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Mobile4D Platform

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Abstract: The mobile telecommunications story 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. There have been large cellular infrastructure investments, which have enabled millions of people to communicate better. This paper looks at the various technical & operational considerations associated with creating a middleware platform for mobile services that will 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 the reusability of components, 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 will enable faster development time.

Keywords: Mobile, Development, Reusable, Development Time

1. Introduction

The International Telecommunications Union 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[1]. The total number of cell phone subscribers continent-wide at the end of the first quarter of 2007 was 208 million which grew to more than 340 million by the end of 2008.

The impact of mobile technology and its implications on the life of ordinary people in developing countries appear to be more far-reaching than what they were in the earlier developed country rollouts[2-3]. Studies have demonstrated that mobile technology is driving improvements in social links, the creation of social capital, improved market information flows and productivity, as well as increases in Gross Domestic Product (GDP) and Foreign Direct Investment[4].

The ubiquity of the cell phone as the "PC of Africa" has overturned traditional models and thinking about the much vaunted "Digital Divide", which has rather become a "Digital Difference [1, 5-6]", with the cell phone as the bridge of choice in Africa into the information society.

2. Objectives

The overall project objectives of Mobi4D are to design, develop and operationalise a flexible and scalable mobile service delivery platform, conceptually depicted in the Figure 1 below. This platform will allow for providing services and support to various communities via currently accessible mobile phone technologies.

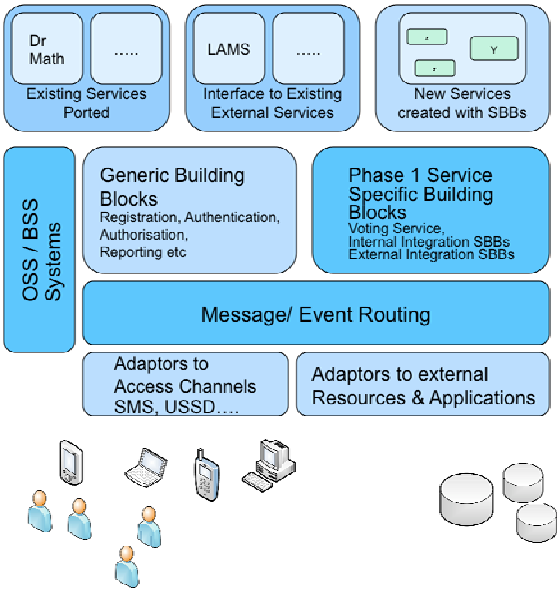

Figure 1: Conceptualisation of Mobile Service Delivery Platform

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 selected solution should be open standards based 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 & external ICT solutions;
- *Reusable Modules*- ability to develop mobile services using new as well as 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 standalone mobile applications;
- *Scalability* - i.e. ensuring that the Mobile Delivery Platform can be scaled up to meet the anticipated concurrent user load;
- *Availability* - i.e. ensuring the platform is architected as a high availability solution;
- *Ease Of Use* - i.e. ensuring that all users of the systems including end users, contributors and facilitators can interface with the solution using properly designed User Interface; and
- *Leverage Available Skills* - development and support of the selected solution should not require scarce specialised skills; with the basic set of Java and related development and support skills, available technical resources should be able to work on the solution.

2.1 Solutions Considered

The following identified solutions and approaches were evaluated against the list of requirements listed above:

2.1.1 OPUCE

Open Platform for User-centric service Creation and Execution (OPUCE) was an Integrated Project that started in September 2006, funded by the European Union's Sixth Framework Programme (FP6), and ended on February 2009. The purpose of the project was to produce an open service infrastructure that could enable users to easily create and deploy services in heterogeneous environments and ambiances. The OPUCE open platform allows traditional information services to be merged with communication capabilities through a user-centric platform, which is supported by Web 2.0 technologies and a User-Generated Service paradigm. This allows non-technically skilled end-users to create and share their own Internet/Telco service Mashups.

2.1.2 SPICE

Service Platform for Innovative Communication Environment was also a European Union's Sixth Framework Programme (FP6) funded project, which formed a consortium consisting of 23 partners in 11 countries ranging from Telecom operators and equipment manufacturers to research centres' and universities. One of the key project objectives was to provide an easy and simple way to create and roll out innovative services over heterogeneous execution platforms, networks and terminals that can reduce development time, cost and risks.

2.1.3 Twisted

Twisted is an event-driven network engine written in Python that supports a wide range of network protocols. It originated prior to January 2001 as the underlying framework for an open source multi-player interactive fiction game called Twisted Reality. Donations, handled by the Twisted Software Foundation, contribute directly to the ongoing maintenance and development of Twisted that forms the basis for several other open source projects. The framework includes various servers and Application Programmer Interfaces (APIs) that help software developers in creating asynchronous based internet applications that make use of different communication protocols.

2.1.4 Mobicents

Mobicents was started as an open source Voice over Internet Protocol (VoIP) middleware platform and evolved to be the first and only open source platform to be certified for JSLEE 1.0 compliance. It is a communication platform that has architecture for creating, deploying and managing services and applications by integrating voice, video and data across a range of IP and telecom communication networks. In 2007, Red Hat made a firm commitment to enter into the emerging Telco middleware space by doubling the investment in the JBoss middleware offering and officially backing the *Mobicents* project. They now offer a carrier-grade middleware platform based on the *Mobicents* project that fall under the JBoss Communications Platform brand.

2.1.5 Telco specific User-Generated Services

A variety of communication network operators have started initiatives to address User-Generated Services for the Telecom domain. Some of these platforms allow users or developers to combine services together to develop new applications for mobile and internet communications. Some of the initiatives we found were: the British Telecom (BT)

Web 21st Century platform, the Spanish Telefonica's Open Movilforum, Vodafone's Betavine, United Kingdom's Orange Partner and America On-Line (AOL) Developer Network

Table 1: Solutions Measured Against Criteria Identified

Cryteria	OPUCE	SPICE	Twisted	Mobicents	Telco specific
Minimal Total Life cycle cost	✓	✓	✓	✓	?
Standards Compliant Solution	✓	✓	×	✓	?
Bearer & Device Agnostic	✓	✓	✓	✓	✓
Ease of use and accessibility	✓	✓	×	×	✓
Synergies and Interoperability	✓	✓	✓	✓	×
Reusable modules	✓	✓	✓	✓	✓
Flexibility and extendibility (1)	✓	✓	✓	✓	×
Flexibility and extendibility (2)	✓	✓	✓	✓	✓
Scalability	✓	✓	×	✓	✓
Availability	✓	✓	×	✓	✓
Ease of use	✓	✓	×	×	✓
Leverage available skills	×	×	×	✓	×

The *Mobicents* middleware platform was selected as the base platform of choice, as it is implemented on the JAIN SLEE specification. The motivation for the JAIN SLEE specification came from the difference between event driven systems and enterprise systems. Event driven systems are typically asynchronous high frequency events seen in telecommunication switching, industrial automation or flow control systems and use specialized high performing event driven engines. The JAIN SLEE specification also permits popular protocol stacks such as Session Initialization Protocol (SIP) and Simple Message Peer-to-Peer (SMPP) protocol to be connected as resource adapters allowing for the addition of further network communication mechanisms. A Service Logic Execution Environment (SLEE) component is called a *Service Building Block* (SBB) and is hosted by a SLEE container, which acts as the SBB's run-time environment, therefore managing the full life-cycle of the SBB on behalf of the developer. This helps the developer to focus on developing reusable service blocks based on business needs, rather than the service architecture.

Mobicents enables the composition of Service Building Blocks (SBB) such as call control, billing, user provisioning, administration, and presence sensitive features. The JAIN SLEE specification allows popular protocol stacks such as SIP to be plugged in as resource adapters. The SLEE service building blocks - SBBs have many similarities to Enterprise Java Beans (EJBs). The extensible standard architecture naturally accommodates integration points with enterprise applications such as Web, Customer Relationship Management (CRM) or SOA end points.

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. *Mobicents* SIP Servlets are also used to handle the SIP protocol and use a stateful Enterprise Java Bean (EJB) as a gateway to communicate between the SIP Servlets and the JSLEE worlds

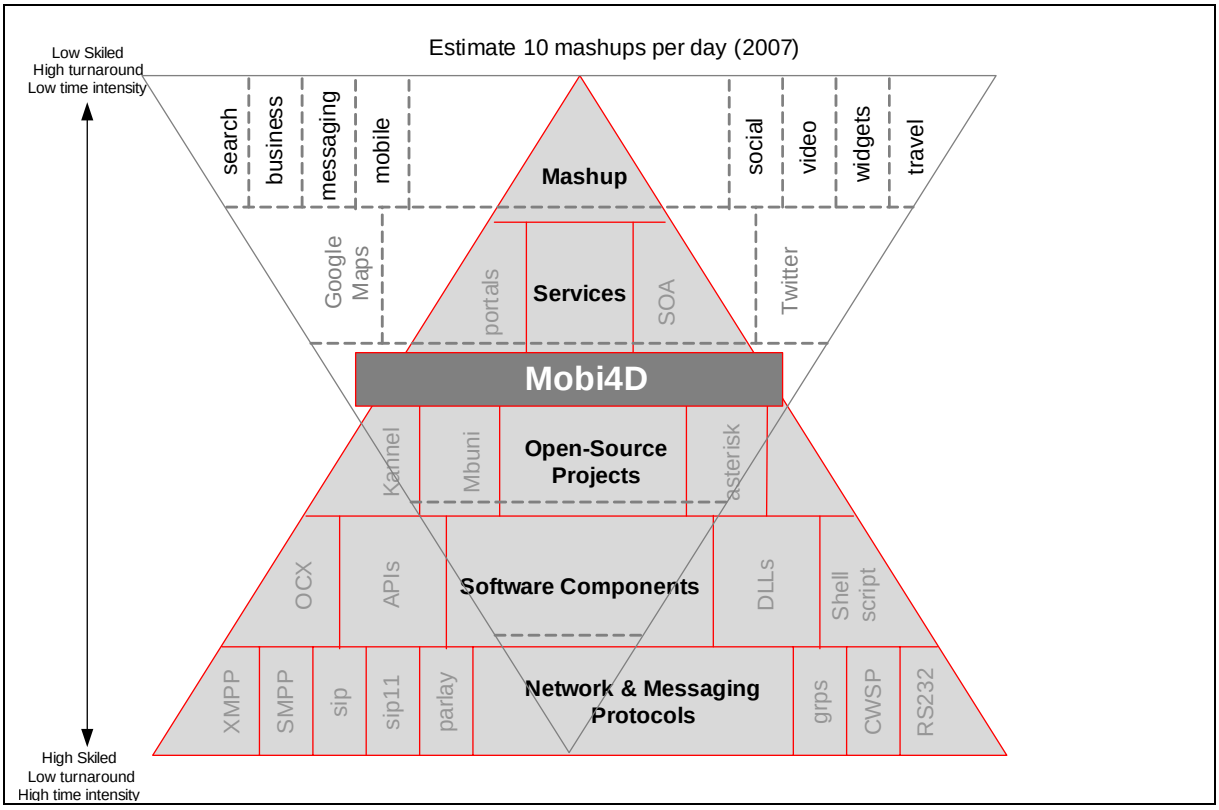

Figure 2: Level of Technology/ skill and effort that Mobi4D is aimed at.

3. Methodology

All development work will be undertaken in close cooperation with users and tried, tested and piloted using an iterative approach via the design research methodology. The domains will then be expanded to include health, disability and rural development. There will also be a focus on operational and business support systems, such as making provision for billing and advertising

Various technology solutions and approaches were evaluated against a list of requirements indentified. The decision was made to use the *Mobicents* platform as one of the principle components of the planned Mobi4D Service Delivery platform. *Mobicents*, part of the JBoss Communication Platform, is a next-generation service delivery platform enabling the delivery of converged, network-agnostic services and applications. The solution brings to telecom applications a robust component model and execution environment that compliments J2EE to enable convergence of voice, video and data in next generation intelligent applications

4. Technology Description

Various technology solutions and approaches were evaluated against a list of requirements indentified. The decision was made to use the *Mobicents* platform as one of the principle components of the planned Mobi4D Service Delivery platform. *Mobicents*, part of the JBoss Communication Platform, is a next-generation service delivery platform enabling 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 [9].

One of the goals of JAIN SLEE specifications is to define standard component architecture for building distributed object-oriented communications applications using the Java programming language [10]. Thus the *Mobicents* solution brings to telecom

applications a robust component model and execution environment that compliments Java 2 Enterprise Edition (J2EE) to enable convergence of voice, video and data in next generation intelligent networks applications and services.

4.1 Mobicents SIP Servlets Application Examples

Converged applications and services can be developed using *Mobicents*. The *Mobicents* SIP Servlet Shopping Demo application [11], for instance, illustrates how J2EE can leverage *Mobicents* SIP Servlets to provide voice, data and messaging services seamlessly. Another example illustrates integration between *Mobicents* and OpenIMS Core, using the Diameter Sh interface to receive profile updates and SIP [11]. The Fraunhofer Institute for Open Communication Systems (FOKUS) has developed the openIMS Core [12] as an ideal testbed environment to provide standard set of technologies that allow researchers to quickly develop and test IP Multimedia Subsystems (IMS) based concepts and service.

Other applications and services examples can be found from the *Mobicents* examples web page [11]. These examples also provide a good starting point for developers and researchers to get hands-on tutorials on the *Mobicents* application server and its technologies.

5. Developments

This platform will differ from similar platforms, in that it will be a first of its kind to focus specifically on the needs of Africa, taking into account the unique context of African users. It will be a technology innovation developed by Africans for Africans, in an agenda set by Africans. It is an opportunity to lead in an ICT space where the rest of the world is sure to follow over the next few years. The concept of the cell phone as the “PC of Africa” is a crucial one and has a significant impact on the approach that will be taken in conceptualising, developing and testing various solutions that will use the mobile platform as an underlying building block. In the developed world, or PC-primary world, cell phones are seen as a mobile extension of traditional PCs, with the most famous example being the iPhone. Very little can be done on an iPhone without extensive access to a PC for customisation and updating. This will not work in Africa, where many people are mobile-primary users who will probably never have access to a PC and are thus using many of the functionalities of a cell phone in the same way as they would a PC. This is a paradigm-shift in thinking with regard to developing solutions for Africa. The success of devices like Netbooks and some of the research emerging from developed countries with regard to the increasing use of cell phones in the youth market, points strongly to the fact that over the next few years the cell phone may become the ICT device of choice worldwide. So, while the platform will be developed for Africa, there are strong indicators that it will have application worldwide.

6. Status of the Mobi4D Platform Development

The first phase of the platform development is aimed at providing a sufficient proof of concept by developing Resource Adaptors (RAs) for popular mobile services such as Short Message Service (SMS), Unstructured Supplementary Service Data (USSD) as well as Instant Messaging (IM). Currently the SMS and USSD RAs and their respective SBBs are fully functional, a Simple Short Message Interface (SSMI) RA has been developed which connects these components to an aggregator, this aggregator acts as a gateway for sending and receiving SMSes and USSDs. The Authentication and Authorization module 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

expressly to enable the platform to communicate, through the LDAP RA with the openLDAP directory server to perform authentication and authorization of services users.
For the IM service, a Libpurple RA has been developed, along with its SBB, this RA allows 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 a user is able to chat to people in his/her buddy lists from one central IM – the Mobi4D IM service.

A Diameter server is planned to support commercialization efforts; it will provide means to support service charging as used in most IMS applications and other converged-networks services. A reconfigurable Keyword SBB is being developed to provide an easy-to-configure keyword lookup service; the look up service is envisaged to allow its owner to define how keyword request responses are to be rendered back to the end user.

7. Business Benefits

Beneficiaries include the target markets in the education, health, Non-Governmental Organization (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 provide the opportunity for application and 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 the his/her complaint has been recorded, along with a reference number for follow-ups.

8. Conclusions

The Mobi4D platform will create an opportunity for South Africa to take advantage of the cell phone as a crucial ICT tool for empowerment and development in Africa. It will enable a standards- and framework-based approach to creating mobile services via re-usable, scalable and integrated components and approaches, utilising the various functionalities of cell phones, in ways that make sense in Africa. Over the long term it will create the building blocks for non-ICT experts to 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 to be a very African-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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