Mobile Service Cost Profiler

Mark Lessey
Department of Electrical and Computer Engineering, University of the West Indies, St. Augustine, Trinidad and Tobago, mark.lessey@sta.uwi.edu

Kim I. Mallalieu, P.hD.
Department of Electrical and Computer Engineering, University of the West Indies, St. Augustine, Trinidad and Tobago, kim.mallalieu@sta.uwi.edu

ABSTRACT

Poverty has a destabilizing effect on development. Sustainable development programmes therefore often prioritize innovative poverty reduction interventions. Increasingly, Information and Communications Technologies (ICTs) have become standard in these interventions: from the acquisition, dissemination, management, storage and access of information to the engagement of multiparty stakeholders using synchronous as well as asynchronous interactive communications.

Key stakeholders in ICT for development programmes are the poor themselves. Tools, mostly based around the ubiquitous mobile phone, have been developed to empower low-income earners in their commercial activity which may include voice, messaging, and even email and other Internet-based communications. Corresponding mobile services are available through packages representing mixes of traditional voice (PSTN) service and "text"-based, as well as Internet-based, data services. While these packages offer rich choice, selection from amongst them is confusing for users and for those developing pro-poor, pro-market interventions.

This paper discusses the implementation of a tool which computes the comparative profile of costs for various mobile services to achieve specific profiles of communications activities and its application is discussed in the context of Trinidad and Tobago. The "Mobile Service Cost Profiler" represents a key resource for the planning of pro-poor, pro-market mobile innovations for sustainable development in the Americas.

Keywords: Mobile, Service Cost, Sustainable Development.

1. INTRODUCTION

To address the vexing issue of poverty in several developing states of the Americas, a variety of social and fiscal poverty-reduction interventions have been, and are currently being, implemented. In Trinidad and Tobago, interventions take different forms, ranging from improvements in health care as a primary productivity enabler, to the development of marketable skills aimed at encouraging wider participation in economic activity among the poor (Ministry of Social Development, 2005) as a sustainable outcome. These initiatives are partially guided by the United Nations' year-2000 declaration of the Millennium Development Goals (MDGs), as is the case with other territories of the region, and the Trinidad and Tobago Government's own Vision 20/20 national strategic plan for development (UN, 2000), (DLAC, 2003). A key element of the Vision 20/20 plan, which focuses on human and infrastructural development toward the attainment of developed-country status by the year 2020, is the development of a knowledge-based society conversant with Information and Communication Technologies (ICTs). To this end, ICTs have featured prominently not only at the national strategic planning level where policy positions encourage ICT growth (GORTT, 2007), but also already in the delivery of many Government-led poverty reduction initiatives, within which computer-based training has formed an integral part of programmes such as the Multi-Sector Training Programme (MuST) and the Healthy Youth Peer Education (HYPE) programme (Ministry of Social Development, 2005). Thus much emphasis has been placed on the expansion of

access to and usage of the Internet, as documented for example in policy and implementation recommendations (Ramlal and Watson, 2007).

Despite this, uptake and usage of computers and fixed Internet services among the poor have remained low across the Caribbean and Latin America (Cambridge and Mallalieu, 2007), while mobile handsets and services enjoy conversely high and increasing adoption in the same group. With mobile technologies offering increasing integration with Internet technologies, such high levels of mobile penetration represent tremendous opportunities for the introduction and continuation of mobile poverty reduction solutions in Trinidad and Tobago and other LAC territories (Galperin and Mariscal, 2007), as have been explored in other regions (Shakleton, 2007), (Alampay, et. al, 2007), (Vodafone, 2009).

Because of the multi-application, multiprotocol nature of mobile networks, however, several technologies may be used to achieve the same communications requirements. For example, small strings of asynchronous data may be sent using SMS messaging or EDGE on GSM networks. A comparative assessment amongst different technologies capable of satisfying the same communications requirements would be useful for users, service providers and policy-makers. Yet, analysis has shown that the relationships between mobile user communication activities, mobile communication technology characteristics, and pricing models used by MNOs are complex (Lessey, 2010). A structured approach is useful in determining real costs associated with conducting communications activities using mobile technologies. Knowledge of the costs contributed by user communication activities, particularly those associated with pro-poor market access leading to revenue increases (Lehr, 2008), can assist users in choosing the most appropriate mobile services and technologies for conducting such activities, thereby facilitating efficiency improvements, such as was observed in Kerala, India (Jensen, 2007).

This paper implements a basic framework for developing profiles of mobile usage cost based on profiles of communication activities (Lessey, 2010). The framework, described in Section 2, is applicable to users for whom mobile technology is well suited to their communications needs (Mallalieu and Rocke, 2007). A set of parameters is considered to facilitate the matching of categories of user activities to sets of appropriate communication services and technologies. The framework is used to create profiles of technology usage and service cost for each technology using characteristics of technology implementations and billing configurations available from Mobile Network Operators (MNOs).

Considerations for the design and implementation of the profiler application based on the framework are presented in Section 3; the basic implementation is discussed in Section 4; results of applying the framework implementation are examined in Section 5 and a Discussion and Conclusions offered in Sections 6 and 7, respectively.

2. MOBILE SERVICE COST PROFILING

The Mobile Service Cost Profiler implements a basic mobile cost profiling framework, developed from study of the Percolator model, itself a framework for the selection of appropriate ICTs for underprivileged or underserved communities (Mallalieu and Rocke, 2007), the mobile services business environment (Pelkonen and Dholakia, 2004), the application of appropriate technologies in developing states, e.g. (Bull and Hazeltine, 1999), and mobile technology characteristics and real-world service pricing (Heine, 1999), (Le Bodic, 2005), (Retford and Schwartz, 2007), (BMobile, 2010), (Digicel, 2010a,b). Its development is detailed in “Cellular Phone Usage for Poverty Reduction in Trinidad and Tobago” (Lessey, 2010).

The following key minimum inputs are required for creating profiles of cost for users of mobile services:

- Profiles of user communication activities, focusing on those involving (tele)communication of information
- Mobile Network Operator (MNO) and other Service Provider billing details, including:
  - Billing delimitations across service implementation technologies
  - Billing *implementation*, that is to say, how billing is actually applied through regular or promotional means

The key outputs are profiles of:

- Mobile service technology usage
- Cost by service implementation technology.

3. CONSIDERATIONS FOR DESIGN AND IMPLEMENTATION OF THE MOBILE COST PROFILING FRAMEWORK

The design of the Cost Profiler defines two distinct entities:

- Profiler Targets
- Profiler Users

Profiler Targets are those individuals or groups who use mobile services and who stand to benefit from application of the framework while Profiler Users are defined as those who use the Mobile Service Cost Profiler application to generate profiles of cost for Profiler Targets. Profiler Users are further classified as *regular* and *administrative* users in order to accommodate restricted administrative rights for critical data entry.

3.1 DESIGN CONSIDERATIONS

The design of the mobile cost profiler, based on the profiling framework, considers a set of key parameters guided by standard software engineering guidelines (IEEE, 1998), and contextualized for target users. For the Mobile Cost Profiling framework, a key design consideration is that of utility. Based on the framework's inputs and outputs, as described in Section 2, a simple design could conceivably be implemented using a set of spreadsheets for data collection, calculations and data visualization. However, for each set of profiler targets, available technologies, and usage and cost profiles, a new set of spreadsheets, including links to several existing sheets, would be required. This type of implementation would be inordinately cumbersome to manage. It would also be susceptible to loss and would lack security.

For increased versatility and efficiency, a centralized, account-based design has been implemented. Such a design offers profiler users the flexibility of easily defining and managing profiles of different sets of target persons or groups and the utility of accounts to separate the work spaces of different profiler users. Such an implementation at the same time facilitates a single repository for all data, and stratified access privileges.

A critical element for the accurate determination of user costs, as identified in Section 2, is the accurate modeling of mobile service billing implementations. In order to capture the variety of service and related technology options offered by mobile network service providers, a flexible means of reliably modeling these inputs is facilitated by the design implemented.

3.2 SELECTION OF IMPLEMENTATION TOOLS

Developing economies may find utility in the application of open source tools for building applications for use by low-income communities on the basis of lower development and deployment cost, potentially increased security, and the availability of technically-focused support communities through freely-available tools such as Subversion (Apache, 2011). Since the emphasis of the mobile cost profiling framework is the development of an analytical tool for improving cost efficiencies for users in low-income communities of the Americas, the technical, not market, lean of open source development approaches and products (Raymond, 1999) render them suitable.

4. SOFTWARE IMPLEMENTATION

Based on the inputs and outputs identified in Section 3, the Mobile Services Cost Profiling framework is implemented for demonstration purposes using a PHP scripting environment and a MySQL database back end on an Apache Web server. Database entity relationships are used to create a generic structure that accommodates the

modeling of mobile service pricing configurations based on surveys of mobile service offerings, as pricing models are not accessible from MNOs. The logic related to the determination of usage and cost profiles is implemented in script, beginning with user registration and login, and followed by the form-based entry of activity profiles. Sets of MNO pricing are pre-loaded for users to select. The overall system architecture of the Mobile Service Cost Profiler is illustrated in Figure 1.

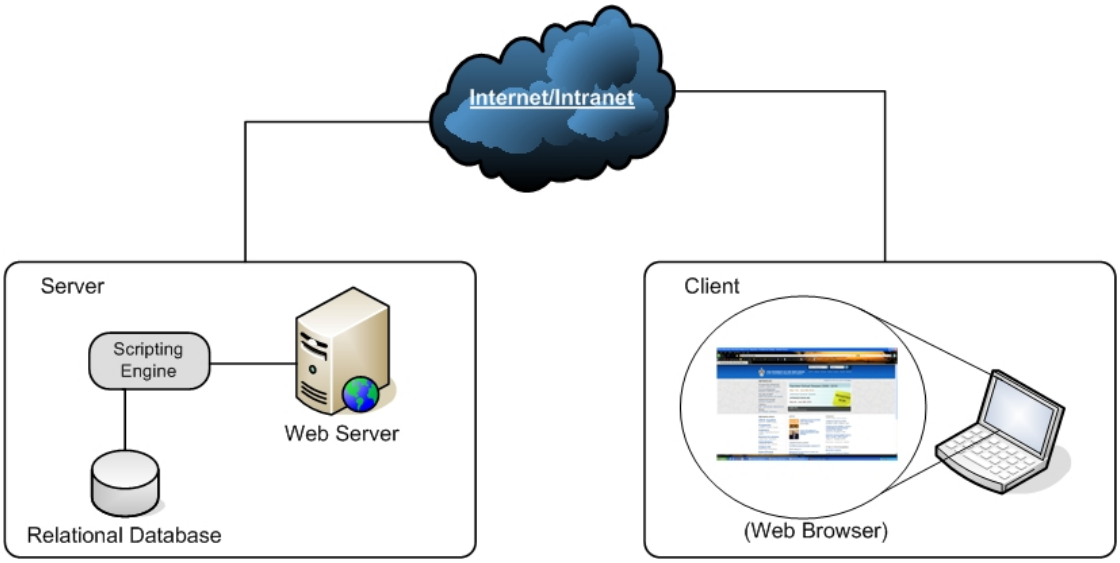

Figure 1: Mobile Service Cost Profiler Architecture

The Profiler is accessed via a Web browser, and configured to permit two levels of user access. The first level grants administrator rights, which permit users to model and configure reference MNO pricing plans, manage Profiler users, and develop and manipulate target profiles for usage and cost. The other level, which is more restrictive, permits users to develop and manipulate target profiles for usage and cost. All users can save, edit, and delete managed profiles. The key algorithm for developing profiles of cost is shown in Figure 2.

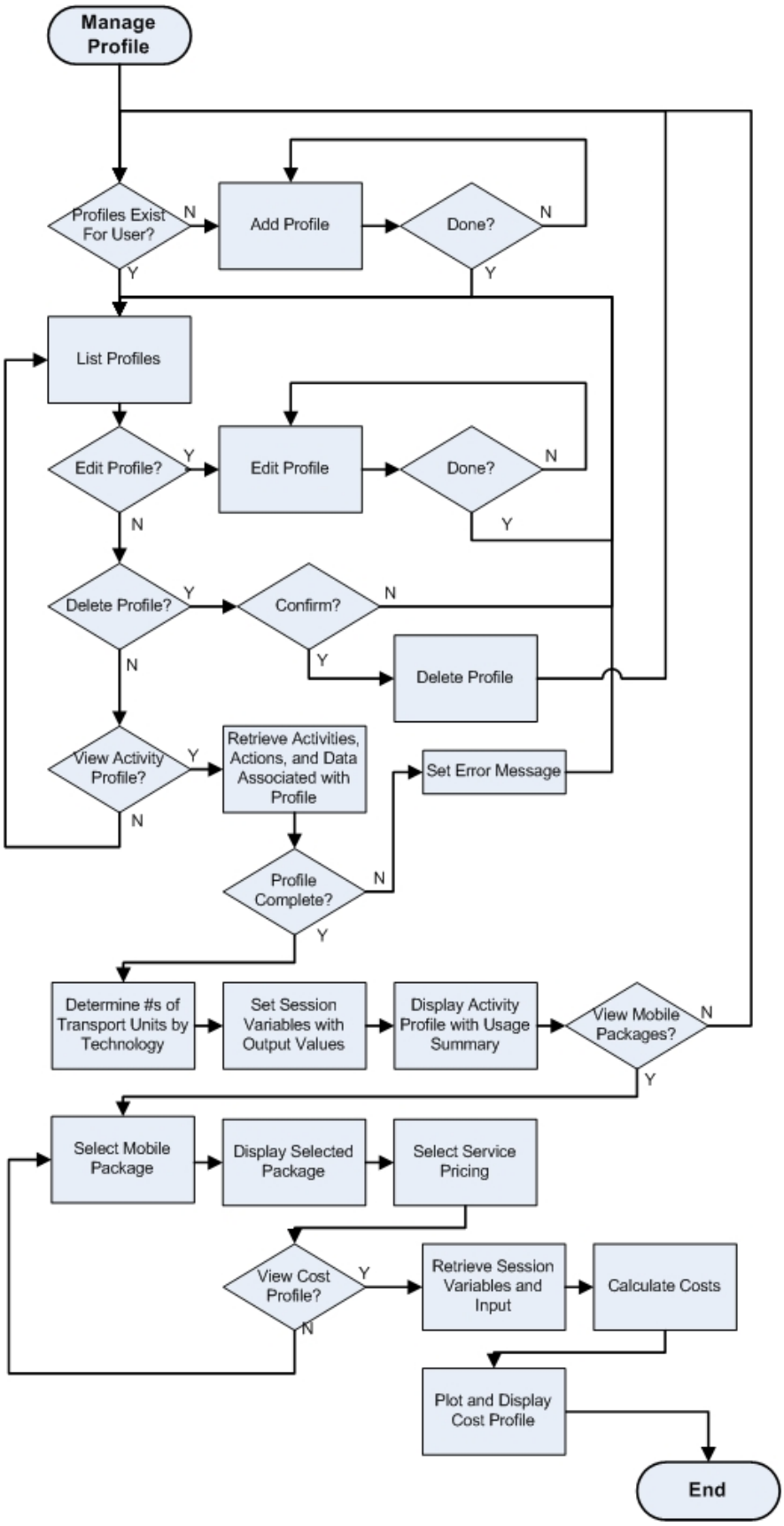

Figure 2: Cost Profile Development Algorithm

5. APPLICATION OF MSCP: A TRINIDAD AND TOBAGO CASE

The Mobile Services Cost Profiler was applied to the commercial communication activities of a small group of Trinidad and Tobago small-scale fisher folk in order to determine the relative costs of conducting their communication activities using a number of technologies offered by MNOs in Trinidad and Tobago. This group, primarily comprising fishermen, vendors and fish processors was selected based on definitions from survey data (Kairi, 2007).

For illustrative purposes, Table 1 represents combinations of a truncated activity, usage, and extended usage profile for fishermen, based on activities which share information and communication attributes that permit transmission with text. As seen in the table, this fisherman's commercial activities involve communicating with purchasers of his fish regarding the details of his catch and to get weather updates. The example assumes that the fisherman communicates the former information to a single buyer. The Mobile Service Cost Profiler captures typical information required for each communication activity and translates this into the corresponding number of bytes of data. The aggregated data required for each communications activity is then mapped onto the data requirement for SMS, MMS and GPRS/ EDGE communications.

Table 1: Activity, Weekly Usage, and Extended Usage Profiles for a Sample Fisherman

User	Activity	Activity Action	Example Info	Data Amount (bytes)	Usage (bytes)	Frequency per week	Total Usage/ wk (bytes)	SMS Msgs	MMS Msgs	GPRS/ EDGE BYTES
Fisherman /woman	Update Buyers on Catch	Send Catch Info to Buyer	950 lbs	7	30	5	150	5	5	5
			Red Fish	8						
			$10/lb	6						
			Chagville	9						
	Get Weather Updates	Request Weather Information	Port of Spain	13	54	5	270	5	5	5
			Today/18-01-10	14						
			Tide	4						
			Atm.	3						
			Temps	5						
			Hum	3						
			Wind	4						
			Sea Cond.	8						

Inspection of Table 1 shows that the small amounts of data generated by user communication activities over the default one-week period may not have been most efficiently transported by the network. For example, for activity "Update Buyers on Catch," 150 bytes of data were generated, but required 5 units of SMS, MMS, and GPRS transportation units, corresponding to a maximum utilization of 21%, 0.98%, and 2.9% of available data carriage capacity respectively, based on billing and service technology data derived from MNOs. The costs associated with using each technology are shown in the cost profile of Figure 3.

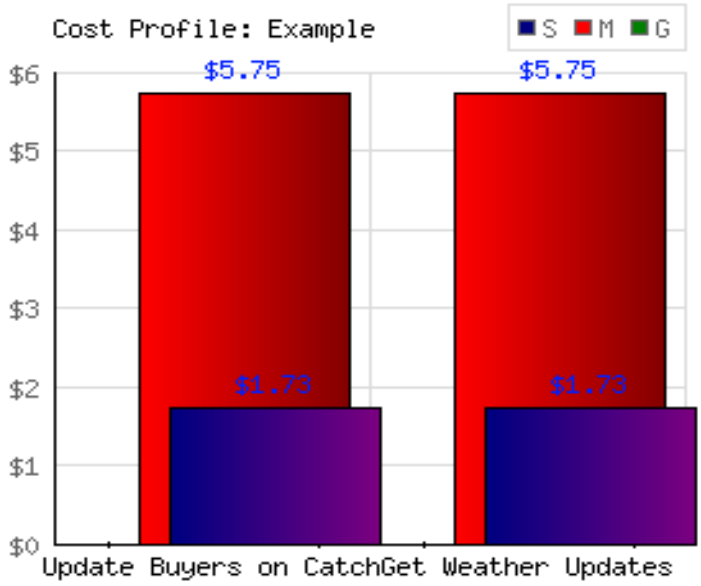

Figure 3: Weekly SMS and MMS Costs for Activity Profile of Fishermen

Prices used in this example were derived from a standard pre-paid mobile service package from one of two Trinidad and Tobago MNOs (Bmobile, 2010). GPRS cost is not shown in the Figure, as it is priced separately from the standard SMS and MMS offerings of the surveyed MNO. SMS costing is indicated in red, while that for MMS is shown in purple. Considering the costs shown in the Figure, along with the utilization levels of each technology, use of SMS is indicated for the given profile of fisherman/woman activities, as is reinforced by Figure 4, where the cost of completing the same activities using the same MNO's fixed-price, unlimited GPRS service offering is illustrated.

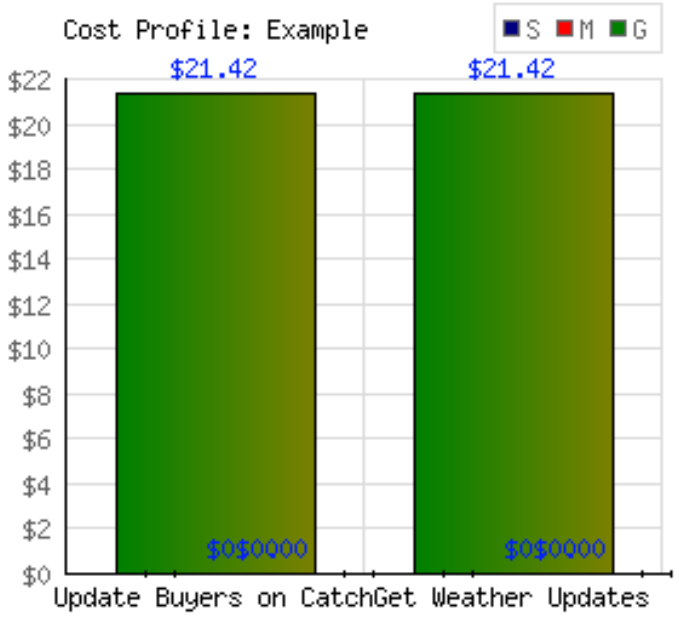

Figure 4: Weekly GPRS Cost for Activity Profile of Fishermen

6. DISCUSSION

The results of Section 5 are the outputs of an analytical methodology to guide the selection of mobile communications services for the execution of profiles of communications activities. In the example case presented, SMS was found to be most cost-effective based on the user's activity profile. More comprehensive activity profiles would comprise several sets of activities whose information communication attributes are unrelated and, again, the most cost-effective mobile service package/s would be revealed.

The comparative costs of executing mobile communication activities have been computed analytically using the Mobile Service Cost Profiler. This approach, despite its potential usefulness as an estimation tool, requires users to accurately recall their typical activities, as well as some sample data as key inputs. Empirical data on the actual usage of all technologies and services on the mobile device and on the mobile network over some period would validate the analytical results.

The successful application of the framework requires accurate modeling of the *application* of MNO billing. The implementations of complex MNO billing configurations and offerings such as "Get X minutes free after the first 3 from 10 pm to 6 am" are not obvious. In this case, for example, the campaign can be interpreted as 'free' service triggered after 3 continuous minutes in one call, or after three minutes total (multiple shorter calls) on any given night. What happens after the first use of the X qualifying minutes is ambiguous. Must one hang up and call again to benefit from another X minutes after 3? Is it automatically done on a continuous call? Is it a single instance only per night, etc.? A reliable means of modeling such billing issues across MNOs is therefore required in order to accurately implement the framework in software. For the application presented, billing configurations are modeled from existing service package descriptions available from the two MNOs in Trinidad and Tobago and described in a set of database entity relationships. However, for the dynamic cases of most MNOs in the Latin American and Caribbean (LAC) region, such a database would require a dynamic structure and query mechanism in the absence of a fully representative generic structure.

The database structure used to represent mobile tariffs and pricing implementations draws to attention the resolution of calculations. Costing details can be lost if the resolution of pricing data used is not relative to the actual time period over which activities occur, or if cost calculations are not mapped to the smallest pricing units with which users interact. For example, if a timeframe of one week is used to determine activity costs by breakdown, significant estimation errors can occur if users benefit from a service deal like the one mentioned in the previous paragraph, but this is ignored in calculations. In such a case, an MNO's regular pricing configuration is applied. Therefore the smallest timeframe that should be used for such calculations would be one day, with a moving sum performed for each day up to a week to arrive at the weekly total. In other words, the mechanics of cost calculations are intricately linked to billing implementations and are critical to the estimation process. Further work therefore would adopt MNO pricing and billing models and automated the analysis leading to selection of the most cost-effective MNO offerings for each profile of usage: mobile application for smart phones and MNO-based application for regular phones.

7. CONCLUSION

The increasing use of mobile applications by general publics has caused a great deal of confusion regarding the choice of appropriate services. This paper has described the implementation of a guidance framework and tool for selecting cost-effective mobile services on the basis of specific communications profiles. The tool is versatile, with provisions for storing the activity and communications profiles of target mobile users ("profiler targets") and editing these profiles at will. The tool also makes provision for adding and editing available MNO pricing packages. Tools such as this may be made available on government websites to guide the general public regarding appropriate choices of mobile service packages.

The utility of Mobile Service Cost Profiler is likely to be most impacting for low-income users. Indeed, it has been shown in developing states outside of the Americas that persons traditionally identified as poor, or otherwise marginalized, stand to reap the most benefit from the use of engineering applications that improve access to commercial markets (Lehr, 2008), (Vodafone, 2009). Many such applications have relied on Internet technology,

but are increasingly taking advantage of the very high penetration levels of mobile service in these communities (Shackleton, 2007). A significant opportunity lies in the relative cost, against earnings, for low-income product and service providers to access new and emerging markets facilitated by the mobile phone.

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