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# Mobile Identity as a tool to develop society

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**Abstract**— Mobile communication, as its name says, is intended primarily for human to human communication e.g. telephony, SMS, IM, etc. but could be used as a direct active tool in the development of the society. In developing countries, especially in rural areas, where there is still very limited or non-existent administration infrastructure mobile communication could play a more important role. This paper presents the Mobile Identity concept, which makes use of mobile communication in the establishment and development of the citizen identity and hence paving the way for other societal services like government, education, health, finance, etc. Use cases such as Mobile Birth registration, mobile phone as identification and authentication token are described to illustrate the Mobile Identity concept. Value propositions for governments and mobile operators and the social benefit are demonstrated. The future financial feasibility Studies are also recommended.

**Keywords**-component: *Mobile Identity; mIdentity; mobile ID; Identity Management, citizen identity*

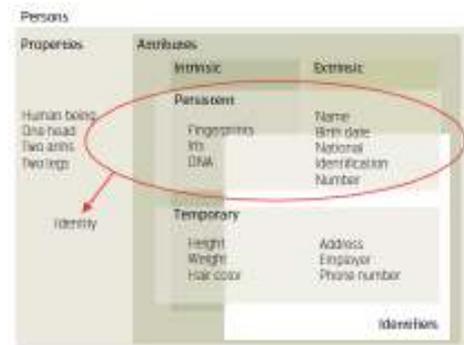
## I. INTRODUCTION

Mobile communication has so far encountered the fastest expansion than any communication system. According to a report by Ericsson, the Swedish provider of telecoms and data communication systems, the global mobile penetration has reached 85% in the fourth quarter of 2011 and mobile subscriptions totaled around 6 billion. This popularity can be easily explained by the fact that communication is the heart of all human activities. Telephony, SMS are "killer applications" that bring value to the user's daily activities. However, the potentials of mobile communication are not yet fully exploited. For example, its capabilities are not yet employed in the development of the society. In emerging countries that do not yet have sufficient infrastructure, the societal and economic contributions of mobile communication could be much larger than it is today. To remedy the situation, the GSM Association [1] with the cooperation of global operators like Telenor [2], Orange[3], etc and international organizations like Unicef [4], Plan [5], etc. has initiated a Mobile Identity programme aiming at releasing the potentials of mobile communication for the benefit of developing countries.

The goal of this paper is to shed light on the concept of Mobile Identity, which proposes to use mobile communication as enabler for the establishment of citizen identity and hence paving the way for other societal and public services. The paper is aiming at showing that the Mobile Identity is both a technically feasible and a social economically beneficial concept. The paper starts with reviewing the notion of identity, citizen identity and digital, which are essential to understand the Mobile Identity concept. The heart of the paper is the clarification of the Mobile Identity concept. Technical implementation alternatives and values propositions for governments and mobile operators are also identified. The paper also recommends future financial feasibility studies for the mobile identity concept.

## II. DEFINITION OF IDENTITY

As defined in [6] an **identity** is a set of permanent or long-live permanent attributes and personal identifiers associated with an entity such as an individual. With an identity, it must be possible to recognize an individual.



**Figure 1 Definition of identity**

As shown in Figure 1 an *identifier* is an *attribute* that is most representative for an entity within a context. An identifier is also referred to as name, label and designator.

Related to identity there are three different processes that need to be clarified as follows:

- **Identification** is the association of a personal identifier with an individual presenting certain attributes [11]. For

example, accepting the association between a physical person and claimed name, or determining the association with a medical record and a patient using physical attributes.

- **Authentication** is proving an association between an identifier or attribute, and the relevant entity. For example, an automobile is identified by its license plate, and that is authenticated as legitimate by the database of cars that are being sought for enforcement purposes.
- **Authorization** is a decision to allow a particular action based on an identifier or attribute. Examples include the ability of a person to make claims on lines of credit, the right of an emergency vehicle to pass through a red light or a certification of a radiation-hardened device to be attached to a satellite.

In most of countries, in order to ensure the rights and obligations of citizens governments needs to establish a citizen identity used in the identification and authentication of their citizens.

A **citizen identity** includes quite often the following attributes:

- Full name (i.e. First, Middle and Last Name)
- Birth Date
- Gender
- Place of Birth
- Parent Names
- National identification number (e.g. social security number, national number, personal identification number, personal number)
- Religion
- Ethnic
- Citizen status

However, an identity with only the mentioned *extrinsic attributes*<sup>1</sup> is very difficult to verify since extrinsic attributes can be copied, falsified and mistaken easily. *Intrinsic attributes*<sup>2</sup> like face, fingerprints, iris, etc. must be used to ensure the authenticity of a person. In addition, these attributes must be stored in databases that are available and accessible for authentication when requested.

To facilitate identity authentication additional credentials or identification document or identity card are introduced.

A **credential** is an attestation of qualification, competence, or authority issued to an individual by a third party with a relevant de jure or de facto authority or assumed competence to do so.

An **identification document** or **identity card** is a credential designed to verify aspects of a person's identity. Information present on the document might include the bearer's full name, a portrait photo, age, birth date, address, an identification

number, profession or rank, religion, ethnic or racial classification, restrictions, and citizenship status. New technologies could allow identity cards to contain biometrics such as photographs, face, hand or iris measurements, or fingerprints.

A **digital identity** is a representation of a human individual's identity in a computer network system like Internet, Corporate Intranet, Home networks, etc. A person does not really exist in the cyber world. Moreover, the communications and interactions in the cyber world are not face to face. People do not see who they are dealing with. Consequently, the physical intrinsic attributes like face, hair colour, fingerprint, etc. cannot be used to identify the user. Extrinsic attributes and identifiers like name, pseudonym, etc. are required. Unfortunately, they can be easily copied and duplicated. A credential must hence be introduced as an additional attribute to prevent theft of identity. This credential is a secret that only each individual and the corresponding authentication authority know. In its simplest and weakest form, this credential is a password. For higher level of security, encryption keys and algorithms are used to realize this credential.

### III. THE MOBILE IDENTITY CONCEPT

There is no unanimous and clear definition of Mobile Identity. According to [7] "*Mobile Identity is an extension of the digital identity which may be divided into three classes (and their combinations): device-to-device, location-to-location, and context-to-context.*" Mobile Identity is intended for the authentication and authorisation to resources when moving and changing devices, locations or contexts. Another different definition is from the Estonian government in their e-Estonia programme [8] which defines Mobile-ID as a service that allows a client to use a mobile phone as a form of secure electronic ID.

With the focus on developing countries we adopt a broader definition for Mobile Identity that will be elucidated as follows:

In every society, establishing the identity of the individual is the cornerstone for development and prosperity. Indeed, a government can only provide services like health, education, security, financial, etc. to its citizen with the existence of a sound identity system. Unfortunately, this is not always the case in developing countries.

**Mobile Identity** is defined as the concept of making use of mobile communication in the establishment, development and protection of citizen identity.

Hence, Mobile Identity includes the following features:

- Use of mobile communication including mobile network, infrastructure and distribution chain in:
  - The establishment of citizen identity.
  - The distribution, authentication and verification of citizen identity.
  - The provision of governmental, public and social services.

<sup>1</sup> Attribute acquired from the outside world

<sup>2</sup> Attribute that belongs by nature

- The provision of financial, private and enterprise services.

- Use of mobile phone as an identification and authentication token.

The Mobile Identity concept will now be illustrated with some concrete use cases.

#### A. Establishment of citizen identity – Birth registration

In developing countries today, people living in poverty in rural areas do not have any kind of identification e.g. social security number, driving license, military ID, etc. and identity verification systems are not functioning properly. Every year, 51 million babies remain invisible and are being denied their right to an identity, to the fulfilment of additional rights and to protection as citizens.

Statistical analysis [9] show that children under five year old whose births have not been registered, tend to:

- Being poor, living in rural areas, having limited access to health care.
- Not attending early childhood education.
- Having higher levels of malnutrition and a higher mortality rate.

The consequences of the lack of birth certificates are very severe as follows:

- Difficulty in enrolling at school or taking exams.
- Access denial to health services such as vaccination programmes.
- Problems in being reunited with the right family after being trafficked or separated from families due to conflict or natural disaster.
- Child headed households are often denied inheritance.
- Problems accessing bank accounts, financial products, passports, ID cards, voting.
- Problems accessing telecommunication services and mobile money services (e.g. M-Pesa).

#### B. Obstacles to birth registration

The low rate of birth registration are due to the following reasons:

- **Long distance and lack of transportation means:** Village chiefs or registration agents have often to travel long distances to register the births which have occurred in their assigned areas. This can be costly time consuming and impractical if they have to use public transportation. The level of effort required can appear disproportionate especially as the importance of birth registration is not always well understood.
- **Lack of awareness:** In many cases, the rural population is unaware of the importance of birth registration. Literacy remains low in many rural areas

of Sub-Saharan Africa and legal documents are often not clearly understood by citizens.

- **Administrative delays and inefficiency:** According to field research in Senegal, it is quite common for registration offices to run out of official registration forms. In other cases, offices refuse to register people if they do not pay for the certificate at the same time. Such problems contribute to undermine people's willingness to register new-borns.
- **Cost and poverty:** Quite often, birth registration is free as in Senegal or rather cheap in Uganda when it is done on time. However, associated travel expenses can be discouraging, though it is important to note that families often travel much greater distances to inform friends and family of a birth (and incur greater cost). Combined with the time required to complete a registration, the low level of awareness of its importance, and the other financial priorities of families on extremely low incomes, the perception of the cost of registration serves to further reduce participation.

Taking into consideration the mentioned obstacles the usage of the mobile telephone and network could contribute to improve the current birth registration.

#### C. Mobile Birth Registration

Out of the 192 UN members only about 100 countries have a national ID card system but all do have some level of mobile communication services. Therefore, it is a reasonable idea to make use of mobile communication in the birth registration.

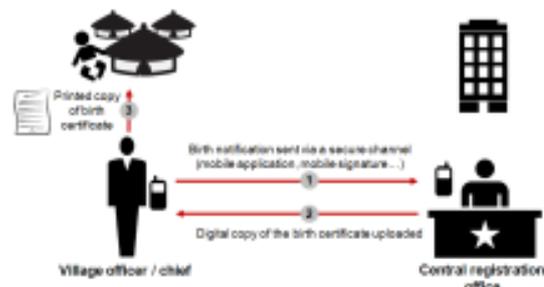


Figure 2 Mobile Birth registration (source: GSMA)

As shown in Figure 2 the mobile birth registration is carried out in the following way:

When a baby is born, the village chief uses a mobile phone equipped with a Java application or with USSD (Unstructured Service Data) to send its details and its parents' ID to the local registration office via the GPRS network. After the registration is confirmed, he receives a message with the birth record number.

When a birth certificate is required, this number can be given to the registration office who can issue an official copy of the birth certificate.

Pilots organised by mobile operators in collaboration with Unicef and Plan have been successfully carried out in Senegal, Kenya and Uganda. 100% of births have been registered in the trial regions and governments are now considering similar mobile solution for marriage and death registration.

*D. Use of mobile phone as an identification and authentication token.*

As mentioned earlier a large number of people in developing do not any kind of identification but there is higher probability that they carry a mobile phone. Consequently, it does make sense to transform the mobile phone to an identification card.



**Figure 3 Mobile phone as an identification card (source: GSMA)**

The use case shown in Figure 3 works as follows:

The user goes to a telecom retailer store with a certified personal information, which could be a birth certificate, a letter from the village chief, a company ID card, a pension card, a passport, etc. The mobile operator scans the document, takes picture of the user, collects data about the user such as first name, last name, date of birth, place of birth, address, etc. and eventually records the user’s biometrics such as fingerprints, eye retinas and irises, voice patterns, facial patterns, hand measurements, etc. The user’s mobile identity consisting of all the mentioned items will then be saved either in the SIM card or/and a data register in the mobile network.

The user can now display and view his/her mobile identity of the mobile phone. He/she is able to forward, send, or retrieve a copy of ID whenever he/she wants from a point of sale.

**IV. TECHNICAL IMPLEMENTATION**

To implement a complete Mobile Identity concept, it is necessary to use advanced security methods both in the SIM card and in the server in the network, which may require substantial investment. However, to start with, operators in developing countries may consider deploying the birth registration that is simpler and hence less expensive.

There are currently two implementation alternatives:

- **USSD solution:** In this solution the protocol Unstructured Supplementary Service Data is used to

establish a connection between the mobile phone and the data register in the network. The strength of using USSD is due to the fact that no SIM replacement is required and current SIM cards can be used. Closed User Group Closed User Groups are set up locally between notifiers, parish chiefs and the sub-county chief. Each of them is identified by his mobile phone number.

- **Pre-installed widget solution:** This solution is based on a java widget which was designed for the birth registration process. Java was preferred to SMS or USSD because it can be customized easily.

Several improvements can be introduced as follows:

- **Stronger user identification:** Currently, the village chief or authorized officer is identified through the MSISDN, which can be strengthened by a PIN. However, stronger solutions based on PKI (Public key Infrastructure) providing both stronger authentication and confidentiality can also be used within reasonable cost limit.
- **Better user friendliness and accessibility:** The ease of user could be improved by introducing local languages that are used in the country.
- **Interoperability:** The next step is to extend the service to other mobile operators in the country, making the mobile birth registration a national service.
- **Introduction of additional services:** In longer terms, it would be very beneficial to offer services like retrieval of birth certificates at point of sales, forwarding of birth certificates to other governmental offices such as health, education, security, etc.

**V. VALUE PROPOSITIONS**

The Mobile Identity is undoubtedly valuable to the people in rural areas but it is nevertheless quite compelling both the governments and mobile operators.

For governments the values are as follows:

- **Cost efficient:** Digital document management is usually 6 times less costly than paper equivalents
- **Better security:** Potentially, mobile ID on the phone can be more secure because it is protected by a pin or is stored securely on the SIM or servers
- **Higher flexibility:** Identity can be managed remotely (mobile certificates can be erased, forwarded to another party easily etc)
- **Better services to the citizens:** Putting identities on mobile phones will allow users to access places and services anytime, anywhere

For mobile operators the values are as follows.

- **Leveraging their assets:** The SIM card own by the mobile operator will have more important role since it carries in addition to service data user personal data.
- **Reducing churn:** With the SIM strongly tied to the users, it is less likely that they will change operators.
- **New revenues:**
  - Diversify revenue streams with new B2B solutions to public and private clients
  - Increase customer ARPU
- **Extended reach and improved image:**
  - Facilitation of ID registration means more citizen will be able to access mobile operator services
  - Improving operator's image
- **Best defence against Internet players:** Big players such as Apple, Google or Facebook are entering the identity field with their Over-the-top services like Google Authenticator, Facebook Connect, etc) and Mobile Identity is the operator's best weapon.

## VI. SOCIAL BENEFIT ANALYSIS

To demonstrate the benefit brought by the Mobile Identity concept, a comparison between mobile birth registration and the traditional paper registration was carried out. The obvious value of the mobile birth registration is to increase the registration rate from around 30-40% to 100%. The challenge here is how to monetize the outcomes of mobile birth registration and how to prove that it is better than the paper registration. In fact it is very difficult or almost impossible to put a value on a child's life. To avoid a Cost-Effectiveness Analysis (CEA) is performed.

*The Cost-Effectiveness is defined as the ratio of Cost to Outcome. Lower CEA will yield high effectiveness.*

According the report the birth registration in Senegal increases from 55% to 100% and Uganda 21% to 80%. We have an outcome of 45% and 49%. The cost of the Mobile Birth registration in the case of Senegal with 300 children registered in 2 months, can be computed as follows:

- 30 mobile phones x \$45,8 = \$1374
- Cost for software: \$0,56 x 30 = \$16,8
- Data packages: \$4,8 x30 x 2 months = \$288

The total cost is: \$1678,5 .The cost per birth registration is: 1678,5\$ divided by 300 = 5,596 – \$6 per birth registration

The current paper birth registration costs 12\$. The cost effectiveness Analysis (CEA) for mobile birth registration in Senegal:  $6/100 = 0,06$ . The CEA for paper birth registration:  $12/55 = 0,21$

The lower CEA shows that the mobile registration is both more efficient and more cost-efficient than the current paper registration.

## VII. RECOMMENDED FUTURE FINANCIAL FEASIBILITY STUDIES

Utilizing Mobile Identity as a tool to develop society is a new concept that been piloted in different sections of the population in third world countries. There has not been a preceding financial evaluation of such system in the current literature. Where mobile devices were used to register birth data, a paper system was still maintained in Uganda and Kenya. The following data should be gathered for future financial feasibility evaluation:

- Current IT (or manual) infrastructure cost for a local government to maintain and update birth registration records
- Manpower required (man hours X hourly wages) and incremental overhead required to maintain existing population growth X % of official birth registration to determine incremental variable costs.
- If the current birth registration level, say 30% was to be expanded to 100%, what would be the cost for the local government to implement such a program?

A financial feasibility can be calculated using the following method:

- A financial return based on infrastructure investment, future revenue streams, incremental cost to implement a mobile identity system, upfront investment for a Mobile Identity system to conform with local laws and security regulations for SIM card registration
- Cost reduction for the local government replacing part of the paper system with a more cost effective digital system
- Future cost avoidance based on scalability of a digital automated system versus a manual system with a more effective back-up recovery system

Various financial institutions such as banks and financial service companies such as Western Union have used mobile devices to transfer encrypted secured money transfers and financial transactions. These financial institutions have established on a worldwide basis KYC (Know Your Customer) and KYP (Know Your Partner) compliance with local rules and regulations and AML (anti money laundering) laws. Local government post offices also have partnered with financial service companies to conduct secured encrypted financial transactions from person to person via a financial institution and local government office networks with a minimal fee as low as \$1 to \$5 dollar per transaction with built-in profits. Compliance with AML, KYC and KYP require significant investment and oversight and thus considered similar to digital birth registration procedures. For purpose of evaluation, this is used as a benchmarking for birth registration using mobile identity as a digital tool. Partnering with these institutions could potentially bring benefits to companies with a larger customer base. A digital system is highly scalable with low variable cost (5%) and large fixed cost investment (95%) when compared to a manual system. The numbers of transactions that staggered and staged for processing on a twenty four hour

basis, 24X7 with minimal peak and valleys for optimal system capacity utilization.

A pilot study can be conducted in the future with a controlled population and a foreign government that is willing to cooperate and share data. Incentives could be provided to the local governments for monetary benefits in term of cost reduction or cost avoidance when funding could be made available for other government services. A system can be developed as a stand-alone system or partnered with an existing government owned post office or financial institution where security. Confidential citizen IDs can be provided and retrieved on an existing encrypted network. Any pilot study that can minimize up-front large scale development or investment and allow large scale utilization would help achieve an earlier break-even level or a profitable level for both the provider and the government.

The following model could be introduced for feasibility studies:

1. Current government cost to provide for the existing birth registrations/number of birth registrations = cost per unit of birth registration at the current registration, say at 30%.
2. If the desired goal is to increase the 30% birth registration to 100%, the cost would become XX dollars.

In addition, the local government could estimate or provide the additional societal costs caused by the lack of birth registration such as healthcare, education, etc. The sum of these social costs plus the incremental variable cost to process the additional unregistered birth registrations by manual system would provide a basis for financial evaluation. For example, based on data presented on May 29, 2011 in the GSMA Mobile Identity Newsletter, the cost for low registrations in Southern part of Kenya is caused by a prohibitive cost for families to get their children registered at \$13/child. Financial institutions have been sending financial transactions varying from \$1 to \$5 per transaction with built-in profits. Using this as a benchmarking basis, a mobile identity used as a tool to register the estimated the 51 million unregistered births in 8 countries could be calculated as follow:

- $\$13 - \$1 = \$12$  potential savings
- $\$13 - \$5 = \$8$  potential savings

Mobile identity if utilized as a tool to register births could save anywhere from \$8 to \$12 per registration. Let examine the case of Uganda (Uganda Bureau of Statistics projections or UBOS) as follow:

- 2011 mid-year population 32,939,830
- Estimated 1.5 million of children born per year
- Children under the age of 5 years old: 6 million births
- Children under 5 years old without birth certificates: 4.5 million children or 70%

Based on these statistics, the current cost of the Uganda government to register 1.5 million children are estimated at 1.5

million X \$13 cost per child = \$19.5 million. To register the additional 4.5 million, it would cost an additional \$58.5 million. The total cost to register the entire Uganda population birth certificates would cost \$78 million. Using financial institution rate per transaction as a proforma ranging from \$1 to \$5 per digital transaction and applying it to mobile identity, it could cost anywhere from \$6 million (\$1 X 6 million unregistered births) to \$30 million (\$5 X 6 million unregistered births). The scalability of a digital mobile identity could save in the range of \$72 million (\$78 million - \$ 6 million) or \$48 million (\$78 million - \$30 million). This would be the basis of justification for an investment in the telecommunication and Information Technology system in Uganda as a breakeven point. The incremental cost for infrastructure investment and variable cost per device could be funded by the Uganda government or partnered with the Mobile Network Operator. Any subsequent sale or profit would be realized by the Mobile Network Operator or shared with the partners. Such investment proposal could be evaluated using a long-term financial modeling taking into account demographic, social cost, revenue streams and incremental cost factors, cost of capital at the country specific levels using a discounted cash flow projections and evaluation method.

## VIII. CONCLUSION

In this paper we introduced this innovative concept of Mobile Identity, which constitutes a mean of establishing the citizen identity that is the fundament for the economic development. Due to the ubiquity of mobile communication Mobile Identity is an efficient enabler for other societal and public services such as government, education, health, etc. Mobile Identity is not only a fascinating but also a feasible and sound concept, which can be deployed in real life. So far, there are successful birth registration pilots in Uganda, Kenya and Senegal and several African and Asian countries have already announced their intention in having similar pilots. The next step will be to experiment the use of mobile phone as an identity authentication and verification token. To ensure the success it is crucial to promote the usage of feature phones in addition to smartphones because they have considerably lower prices and hence more affordable to the large population. It is therefore necessary to have the support of the terminal vendors such that the functionality required for Mobile Identity could be installed in feature phones.

## REFERENCES

- [1] The GSM Association – <http://www.gsma.com/>
- [2] Telenor ASA – <http://www.telenor.com>
- [3] France Telecom - Orange - [http://www.orange.com/en\\_EN/](http://www.orange.com/en_EN/)
- [4] UNICEF - <http://www.unicef.org/>
- [5] PLAN - <http://plan-international.org/about-plan>
- [6] Do van Thanh & Ivar Jørstad – The ambiguity of identity – *Telektronikk* Vol 103 No. 3 / 4 20057 – Identity Management - ISSN 0085-7130, published in Jan 2008.
- [7] European Network and information Security Agency (ENISA): *Mobile Identity Management*, edited by Maria Papadopouli, University of Crete, Greece April 13, 2010
- [8] E-Estonia Mobile ID - <http://e-estonia.com/components/mobile-id>
- [9] Unicef: *The 'Rights' Start to Life: A statistical analysis of birth registration*, Feb 2005, ISBN: 92-806-3858-0.