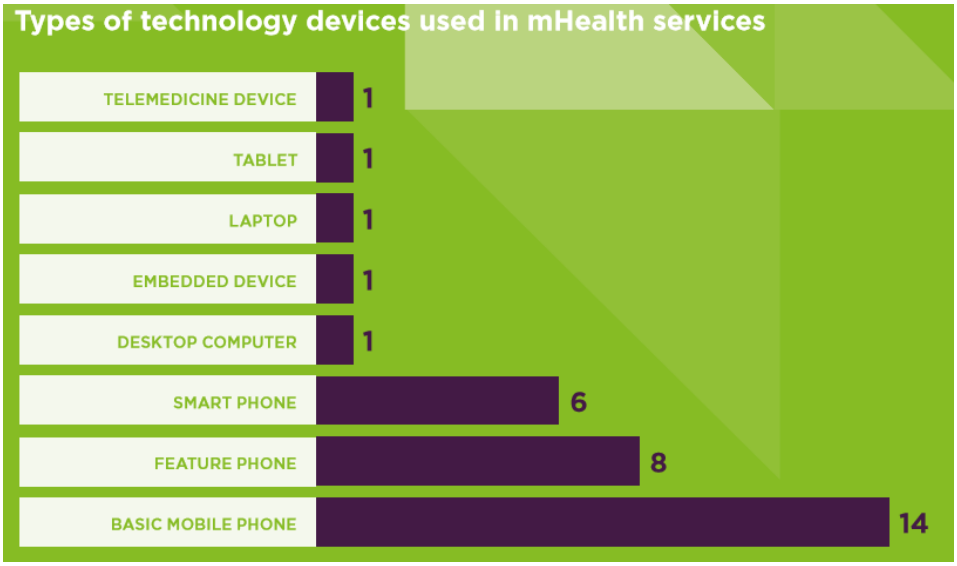
Personal computers. The computer has undergone a major change in recent years with the introduction of new form factors including tablets and 2-in-1's (notebooks with detachable screens that can be used as tablets). While these new devices are available in

[9] GSMA Intelligence, "The Mobile Economy 2014: Sub-Saharan Africa." Available at: http://www.gsmamobileeconomyafrica.com/GSMA_ME_SubSaharanAfrica_Web_Singles.pdf

Zambia, the traditional desktop computer is still most widely used in Zambian schools. Tablet computers are much less available in Zambia, especially at the low end of the market. However, it is important to consider these new models when thinking about data collection and use in schools. A low-cost tablet can be connected to existing keyboards and mice and used just like a desktop but with the added advantage of portability and can be powered for hours on an internal battery, which makes them more appropriate for Zambia's situation.

The following graphic is from a very recent GSMA Intelligence assessment of mHealth projects in Zambia.[10] As you can see, nearly half of the projects used standard phones with seven choosing smart devices (smartphones or tablets) and two using computers.

Figure 8. Basic/feature phones account for two thirds of mHealth projects surveyed



CHALLENGES OF PROVIDING DEVICES AND CONNECTIVITY

The obvious platform for widespread data collection and dissemination is the standard mobile phone (also referred to as a feature or basic phone). It is low-cost, readily available, familiar, and already in hands of teachers. While more advanced devices provide additional capabilities, they also have challenges in an environment like that of Zambia, including those listed below.

Acquisition and ownership. Who will be responsibility for purchasing the devices? Who will be responsible for supporting the devices? How is breakage or theft handled?

[10] GSM Association, "Mobile for Development: mHealth Country Feasibility Report: Zambia." 2015. Available at http://zambia.gsmamhealthfeasibility.com/

Connectivity. There is no single mobile operator who provides coverage for the entirety of Zambia. None of the projects that were reviewed were able to work with just one single mobile operator despite their desire to do so. This will be true of any nationwide project requiring cellular connectivity.

Paying for data. For projects that require data, the challenge is ensuring that the data purchased is used for the project work. For example, if a 1GB data bundle is purchased for data collection in a certain area and is applied to workers devices, how can the project ensure the data is used for project work? More importantly, how can the project ensure that the data is available when needed. For various reasons, it is common to find that the data bundle has expired before the project work has been completed.

SECTION 3
RECOMMENDATIONS

It is very difficult to forecast the speed at which improved connectivity will reach schools in Zambia, as it is not a matter of technological progress but of capital investment and economics. The recommendations below focus on (1) what can be done in the near future and (2) what can be done to prepare for the longer term over the coming years.

DATA COLLECTION RECOMMENDATIONS

USE SMS/USSD FOR THE COLLECTION OF SIMPLE DATA DIRECTLY FROM SCHOOLS AND SCHOOL ZONES

The current spreadsheet-based solution — the LLPT — works exactly as intended. However, should the project want to collect data directly from the school or school zone, it will need to implement a USSD-based solution, much like that already in place with the School Gateway System a Praekelt Foundation and RTI International project that uses mobile to support USAID's Read to Succeed initiative (further described here http://blog.praekeltfoundation.org/post/52930778479/mobile-technology-set-to-impact-zambian-education). This change will provide the greatest reach into even rural schools and will not require information to be gathered and entered at the district level. However, due to the amount of data currently collected, USSD would not be appropriate unless the amount of data collected could be reduced.

PILOT ANDROID APPLICATION ABLE TO STORE INFORMATION OFFLINE AND TRANSMIT WHEN SERVICE IS AVAILABLE

At the same time, it would be practical to pilot a smart device solution for those schools/administrators who have smart devices and periodic access to data networks. This solution would allow for the project to gain experience in collecting data on smart devices. Such devices currently represent a small but growing portion of the market and provide the foundation for richer interaction with the data collected.

Any smartphone solution should:

- Be based upon Google's Android Operating System and designed to run on basic smartphones,
- Allow data to be entered and stored without requiring network connectivity, and
- Be capable of submitting data when a network is available.

INTEGRATE AUTOMATED SMS REMINDERS/REPORTS INTO DATA COLLECTION TOOLS TO IMPROVE RESPONSE AND COLLECTION TIMES

SMS messaging provides a cost-effective way to communicate with users of the system. SMS messages provide two significant benefits to the project:

- SMS messages can be used to increase participation and enthusiasm for data collection by providing near instant feedback. For administrators submitting data to a project or the ministry, this would involve providing confirmation that the data has been received and will be included in reporting. It might also involve periodic updates to teachers so that they feel a connection to the data collection process and that their efforts to provide data are valued.

- SMS messages can also be used to automate prompts to improve data collection speed. Currently, many processes rely on a person to discover non-reporting schools and to follow up with those schools to ensure participation. By incorporating the ability to auto-generate reminders, the system can automatically remind school administrators that they have outstanding reports, and it can send summaries to school zone and district officials to notify them of which schools have not reported data. For example, for the ministry to prepare the annual Education Statistical Bulletin, each district submits data to the province to be consolidated and forwarded to the central office. Upon receipt and examination, sometimes it is found that a number of schools have not reported data, which delays the release of the ESB. To avoid such a situation, the system can be set up to send automated reminders to individual school administrators and other relevant managers to more quickly obtain school data.

AVOID PROVIDING AIR TIME FOR DATA COLLECTION (USE CENTRALIZED PAYMENT AND FREE SMS)

As the use of mobile reporting becomes more common, there is a risk that users will come to expect compensation to cover the cost of providing the reports. While it is reasonable that those reporting data into the system will not be required to spend their own money to submit reports, it is difficult to manage this on a large scale. Fortunately, the technology and processes exist to ensure that the cost of the data collection is carried by the project not the individual by using centralized payment or free SMS.

DATA DISSEMINATION RECOMMENDATIONS

SURVEY DISTRICT OFFICE INFRASTRUCTURE

The district office will continue to play a key role in getting information to the schools as it is most likely to have the required infrastructure. This infrastructure includes reliable electricity and internet access and working computers and printers. At this point, it is not clear exactly how the various district offices are equipped, and it is important to understand the capabilities of these offices. Therefore, it is recommended

that a basic survey be conducted to record the location and resources available and assess any needs that the districts might have.

UNDERSTAND WHAT IS NECESSARY TO MOVE BEYOND PAPER-BASED REPORTS

Value of Information

To move away from paper-based information sharing in which lengthy reports are shared with the schools, and push information down to the schools to help them make better decisions, it will be critical to understand what information is valued by schools for decision making. This can only be done by taking the time to talk with those at the school, zone, and district levels.

Electronic Dissemination

Across the EU, DFID, and USAID/PEPFAR projects surveyed, there appeared to be a significant differences in how information was displayed. Many reports were designed for people who are adept at reading various types of charts and graphs. However, not only do charts and graphs not lend themselves to the technology available (primarily SMS), it was not clear that such a presentation matched the manner in which administrators prefer to receive information. At each step down the organizational chart, ministry staff seemed less comfortable with this type of presentation. It was apparent that research should be done on the most effective ways to communicate information (given users' preferences and needs) and how such information might be disseminated given the limitations of SMS. It is recommended that a small pilot be set up that includes participants from the various levels of the decentralized ministry that focuses on how to best communicate LLPT results to administrators to aid decision making.

INCORPORATE REPORTING INTO ANDROID PILOT

In conjunction with the proposed Android-based data collection pilot mentioned above, the LLPT application should also provide the ability to create and display reports on smart devices. Such devices provide a richer medium for displaying data but it is important that such displays convey the information in a clear and actionable format for users. When a teacher enters an area with connectivity, he or she should be able to download the latest information for their school and keep it on the device and available to the administrator even when there is no connectivity.

AVOID PROVIDING AIR TIME FOR DATA ACCESS (EXPLORE "ZERO RATING" FOR DATA COLLECTION/DISSEMINATION)

For basic data reporting, SMS messages (free to users) should be used to communicate with the local administrators. Since this information will be sent by the systems, the cost will be borne by the project as discussed above.

Cellular networks treat voice and data differently. From a technical perspective, SMS and USSD do not use data, they are features of the voice network. Smart devices such as smartphones and tablets can also use SMS and USSD, which is what makes them solutions compelling as they can reach essentially any device. However, to use the additional features available on smart devices, it is important to consider their impact on data costs. Under normal circumstances, LLPT users sending and receiving data using the data portion of the cellular network will be charged, though the amount of data the application may send or receive can be quite small, especially if the application is designed to minimize data use. For complex data (as defined above), data exchange can become much more costly. Projects by USAID, PEPFAR, UNICEF, and other donors in Zambia have provided air time or data bundles to cover those costs. But there is no way to ensure that they data is used in the way that the project intends. As a result, the data can be consumed by other internet use and is unavailable for reporting purposes.

Fortunately, there is a way to collect data and report that ensures the project is only paying for its data needs. By working with the mobile operators, it is possible to have project internet sites zero-rated, which means that project users have free data access to specific sites. For example, Airtel Zambia has zero-rated a simplified version of Facebook for their users. This allows Airtel customers to access Facebook free of charge. In this case, the simplified version of Facebook does not support images or video, it is just text-based access, which consumes little data. Airtel hopes that by providing simplified access to the site for free, it will spur customers to pay for full access to Facebook, which drives additional revenue for Airtel. More details on the implementation and value of zero-rating are covered in the next section.

CAPACITY BUILDING/SUSTAINABILITY RECOMMENDATIONS

CREATE A MOBILE TECHNOLOGY WORKING GROUP WITHIN MINISTRIES WITH THE GOAL OF SHARING BEST PRACTICES AND STANDARDIZING MOBILE TECHNOLOGY ACROSS THE GOVERNMENT

Zambia's government has many different projects in different ministries underway that involve mobile technology, at least 35 different projects. Two of the biggest areas are in health and education, but there are also projects related to water and sanitation (for example) that fall under other ministries. However, based on the research for this report, though many of these projects are using the same technologies, there is little evidence of collaboration between — or even within — ministries implementing mobile technology solutions, sharing of best practices, or work to create a common technical infrastructure. For example, the Examination Council of Zambia is beginning to use SMS for communicating results to parents/guardians but there is not yet evidence of information sharing within the Ministry of General Education.

There needs to be a push for coordination and collaboration within the various Zambian government ministries. At a minimum, they should be sharing best practices and working towards standardization in mobile technology. For example, there are several different providers of USSD/SMS gateways that enable these mobile solutions. Ideally, the proposed working group could identify a common platform, which would focus resources, provide cost savings, increase internal capacity to maintain the projects, and allow new projects to be implemented more quickly.

WORK WITH ZAMBIAN ICT COMMUNITY TO BUILD THE TECHNICAL CAPACITY TO BRING MOBILE SERVICES INSIDE ZAMBIA

Building technical capacity within the government is a great goal, but it is particularly challenging to do so in the area of ICT due to the strong market demand for ICT skills, particularly mobile technology skills. In light of this challenge, it seems more practical to build the capacity of the Zambian ICT community. Most project-supported ICT interventions in Zambia are implemented with partners outside of Zambia. For example, the Praekelt Foundation was referenced as a supplier in several interviews. While people complimented their ICT skills, they criticized their high costs. However, there do not appear to be technology companies inside Zambia that currently have the specialized technical skills to assist on these projects.

Zambia does have a tech incubator, Bongo Hive (http://bongohive.co.zm), that would be a good partner to help build capacity within Zambia. Its co-founder and executive director, Lukonga Lindunda, is interested in exploring this potential.

Beyond building the local capacity to implement mobile technology projects, there is an additional benefit to bringing these skills to Zambia. While Zambia has made dramatic progress in connecting to the world via fiber optic cables, very little content is hosted within Zambia. This is significant for local projects because a substantial cost associated with internet access is related to the reliance on international gateways. Every provider (mobile operator or ISP) has an international gateway that connects their network within Zambia to the resources outside of Zambia (for example, Facebook). If content is hosted within Zambia, there is no need to access these international gateways, which makes access to content much cheaper. This is an especially relevant fact when negotiating zero-rating. If you request that local content be zero-rated (i.e., you are sending and receiving data only from a site within Zambia), you will be able to minimize the cost of that data since there will be no need to use the provider's international gateway.

WORK TOWARD OBTAINING ZERO-RATING FOR ZAMBIAN GOVERNMENT DATA COLLECTION/DISSEMINATION

Zero-rating could be a huge step forward for the Zambian government/ departments and everyone who works with the government to collect and act upon data. Potentially, it could also increase citizen access to - services. In addition to the Facebook example

mentioned above, another common use of zero-rating in Zambia is for access to online banking sites. Many banks have negotiated zero-rating for their sites so that their customers can perform online banking from their phone or computer without incurring fees. This same concept can be applied to data collection and/or larger e-governance initiatives.

While this concept can be applied much more broadly, for the purpose of this document, let's consider obtaining zero-rating for a government data collection/reporting site: zambiadata.gov.zm. To create such a site requires the participation of each of the mobile operators (Zamtel, MTN, and Airtel) as well as ZICTA. For this site to be accessible on each network, each mobile operator would need to zero-rate it for their network. ZICTA would be instrumental in working with the mobile operators to negotiate compensation for this access. In conjunction with the previous recommendation to keep the data inside Zambia, this could significantly reduce the cost of collecting and sharing data. The agreement could work out in one of several ways, including:

1. Mobile operators may participate as part of their corporate social responsibility initiatives;
2. ZICTA could determine that this falls within their Universal Access mandate and compensate the mobile operators;
3. Each project using the site could share in the data costs paid directly to the mobile operators;
4. Each project could use their own unique site (for example, llpt.zambiadata.gov.zm) and pay actual data costs to the mobile operator; or
5. Some combination of the above.

Obviously, this has great potential for e-governance in general. However there are significant advantages even if its use is limited to just collecting and reporting data:

- *From the user perspective, the service is free*. It costs them nothing to send their data and nothing to review data and reports, even if they have no airtime available.

- *Projects pay only for actual data sent/received*. It eliminates the potential for abuse since it only covers communication with the projects server as opposed to purchasing airtime for users that can be used to access any data. This arrangement also maintains the incentive for projects to optimize the size of data transferred.

- *Discourages the idea of projects "paying" for data*. Just like "sitting fees" have become expected in order to participate in an event, without zero-rating there is potential to establish a precedent of paying for data collection (i.e., if you want me to submit data, you must provide me with airtime for submission).

ANNEX A. RESEARCH METHODOLOGY

The study used three working methods:

- desk research into statistics, reports and policy development resources,
- interviews with approximately 15 stakeholders involved in mobile projects in Zambia, and
- direct experience gained in spending time in rural Zambia and visiting rural and urban schools.

Below, we name the stakeholders interviewed.

Date	Organization	People Met
Nov 17, 2015	Ministry of Education	Planning Team
Nov 18, 2015	Read to Succeed	Guy Bostock: Educational Leadership & Management Advisor
Nov 19, 2015	SPLASH – Schools Promoting Learning Achievement through Sanitation and Hygiene	Justin Lupele, Chief of Party
Nov 20, 2015	UNICEF - Real-Time Monitoring of Rural Sanitation	Nicolas Osbert, Chief of Water, Sanitation, Hygiene
	MTN Zambia – Mobile Operator	Lindiwe Banda, Manager, Enterprise Solutions
Nov 23, 2015	Hai Telecom Limited is a wholly owned subsidiary of CEC Liquid Telecom Limited	Emmanuel Mumba, Senior Sales Manager
Nov 24, 2014	Time to Learn	Stefan McLetchie, Deputy Chief of Party – Teacher Development Specialist and Patrick Fayaud, Chief of Party
	ZICTA – Zambia Information and Communications Technology Authority	Garry Mulelabai – Manager, Information Technology
Nov 25, 2015	Read to Succeed	Joseph Chintende & Mukela Mukela – Field Workers (Northern and Western Provinces)
Nov 30, 2015	BongoHive - Technology and Innovation Hub	Lukonga Lindunda, Co-founder and Executive Director

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