

The mobile phone in Africa: Providing services to the masses

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Abstract

The story of mobile telecommunications in Africa and the developing world is a remarkable one. Africa's mobile cellular growth rate has been the highest of any region over the past 5 years, averaging close to 60% year on year. Large cellular infrastructure investments, which have enabled millions of people to communicate better, have been made. In accordance with the Meraka theme and objective of increasing ICT intensity and pervasiveness in society, this paper looks at the various technical and operational considerations associated with creating a middleware platform for mobile services. The platform should be able to support different mobile paradigms (voice, text, multimedia, mobile web, applications) using a variety of communications protocols (SMS, USSD, MMS, Bluetooth, WAP data via GPRS/3G/HSDPA). This will enable components to be reused, ensure scalability, support multiple access devices (from basic phones to more powerful smart phones, including traditional PCs), provide interoperability via different modes of access and also ensure faster development time.

1 Introduction

The new millennium is witness to a telecommunications world that differs vastly from even the recent past, with developments in the mobile sector having dramatically changed the Information and Communication Technology (ICT) landscape. Mobile cellular technology has proliferated faster than any previous technology and is now the most ubiquitous technology in the world. It enables more than 4,7 billion people worldwide to communicate and share information. By the end of 2009, about one in every two people in the world owned a mobile phone, while the International Telecommunications Union (ITU) reports that Africa's mobile cellular growth rate has been the highest of any region over the past 5 years, averaging close to 60% year on year (ITU Report, 2009).

2 Context

The impact of mobile technology and the implications for the lives of ordinary people are far-reaching as it empowers users with new abilities. These 'abilities' refer to the user's capacity to connect to the information society as a contributor and a user. Mobile cellular technology is driving improvements in social links, creating social capital, improving market information flows and productivity, as well as increasing local Gross Domestic Product (GDP) and Foreign Direct Investment (Frost & Sullivan, 2006). As "[m]obile technology is changing the way many Africans live and work" (GSMA, 2008: 14; Kwaku Kyem and LeMaire, 2006), this ability to connect and be connected is of primary advantage in areas where other means of information access are not available as a result of infrastructure and physical realities. This mobile-centric perspective (Donner et al., 2009) difference is illustrated in Figure 1.

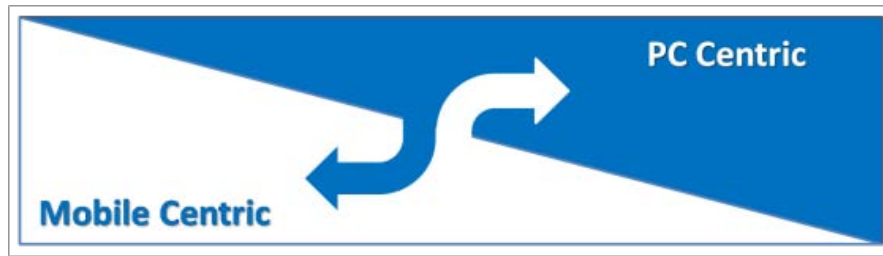


Figure 1: Mobile-centric and PC-centric access to information and-services (Adapted from Donner, 2009)

The use of networked PCs extended to the mobile platform (for the added dimension of mobility and contextual access) depicts a trajectory that is evident in Europe, the Pacific Rim and North America. Here access to information and services is gained predominantly through desktop computing. Africa and other developing regions are, however, testing or contradicting this conventional thinking and entering the information society from a mobile-centric perspective. Mobile phones' capabilities are extended with desktop capabilities where the functionalities of the technology are not able to support the activities of the user. This ubiquitous alternative access to the information age challenges the concept of a 'digital divide' with that of a 'digital difference' (Botha, 2009; Botha and Gregory, 2009; Botha and Gregory, 2010).

2.1 Objectives

A major challenge inherent in this paradigm is to provide cost-effective and affordable access to meaningful content and services through technology that is already owned. As such, to improve the significance, sustainability and reach of Meraka's mobile services initiative, the need was identified to create a more generic mobile service delivery platform. This platform, and the associated tools required to extend the benefit of mobile technology to other domains, was the focus of the *Mobi4D Platform initiative*.

The aim of the *Mobi4D Platform initiative* is then to use the expertise developed over the past years in order to design, develop and deploy a mobile service delivery platform that will be scalable and standards-based, and will support inter-operability in the mobile environment.

The platform would be as device-agnostic as possible, making use of:

- Voice and text, using technologies such as human language technologies (text-to-speech, speech recognition, speech interfaces, voice XML systems, etc.), SMS (text messages) and USSD (session-based text menu systems)
- Multimedia using MMS (multimedia messaging services), camera and video capabilities
- Mobile web
- Mobile applications using cell phone development frameworks such as J2ME, Windows Mobile, Symbian and Android
- Various communication and telephony protocols such as GSM/ GPRS/ 3G/ Bluetooth/ WiFi.

The platform is being developed and tested within a 'Mobile for Development' paradigm, focusing on the application of the technology in national priority areas such as education, health, disability and rural development. Figure 2 presents a conceptualisation of the mobile service delivery platform.

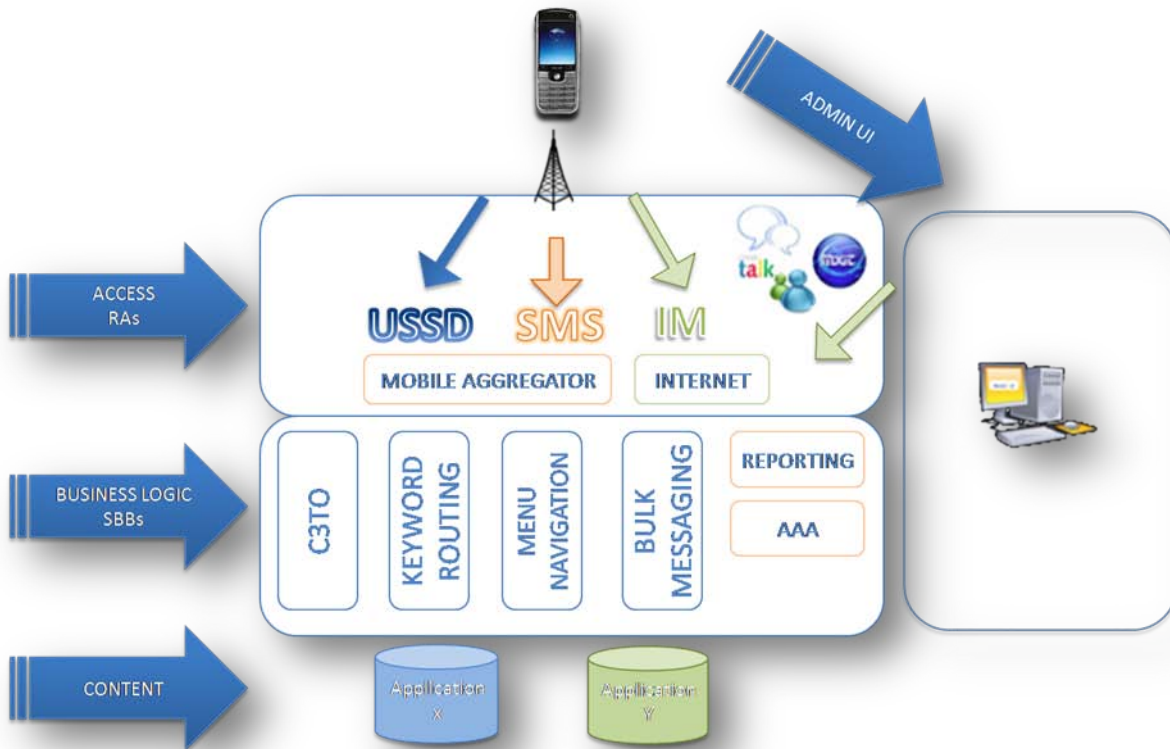


Figure 2: Conceptualisation of mobile service delivery platform (Botha et al., 2010)

Building further on the conceptual platform depicted in Figure 2, the desired service delivery platform was envisaged to be network protocol agnostic. This implies that a request coming into the platform could come from any network, using any protocol. The Resource Adaptor (RA) layer adapts this external protocol into a format understood by the platform. The resource in this case could be a protocol stack that represents the network from which a request came; it could also be an interface into external application servers through an Application Programming Interface (API). A feasibility study indicated that the mobile platform solution should, as a minimum, meet the following functional and non-functional requirements:

- *Minimal total life cycle cost* – Built using low-cost open source components that require minimal upfront expenditure with limited ongoing operating expenses in the form of licensing and support fees
- *Standards-compliant solution* – To ensure interoperability, the solution selected should be based on open standards, e.g. Service Oriented Architecture (SOA), Java API for Integrated Networks Service Logic Execution Environment (JAIN SLEE), etc.
- *Bearer & device agnostic* – Allow for the same service to be accessed from different mobile devices using different access mechanisms.
- *Ease of use and accessibility*, making it much easier to create, operate and maintain specific mobile services and reducing the required minimum skills levels.
- *Synergies and interoperability* with other projects and external ICT solutions
- *Reusable modules* – Ability to develop mobile services using both new and existing reusable modules.
- *Flexibility and extendibility*, with reference to the addition of further communication mechanisms, e.g. Near Field Communication, Multimedia Message Service (MMS), Session Initialization Protocol (SIP) etc.
- *Flexibility and extendibility*, with reference to adding new reusable Service Building Blocks (SBB) and incorporating existing stand-alone mobile applications

- *Scalability* – Ensuring that the Mobile Delivery Platform can be scaled up to meet the anticipated concurrent user load
- *Availability* – Ensuring that the platform is architected as a high-availability solution
- *Ease of use* – Ensuring that all users of the systems, including end-users, contributors and facilitators, can interface with the solution using a properly designed user interface
- *Leverage available skills*. Through the development and support of the solution selected, the ‘client’ making use of the platform should not require scarce specialised skills.

The Mobicents middleware platform was selected as the base platform of choice. Mobicents, part of the JBoss Communication Platform (JBOSS), is a next-generation service delivery platform which enables the delivery of converged, network-agnostic services and applications. Mobicents is the first and only JAIN SLEE 1.1 and SIP Servlets 1.1 certified Open Source VoIP platform (Mobicents). Thus the Mobicents solution brings to *Mobi4D* a robust component model and execution environment that complements Java 2 Enterprise Edition (J2EE) to enable convergence of voice, video and data in next-generation intelligent networks applications and services. The JBoss Communication Platform advocates for any device, any network and any content philosophy of the next-generation intelligent networks.

Mobicents enables the composition of Service Building Blocks (SBB), such as call control, billing, user provisioning and administration, and the presence sensitive features. The SLEE service building blocks (SBBs) have many similarities to Enterprise Java Beans (EJBs). The Mobicents JAIN SLEE platform should be seen as an application environment that is truly protocol agnostic through Resource Adaptors, thus covering a variety of telco protocols. The motivation for the JAIN SLEE specification came from its event-oriented component model. Event-driven systems are typically asynchronous, high-frequency, low-latency and high-throughput systems used in telecommunication switching, industrial automation or flow-control systems and they are powered by specialised high-performing event-driven engines.

2.2 ***Mobi4D* technology description**

Mobi4D is a communication services delivery platform based on the JAIN SLEE-compliant and certified Mobicents Application Server. As a communications service delivery platform, *Mobi4D* provides agnostic access to services – an abstraction between the end-user access device, content providers and the underlying telecommunication networks and protocols. Given the socio-economic conditions in Africa, this abstraction presents an opportunity to enable service delivery that capitalises on the technologies that end-users can afford and often already own. This abstraction is achieved through Service Building Blocks (SBBs) and Resource Adaptors (RAs) defined in JAIN SLEE 1.1 specifications. The JAIN SLEE 1.1 Specification (2005) identifies some of the goals of this architecture as being able to define standard component architecture for building distributed object-oriented communications applications, and to allow the development of distributed communications applications by combining components developed using different tools from different vendors.

2.3 **Status of the *Mobi4D* platform development**

The first phase of the platform development was aimed at providing sufficient proof of concept by RAs for popular mobile services such as Short Message Service (SMS), Unstructured Supplementary Service Data (USSD), as well as eXtensible Messaging and Presence Protocol (XMPP) used in Instant Messaging (IM). Currently, the SMS, USSD and IM RAs and their respective SBBs are fully functional. A Simple Short Message Interface (SSMI) RA has also been developed which connects these components to a mobile network aggregator which acts as a gateway for sending and receiving SMS and USSDs. In addition, the Authentication, Authorisation and Administration module (AAA) has also been developed. This module uses openLDAP; an open source Lightweight Directory Access Protocol (LDAP) as its directory server. An LDAP RA has been developed with an API client to enable the platform to communicate, through the LDAP RA, with the openLDAP directory server to perform authentication and authorisation of service users (*cf.* Figure 1).

For the IM service, a Libpurple and an XMPP RAs have been developed. Along with the SBBs, these RAs enable an instance of the SBB to connect to multiple IM services providers, such as MXit and GoogleTalk, using accounts for each of these IMs. This means that an end-user is able to ‘chat’ with the platform

through different IM accounts by adding the relevant service, utilising the *Mobi4D* IM service, as one of his or her contacts.

The Keyword SBB was developed to provide an easy-to-configure keyword look-up service. The look-up service is envisaged to allow its owner to define how keyword request responses are to be relayed back to the end-user. This Keyword SBB provides text-based user-system interaction, as well as look-up services for other SBBs within the platform.

A Diameter-based session control plane is planned to support Authentication, Authorisation and Accounting (AAA) efforts. It will provide means to support service charging as used in most IMS applications and other converged-networks services.

2.4 **Business benefits**

Beneficiaries include the target markets in the education, health, non-governmental organisation (NGO) and small, micro and medium enterprise (SMME) rural development sectors. Sample services will be developed to demonstrate the use of cell phones in these markets. The platform itself will further provide the opportunity for application, service development and customisation in a wide variety of markets (including government service delivery and the private sector). For instance, using the Keyword service as an example, a Keyword such as '*President*' can be configured to allow the sender to log a complaint via the Presidential hotline service and send back an SMS to the user confirming that that his or her complaint has been recorded, along with a reference number for follow-ups.

As the platform provides integrated and coherent access to various mobile channels, it becomes possible to provide services that are independent of the capability of individual handsets and which are future-proof. For example, an information access service such as weather information can be provided via a keyword-SMS request (e.g. weather Pretoria), a USSD menu system, a Mxit menu system, an interactive-voice-response (IVR) service, an MMS-response (e.g. picture of the weather in the region in response to an SMS request), a customised mobile application and a mobile web interface. The basic data and service are made available according to the capabilities of the handset.

For the telecom network operators to be more than mere 'bits pipes', they need to create high-performance open service platforms which third parties can use to build service (Cuevas et al., 2006). The IP-based signalling protocols such as SIP can form a service control overlay on top of this infrastructure layer; *Mobi4D* then sits as a service delivery platform. The value proposition for this JSLEE-based platform lies in the Resource Adaptor architecture which allows integration with legacy telecommunication networks.

2.5 **Organisational benefit**

In addition to the stated business benefits, Meraka Institute and the greater CSIR will enjoy the following further benefits:

- Accelerated mobile innovation with all mobile-related activities consolidated as part of the *Mobi4D* research and development project
- Increased cost efficiencies through economies of scale
- Development of a cross-functional mobile centre of excellence within the CSIR
- Establishment of internal mobile solution delivery capabilities servicing the various CSIR divisions and, in so doing, ensuring that the various divisions focus on improving their own unique core capabilities rather than redirecting limited resources to developing fragmented mobile capabilities
- Enhanced probability of attracting further funding from external parties interested in mobile innovation.

3 Conclusions

Mobi4D, through its network agnostic service delivery capabilities, provides an ideal environment for valued-added mobile services. The inherent complexity, in terms of technology and telecommunications expertise and knowledge, is handled by the platform and thus enables service providers to focus on their specific services. Value-added services can be developed and deployed by various developers

independently of networks. This capability further allows *Mobi4D* to deliver services to a wide range of mobile devices, independent of their individual capacities and capabilities – thus providing access to services and content to users of not only feature phones, but also low-end phones.

The *Mobi4D* platform will create an opportunity for South Africa to take advantage of the cell phone as an alternative, yet crucial, ICT tool for empowerment and development in Africa. It will enable a standards- and framework-based approach to creating mobile services via reusable, scalable and integrated components and approaches, utilising the various functionalities of cell phones, in ways that make sense in Africa. In the long term, it will create the building blocks from which non-ICT experts can quickly and easily create services and applications so that they can more efficiently reach their markets, using the most pervasive ICT device in the world today. Although this may seem like a very Africa-specific approach, we are convinced that the use of the cell phone as the computing device of choice will quickly be emulated in the rest of the world as these devices become more powerful, more ubiquitous and even more multi-functional.

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