SMS vs Mobile Application

Overview

One of the main technology design decisions ICT initiatives face is whether to transmit data via Short Message Service (SMS) or General Packet Radio Service (GPRS). SMS is a tool built into any modern cellphone which allows its users to send short messages, typically between 70 and 160 characters, over the voice network. GPRS is a mobile data service which allows certain phones to send and receive information using the internet protocol (IP), the same messaging technology which powers the World Wide Web. While an SMS-based system has no specific phone requirements, a system that relies on GPRS data transmission requires Java-enabled handsets that are capable of supporting mobile applications.

	SMS	**Mobile Application**
Phone Requirements	• Standard built-in feature of all GSM phones	• Java-enabled phones and smartphone
Setup Cost	• Low upfront cost • Can use existing phones, doesn't require investment in project-dedicated handsets for end users. Lower the likelihood of data leak out in projects where workers share project-specific phones with family members	• High upfront cost • Project-dedicated handsets. • Significant coordination is required to ensure appropriate use of project-specific phones to avoid data leaking out to non-affiliated community members due to phone-sharing behavior (especially true for projects involving large facilities or user groups, where lines delineating phone ownership may be fluid.
IT Demand	• No need to install anything • Low demand for technical capacity • Low training barriers	• Greater effort around installation and troubleshooting: Typically requires installing a software application on the phone. This can be anything from a browser or email client to a custom software application • More training effort is required
Data Collection & Transmission Cost	• Data sent within an SMS-based system is often limited to the amount of data allowed in a single SMS (limited to 70, 140, or 160 characters, depending on the type of character encoding used) • Transmission cost might add up quickly and be high when systems go to scale or use cases involve frequent messaging (such as on a daily basis)	• Significantly lower transmission costs than an SMS-based system • Significantly lower operational costs as projects scale than an SMS-based system
Data Security	• Rarely secure	• GPRS provides guaranteed delivery using the Transmission Control Protocol/Internet Protocol (TCP/IP) • Delivery information in a secure, authenticated manner by data encryption in transmission
User Experience	• Well-recognized communication medium familiar to many people that can run directly on off-the-shelf, unmodified phones • The free-form nature of SMS text messages can lead to significant user input error and confusion • Strict syntax and character limits • Delayed or dropped messages	• Allow for richer and better quality data by supporting multi-step data validation and the ability to track a higher number of commodities than through SMS • More user-friendly experience in allowing project coordinators to incorporate pictures or audio to support low-literate users
Others	• SMS-based systems for national programs typically require negotiating a toll-free shortcode and this can mean an arduous, long-term, and expensive negotiation process spanning months, or even years, if the SMS aggregator industry is not well evolved	
Conclusion	• Suitable for projects collecting a small amount of data and information among a large group of users	• For projects collecting multiple types and large amount of data among users

Considerations

Because SMS capability is a standard built-in feature of all GSM phones, a project that relies on data transmission via SMS does not require implementers to invest in project-dedicated handsets for end users. In addition to reducing upfront costs, using existing phones also bypasses significant coordination that is required to ensure appropriate use of project-specific phones. This is especially true for projects involving large facilities or user groups, where lines delineating phone ownership may be fluid. Workers sharing project-specific phones with family members may reduce the availability of phones at project sites and/or increase the likelihood that sensitive data will leak out to non-affiliated community members.

Another advantage to an SMS-based system is that it relies on a well-recognized communication medium familiar to many people that can run directly on off-the-shelf, unmodified phones. Typically, more technical capacity is required to provide installation and troubleshooting support for applications on Java-enabled handsets than with basic SMS-supported phones. Thus, an SMS-based system typically provides a lower barrier to entry for projects without the technical capacity to install and troubleshoot a mobile application. SMS-based systems low set-up costs and low training barriers may be more suitable for projects collecting a small amount of information from a large user group.

Alternatively, data transmission via GPRS enjoys significantly lower transmission costs than an SMS-based system and hence reduces significant operational costs as projects scale. SMS is a 'best-effort' transmission medium, which can frequently result in delayed or dropped messages, while GPRS provides guaranteed delivery using the Transmission Control Protocol/Internet Protocol (TCP/IP).

The main drawback of choosing GPRS as a communication medium is that it typically requires installing a software application on the phone. This can be anything from a browser or email client to a custom software application. In the case of custom software applications, it is quite common to supply phones to end users instead of relying on users' personal handsets, in order to ensure a consistent, functional tool across all users. While, as mentioned above, this results in greater effort around installation and troubleshooting, there are also benefits to this approach. GPRS-enabled handsets can provide for a more user-friendly experience in allowing project coordinators to incorporate pictures or audio to support low-literate users. The free-form nature of SMS text messages can lead to significant user input error and confusion while an application allows end users to bypass the need to follow the strict syntax of an SMS. The use of GPRS-enabled handsets can also allow for richer and better quality data by supporting multi-step data validation and the ability to track a higher number of commodities than through SMS. Finally, delivery information in a secure, authenticated manner requires the installation of a mobile phone application, in order to encrypt data before transmission and decrypt it upon receipt. Sending data over SMS is rarely secure.

SMS-based systems for national programs typically require negotiating a toll-free shortcode and this can mean an arduous, long-term, and expensive negotiation process spanning months, or even years, if the SMS aggregator industry is not well evolved. There are also fewer limitations on how much data can be transmitted over GPRS-based systems. Data sent within an SMS-based system is often limited to the amount of data allowed in a single SMS, so is limited to 70, 140, or 160 characters, depending on the type of character encoding used, although many SMS systems rely users to send and receive multiple SMS. Finally, while the transaction cost of individual SMS is small, as systems go to scale, this cost adds up quickly and needs to be weighed against the anticipated benefit. In use cases involving frequent messaging, such as on a daily basis, the upfront cost of a GPRS-enabled phone can be offset by savings in data expenditures in as little as a few months. A more extensive analysis of tradeoffs within each system are discussed in, "Mobile Technology for Community Health in Ghana," a report published by the Grameen Foundation.

Decision

Many of the projects featured in the case studies below chose an SMS approach to reduce the initial complexity of these systems. This reduced startup costs, technical support needs, and implementation challenges around phone management. However, this also limited the complexity of the data that can be managed in these systems and limited the ability to store data while offline or when the network connectivity was poor. This choice was appropriate given the small amount of data prioritized for mobile collection. As each system scales and additional reporting requirements are added, however, we will need to explore at what point projects should transition to a fully functional, GPRS-based system.

Lesson Learned

SMS based systems are simpler to deploy, easier to maintain especially across a large number of users, and require minimal training particularly when users are already familiar with the technology. However, compared to GPRS systems, they can be limited in the amount of data they are capable of transmitting, the quality of the data, and the ability to provide strong visual or even multimedia feedback to end users. Also, while GPRS systems typically require a greater investment in mobile phone hardware and support, the transaction cost of SMS systems are higher and can become an overriding factor depending on the scale and complexity of a system.

(The following excerpt is taken directly from the MOTECH Lessons Learned document)

NURSE HANDSETS – SMS VS. JAVA

OVERVIEW

Initially, MOTECH was to be designed to utilize the personal phones that nurses already owned. The field team conducted a survey and found that while 99% of the nurses had access to a mobile phone, it was their personal phone, often shared with other family members. 85% of the phones could only transmit data via SMS and usually had worn-out batteries with limited charge life.

Hoping to be able to use existing phones, we did a brief field trial with an SMS-based system, which revealed a number of challenges. Older nurses in particular did not know how to send or retrieve SMS, so induction had to include basic SMS lessons in addition to data entry training. Even those nurses proficient with SMS struggled to follow the strict syntax required to compile a structured SMS – typos, missing spaces, and incorrect data order made data capture difficult. We tried to overcome this by saving SMS templates containing field titles on to the phone as SMS drafts. This did not work in many instances since the low memory capacity of many of the phones put a limit on the number of SMSs that could be saved as drafts, and yet there were around 10 different SMS types that were required for our purposes. Some phones did not even have a drafts folder. In these cases we saved the messages in the inbox, but again here we were met with the challenge of low SMS storage capacity. We also found that nurses accidentally edited the SMS templates, meaning that subsequent submissions were flawed. Some phones were not able to send SMS because Message Center settings were incorrect. Providing training to overcome these challenges was extremely difficult when supporting the many different handset types owned by nurses.

In addition to the data challenges, there were several social aspects which made using nurses' own phones impossible. Phone access and ownership seemed to be as fluid among nurses as it was among people in the community. Many nurses shared phones with family members so there would be times when no phone was available in the clinic, and the fact that phones were lent to non-Ghana Health Service staff risked the leak of patient data. Lack of charging solutions was also an issue, as not all facilities had reliable power. Providing a charging solution for the many different phone types that nurses were using would have been expensive, difficult, and cumbersome. Furthermore, nurses were unsatisfied with using personal phones for professional purposes; they felt that if they were required to do something for their work, their employers should provide the equipment deemed necessary to do it.

Given these results, the MOTECH team began a two-tiered assessment that sought to answer the following questions:

Handset: Should MOTECH use the nurses' own phones or Java-enabled dedicated MOTECH phones provided by the project?

Data transmission method: Should MOTECH send data using SMS or GPRS?

The reasons for our hesitance to provide dedicated MOTECH handsets to health facilities were in part financial; using nurses' own phones would eliminate the upfront cost of hardware provision thus making the project more accessible to and sustainable for government agencies in resource-limited settings. However, when we incorporated data transmission costs into our business model and calculated data transfer costs vs. SMS costs, we realized that using Java-enabled phones which could transfer information over GPRS would yield a lower total cost of ownership. GPRS data transmission is many times cheaper than SMS – an SMS message costs US$0.03 on average to send in Ghana, while GRPS rates are US$0.11 per megabyte. A single MOTECH form that requires 1-2 SMS messages can be transferred in less than 1KB of data, resulting in savings of approximately $11 per health facility per month. With this savings, the cost of the dedicated GPRS phone is easily offset by the savings in data expenditures in just over 5 months, making the financial sustainability of the project more feasible.

Crucially, investing in dedicated MOTECH phones for the nurses also eliminated our reliance on SMS as the "lowest common denominator" for data transmission. However, even low-end java phones unlocked opportunities that could not be realized with SMS:

- Java-enabled handsets are more suited to poor network areas than SMS because forms can easily be saved on the phone and uploaded when connectivity is restored. We had found network reliability to be a challenge in the rural areas in which we were working, so this was an extremely u seful feature.
- Security features such as user authentication schemes can be built into java forms, but are not possible with SMS. This is an important aspect of a system that is transferring sensitive patient information.
- Leveraging java-enabled phones from the outset of the program better facilitates the development of more sophisticated applications, without needing to re-train users, re-distribute hardware and

softcopy documentation, or change platforms. Therefore, we felt that java-enabled phones provided a stronger foundation for developing applications, providing more potential for supporting effective service delivery.

We selected the Nokia 1680 for our pilot because it was low cost, had a long battery life and was durable. Eighty percent of the nurses already owned Nokia phones of their own, so we expected them to be more familiar with how to use them than phones from other manufacturers.

Phones were issued to facilities with an equipment agreement that was developed together with Ghana Health Service. The agreement indicated that MOTECH handsets should remain in the clinic or any other place of service delivery at all times. It included a penalty for nurses in the case that a phone was lost or stolen owing to negligence. Levying a penalty for a lost or stolen phone is at the discretion of the District Director. Therefore, if s/he decides that the phone was lost or stolen not owing to any negligence on the part of the nurse, s/he can decide not to enforce the penalty. We ensured that the penalty was low enough and left enough room for discretion that it would not deter nurses from using the phones. Should the penalty be imposed, it is shared by all nurses at a facility, with the majority being paid by the nurse who lost the phone. This shared responsibility model was created in order to encourage nurses to accept joint

responsibility for the handsets and to support each other in keeping it safe. The full handset agreement is included in the Appendix.

ISSUES & CONSIDERATIONS
The following factors were considered when determining what type of handsets should be provided to nurses:

1. Cost: GPRS data transmission reduces the total cost of ownership
2. Operations: Supporting a dedicated MOTECH phone streamlines operations
3. Functionality: Java-enabled phones provide increased functionality
4. Usability: Java forms are more user-friendly and enable quicker data entry
5. Data Quality: Java forms are likely to yield more accurate data

Given the volume of data that was anticipated, there was a significant cost savings in sending data over GPRS vs. SMS. In less than six months, a new phone would pay for itself simply given the data-transmission cost difference. The field team ended up providing nurses with Nokia 1680 phones at a cost of about $40 per handset. A detailed analysis of this decision is in the Appendix.

LESSONS LEARNED
The following lessons were learned throughout this evaluation and as the team went into early implementation:

1. Build on an existing policy – Providing nurses with handsets required coordination with GHS management to coordinate a handset policy that addressed loss, theft and other issues related to the use and misuse of the phone. See the “Nurse Handset Policy and Incentives” section below for more detail.
2. A lot needs to happen to deploy phones – The logistics of purchasing and setting up more than 40 mobile phones with updated versions of the MOTECH forms, ensuring that they were charged, adding credits, deploying them, and training everyone on their use was an ongoing effort that re quired weeks of in-person field-staff visits, as well as a coordinated effort with the field staff to ensure that in the early days – when updates to the forms were frequent – all the phones were updated correctly, the time zone on the phone was set properly, and phones were labeled and tracked. However, we are sure that this requires less effort than managing the many different types of nurses’ personal phones.
3. Use the same handsets – Having everyone use the same type of phone did prove to make the initial and ongoing training process easier to explain and understand. It also meant that nurses could be held more directly accountable for the phones than if they were using their own phones.
4. Plan for network un-reliability – The networks are often spotty and unreliable; even bad weather can result in lost coverage. With java forms nurses are able to upload their completed mobile forms and send them once they are in range of a functioning network.

IMPLICATIONS FOR FUTURE WORK
Scaling in this case will require:

1. **Cost Analysis** – An analysis of the cost should include providing basic handsets initially, supporting the handset use over time and replacing them approximately every two years. Data transmission costs for sending information over GPRS are extremely low and unlikely to significantly impact implementation budgets.
2. **Logistics Plan** – Scaling this to a larger set of users requires an aggressively proactive plan for handling how phones are ordered, how phones are set up initially (e.g., time and date, initial loading of forms, phone charging) and how they are distributed, updated and replaced over time.
3. **Policy Development** – It is imperative that a policy be developed (if working with a government health service, it must be in accordance with their policies) to address how loss, theft and misuse of phones will be handled. To date, the policy in place in the Upper East Region has been successful and we have had no phones stolen or lost.