

The Evolution of India's UID Program

Lessons Learned and Implications for Other Developing Countries

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Abstract

India has embarked on an ambitious new program to provide its citizens and residents a unique, official identity. The UID (Universal ID) program aims to improve the delivery of government services, reduce fraud and corruption, facilitate robust voting processes, and improve security. It is by far the largest application of biometric identification technology to date and will have far-reaching implications for other developing countries that are looking to adopt national ID programs to further social and economic development. This paper discusses the evolution of the UID program, the innovative organization and pathbreaking technology behind it, how it is being rolled out, and how robust ID is beginning to be used.

The paper also draws lessons for other countries. Unlike many “legacy” national ID programs, the UID is designed from the ground up to

support authentication. Its use of multimodal biometrics increases inclusion into the main enrollment database and has a huge impact in improving accuracy. It relies on mobile technology, but has also become a driving force behind the development of that technology. Its standards-based approach opens the way for vendor competition and cost reduction. At the same time, its exclusive focus on authentication still leaves the problem of how to validate certain aspects of identity, such as citizenship status. The paper discusses this in the context of the turf war between the UID and the National Population Registry.

UID also shows the importance of learning from failure. The case of Andhra Pradesh, discussed in the Annex, showed both the potential value of biometric ID and weaknesses that led to that massive exercise failing to deliver on its potential.

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Foreword

Although it is still a work in progress, with close to 200 million people enrolled, India's innovative and ambitious UID program is already the largest biometric ID program in the world. Its applications are still at an early stage but the lessons—positive or otherwise—will have far-reaching implications for many other developing countries seeking to strengthen their ID systems to provide official identity to their citizens and to underpin improved delivery of services. It is also relevant for donors who fund many of these programs.

This paper by Frances Zelazny was commissioned as part of CGD's research to better understand and monitor the use of new technology for development. Biometric ID is a much-debated technology, and not all attempts to use it have been successful. Drawing on prior experience in India, the paper also shows the importance of learning from failure.

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Introduction

Over and over in the developing world, the lack of identity documents and identity systems has contributed to a poverty cycle and societal exclusion that limits access to education, health, banking, and opportunities for personal economic growth. Many countries with low GDPs do not have national identity systems in place, and many of the ones that do, suffer from high rates of under-registration. This means that citizens in those countries have no standard means to verify that they are who they claim to be. This becomes problematic because social programs, banking and aid interventions are based largely on claimed identities, which may or may not be valid, and these interventions may not be reaching the people who need it most. The implications of this are huge and oftentimes not recognized. In the meantime, millions of dollars are lost, resources wasted, and opportunities for advancement vanish. This is a phenomenon that has been recognized by various policy makers and stakeholders in the international community, yet one that has been hard to impact in a meaningful way.

Take for example, the phenomenon of ghost workers in Africa and elsewhere, which is as old as the civil governments in those countries. Instead of spending money on critical infrastructure and services, the bulk of government spending in many cases goes to keeping the governments running. Recent reports from Nigeria state that by weeding out 71K ghost workers, the government would be able to save \$175M annually¹. In Tanzania, the number is \$6M²; in Cambodia, \$32-43M per year³; putting the numbers into a clearer perspective, in Honduras, ghost workers makes up 8.3% of general practitioners and 5.1% of staff in the health sector⁴. Requiring a national ID system and running government payrolls and pension payments through systems that require biometric verification of identity when making and collecting payments can ensure that these misused funds can be put into good use.

In Pakistan, the National Database and Registration Authority (NADRA) has developed a very robust national ID system that was leveraged recently in providing cash assistance and prepaid debit cards in the wake of some recent flooding. The Watan Card program as it is called, provides victims displaced by the 2010 floods with pre-paid Visa cards. Qualification is based on an assessment by the Provincial Disaster Management Authorities and verification of identity against the NADRA database to ensure that people are who they claim to be. According to ReliefWeb, as of September 2011, more than 1.6 million households were served through program and a second phase, which was expected to serve an additional 1.1 million households⁵, was in the process of being launched.

¹ <http://www.news24.com/Africa/News/Nigeria-spends-175m-on-ghost-workers-20111028>

² <http://www.shout-africa.com/news/tanzania-ghost-workers-loot-tanzanian-budget/>

³ <http://www.radioaustralia.net.au/connectasia/stories/201011/s3073956.htm>

⁴ "Fighting Corruption in the Public Sector", Jorge Martinez-Vazquez, Javier Arze del Granado and Jameson Boex, 2007, p.99

⁵ <http://reliefweb.int/node/446866>

While it should be noted that in the developed world there continues to be resistance to national ID programs for various reasons, in the developing world, the national ID is increasingly becoming the cornerstone of a secure and trusted ecosystem, where the ultimate goal is for the ID card or the ID number to act as the single unique identifier in the country that supports multiple purposes and multiple applications in the private and public spheres. These could include tax filings, salary and pension payments, border crossings, voter verification, banking, land title registration, and so on. Very few examples of this exist today, but industry analysts expect that within 5 years, most countries will have some form of a national ID system in place and that these national ID systems will include biometrics⁶. The question for governments of developing countries becomes how to leverage these new eIDs in favor of more inclusion, greater efficiencies and improved delivery of services, as opposed to simply doling out fancy cards and creating high end digital registries that are unused.

This is an evolution that is still ongoing. It is an evolution that forces governments to think about identity as an integrated concept, as opposed to a card or piece of paper that is carried around. Today, there are several examples of this manifestation. In Estonia, the national ID is integrated into a broad range of e-government services, albeit without biometrics. Similarly, Belgium has promoted government applications online via the use of its eID card and has distributed smart cards to citizens. In Germany, a contactless ID card was introduced in November 2010 designed to support e-government and e-commerce services, and one million card readers were issued to consumers to promote the active use of the cards. In the developing world, Malaysia has one of the earliest multipurpose ID schemes, called MyKad, which serves as an ID card, driver license, travel document, health card, ATM card, electronic wallet and public transport payment card. China is the latest one to announce that it will add biometrics to its national ID card scheme, which will take over the old cards by January 2013⁷.

A big effort is underway in Latin America, as a result of specific initiatives put forward by UNICEF and the Inter American Development Bank (IDB)⁸ to address birth registration and civil registries specifically, and national ID systems more generally as a foundation for services. As a result, social, political and economic inclusion is becoming more pervasive in many government plans, although most have yet to be implemented.

As more and more countries begin to adopt this paradigm, the way in which countries go about it and the technologies chosen depend on their frame of reference. Regardless of the motivation, there are critical challenges that must be addressed in any national ID roll out,

⁶ Of the 114 projected National eID programs to be in effect by 2015, 81 include a microprocessor chip or optical memory based ID card with or without biometrics. Four programs consist of massive biometrics unique identification registries such as the UID program in India. Another 26 rely on a non-chip based cards, but utilize biometrics to uniquely identify cardholders with biometrics residing on the card, in a central database, or in both locations. Source: The Global National eID Industry Report, Acuity Market Intelligence, August 2011.

⁷ <http://www.eeo.com.cn/ens/2011/1024/214197.shtml>

⁸ IDB, Sector Strategy: Institutions for Growth and Social Welfare, March 2011

and these become especially magnified in countries with limited infrastructure, large rural populations, large manual labor workforce, unreliable communications and limited in-country skill sets. Compounding the problem can be past issues associated with delivery of government services and distrust associated with collecting personal information for one reason or another.

And so it is in this context, that India and its Universal Identity program (UID) provides a truly fascinating case study. What exactly is the intention of this approximately Rs. 180B⁹ (US\$3.4B) project, and why is it needed? The government professes that the UID project will provide each of the 1.2 billion people an identity and that this identity will be their ticket to upward mobility in ways that the current systems cannot provide. How is it being done? How is the project structured? Who are the players? What are the policies that the government has put in place to ensure uniformity, privacy and access for all? As UID evolves, it continues to be a learning process. Through it, there are critical lessons to be learned around standards, system design, government policy and jurisdictional considerations that this paper analyzes. One of the main issues that arises from UID are the limitations of its use as well, where the technology is ahead of the policy or the logistical issues on the ground are lagging behind the capabilities that the UID system can provide. For example, in establishing payments for employment guarantees, human intervention is still required to create the employee rolls, approve the hours worked, submit payroll information, etc. These steps must all still take place, regardless of whether the worker collects his/her payment via a UID-enabled mechanism or not. And oftentimes, the bottlenecks are unseen. (Issues of the security and public safety implications, privacy and legal frameworks are of clear interest as well, but are beyond the scope of this paper.)

At its conclusion, this paper also offers some suggestions on how other countries can leverage the Indian experience and where NGOs, policymakers and funding agencies can be most instrumental in promoting and managing biometric technology programs for service delivery and furthering social and economic objectives.

An Annex on the case of Andhra Pradesh provides insight into some of the questions around how the technology would scale, the importance of quality enrollment data and clear policy on program eligibility and the importance of having one identifier for multiple programs.

We conclude with three important disclaimers. First, UID is a work in progress. Research for this paper was conducted from December 2011 through April 2012, and many of the facts and statistics reflect the data available during this time period. As an emerging program, the UID is likely to present new lessons as it evolves further and as new information emerges – its outcome and impact are to be watched closely.

⁹ http://www.moneycontrol.com/news/current-affairs/uidtrouble-as-home-ministry-raises-questions_631934.html

Related studies on other programs will also likely have an impact on the future of UID. For example, among ongoing evaluation work, is Professor Karthik Muralidharan at University of California San Diego's continued analysis on the longest-running biometric electronic benefits transfer (EBT) initiative effects in Andhra Pradesh where smart cards are being issued to provide beneficiary welfare for over 18 months. More recently, Professor Muralidharan has also been looking at the potential for direct cash transfers to streamline the Public Distribution System in the State of Bihar, to increase efficiency, increase choice and minimize waste. In a presentation given in December 2011, Professor Muralidharan acknowledges that the UID is likely to result in lower levels of leakage with direct cash transfers since bank accounts are issued upon enrollment¹⁰, and calls for a pilot program to test different approaches.

Given India's size and complexity, it is likely that multiple programs will continue to run simultaneously as the UID gets rolled out and that ultimately the landscape will be an amalgamation of programs, some of which are stand alone and some of which rely on the UID.

Second, we recognize that technology alone does not determine impact. Much will depend on the social, logistical and political context in which it is used. UID will create winners and also potentially losers. The main losers will presumably those that had previously gotten away with double-dipping and other corrupt practices, but there are always questions raised by social economists on the use of biometrics in distributing entitlements and whether there is potential for exclusion if certain groups choose not to enroll or coverage is partial. Jean Dreze, a prominent activist, has been one of the more outspoken critics, arguing that the UID changes the approach of entitlements and benefits from that of human rights to more targeted and individualized.

Third, issues of security and public safety, jurisdiction, privacy and legal frameworks around identification are of clear interest, and have been the subject of considerable debate in India as well as in other countries. The paper does highlight some of the struggles between the National Population Register and the UIDIA, at the heart of which are security and jurisdictional concerns, but overall these issues go beyond the scope of this paper, which focuses on the design and rollout of the UID program, and the lessons for other countries that plan to strengthen their ID systems along similar lines.

¹⁰ http://www.theigc.org/sites/default/files/piloting_and_evaluating_e-pds_and_cash_transfer_options_for_improved_food_security_in_bihar_karthik_muralidharan.pdf

Section 2: Universal Identification for All Indians

Evolution of the UID

According to media reports, India's subsidy programs have historically amounted to nearly 14% of GDP¹¹. In fact, for the 2011-2012 budget, there was \$10B allocated for fertilizer subsidies, \$12B towards food subsidies and \$4.2B for petroleum subsidies¹². Yet, with all the resources that the government was pouring into food subsidies, including running approximately 499,000 Fair Price Shops across the country, an Asia Development Bank study found that the actual impact on the poor was minimal (approximately 5% of incremental spending). One reason was poor participation; another reason was that the subsidies were not actually reaching the intended beneficiaries – the poor makes up 55.4% of the population in India (645M people)¹³, whereas approximately 330M (or 27.5%) people were participating in the Public Distribution System (PDS)¹⁴. This was mainly due to fraud and excess costs, which accounted for as much as 71% of total public spending¹⁵. A 2008 Planning Commission report demonstrated that for example, more than one third or 36.7% of grain intended for poor households was instead sold to non-poor households, and that 58% of subsidized grains did not reach intended recipients due to various errors in delivery and identification¹⁶. From a policy perspective, finding ways to save resources that could be used to increase the participation rate in the various subsidy programs, and shed the waste, became a top priority.

The concept of a unique identification for all Indians was originally conceived in 2006, but it was not until 2008 that the Planning Commission of India created the Unique Identification Authority (UIDAI). In 2009, the UIDAI was elevated to a cabinet committee level post, and Nandan Nilekani, former Chairman of Infosys, was appointed Chairman. The goal of the UIDAI was “to develop and implement the necessary institutional, technical, and legal infrastructure to issue unique identity numbers to *residents* all across India” and to “issue a unique identification *number* that can be verified and authenticated in an online, cost effective manner, which is robust enough to eliminate duplicate and fake identities.”¹⁷ It was

¹¹ http://en.wikipedia.org/wiki/Subsidies_in_India

¹² <http://india.blogs.nytimes.com/2012/03/15/indias-budget-2011-what-was-promised-what-was-delivered/?scp=6&sq=government%20of%20india%20subsidy%20programs&st=cse>

¹³ Source: India Country Briefing, Multi-Dimensional Poverty Index, Oxford Poverty and Human Development Initiative, July 2010 - <http://www.ophi.org.uk/wp-content/uploads/Country-Brief-India.pdf>

¹⁴ Source: India Department of Food and Public Distribution
http://fcamin.nic.in/dfpd/EventListing.asp?Section=PDS&id_pk=1&ParentID=0

¹⁵ Source: How Can Food Subsidies Work Better? Answers from India and the Philippines Asia Development Bank, Economic Working Papers Series, September 2010,
<http://www.adb.org/documents/working-papers/2010/economics-wp221.pdf>

¹⁶ ASARC WP 2011/16, A Comparative Analysis of the Public Distribution System in India's States

¹⁷Source: Unique Identification Authority of India

determined that the UIDAI would have the authority to select the technology and decide how to build and manage the database. With a population of 1.2B people, the amount of data compilation and processing required was absolutely staggering; the UIDAI set out to develop a model of identity, security, and inclusivity to ensure people were who they claimed to be, that multiple identities for individuals were eliminated, and to allow the government to confirm that key services were delivered to the poor. But most importantly, the UIDAI wanted to ensure that people would not be denied services because they did not have an ID. The lessons learned from past ID programs indicated that the use of biometric technology was the way to ensure this.

After the launch of the program in February 2009, it was anticipated that 600M UIDs would be issued over an initial five-year period¹⁸. By the end of December 2011, the rate of enrollment was up to 1M per day and as of the middle of February 2012, 200M people were enrolled. As of April 13, 2012, approximately 168M Aadhaars had been issued.¹⁹

The UIDAI has not specified the exact cost per each unique identification number issued. The cost is reflective of a host of factors and varies depending on the scale of the enrollment, the equipment used, the training of the enrollment agents, and many other factors. However, based on the 200M people enrolled as of February 2012²⁰, the cost is equivalent to approximately Rs. 40.62 (US\$0.79) per number²¹. This represents a total expenditure of approximately Rs 813.29 Crore (US\$158M) since the inception of the UIDAI in 2009²². Part of the expenditure includes an incentive fee for Registrars. To defray the costs, the UIDAI plans to institute a charging policy to agencies using the system to authenticate identities. For the first three years, however, this service will be offered free of charge.²³

Biometric Technology: Ensuring Uniqueness

At this large scale, and to enable the maximum usage of the system, it was important that the biometric capture and identification and verification processes be completely standardized.

http://uidai.gov.in/index.php?option=com_content&view=article&id=141&Itemid=164 Another agency, the National Population Register, would have the mandate to issue national identity cards to Indian *citizens*. This policy decision would create a tug of war as the UIDAI program was being implemented later on.

¹⁸ It should be noted that the UIDAI originally only had budgetary authority for 200M enrollments, which resulted in significant confusion as to the fate of the program. The UIDAI received expansive authority to complete all 600M enrollments by the Cabinet in January 2012.

¹⁹ <https://portal.uidai.gov.in/uidwebportal/dashboard.do>

²⁰ Numbers are released quarterly. The next date for which expenditure data will be available is March 31, 2012.

²¹ One of the main reasons that the cost per-person is relatively low is that the UID is not a card-based system.

²² The cost cited includes expenditures up to December 2011. UIDs issued are cited through December 31, 2011. Source: UIDAI Expenditure for UIDAI for the years 2009-10, 2010-11, 2011-12(up to Feb 12).

²³ http://uidai.gov.in/index.php?option=com_content&view=article&id=190&Itemid=233

From an accuracy perspective, matching rates would have to be extremely high because false matches would create an unbearable manual review process.

In making a recommendation as to which biometrics to use, the Biometric Committee in its report²⁴ to the UIDAI stated,

“While 10 finger biometric and photographs can ensure de-duplication accuracy higher than 95% depending upon quality of data collection, there may be a need to improve the accuracy and also create higher confidence level in the de-duplication process. Iris biometric technology...is an additional emerging technology for which the Committee has defined standards. It is possible to improve de-duplication accuracy by incorporating iris. Accuracy as high as 99% for iris has been achieved using Western data. However, in the absence of empirical Indian data, it is not possible for the Committee to precisely predict the improvement in the accuracy of de-duplication due to the fusion of fingerprint and iris scores. The UIDAI can consider the use of a third biometric in iris, if they feel it is required for the Unique ID project.”

The UIDAI in fact heeded this recommendation and decided to include fingerprints and iris in the system as the primary biometrics for identification and de-duplication purposes²⁵. Facial recognition was to be used to help with human visual inspection and to provide a duplicate check on a small subset of enrollments. Having the photograph on file would also serve as a secondary means of ensuring authentication and deduplication.²⁶ This multi-modal system of biometric data would ensure the highest accuracy levels and the least room for error. The inclusion of iris, however, had three other major benefits: it would maximize inclusion among the poor, enhance security and allow for children as young as 5 years old to be enrolled. Fingerprints can get worn with physical labor, which makes them hard to capture. And given that the poor tend to have occupations involving manual work, relying on fingerprints alone would have substantially increased the failure to enroll rate.

[A proof of concept study, conducted from March 2010 to June 2010 helped to validate the technical, operational and behavioral aspects of enrollment. The proof of concept also helped to establish a baseline for the quality of biometric data that could be collected in the Indian context. With regards to children, the study found that “children in the age range of four to fifteen could be biometrically enrolled using the same process as that used for adults

²⁴ http://uidai.gov.in/UID_PDF/Committees/Biometrics_Standards_Committee_report.pdf

²⁵ The enrollment process also involves capturing a photograph and demographic data containing the name, gender, birthday and address of each citizen is obtained. Once gathered, all data is sent to the Central ID Repository (CIDR) database.

²⁶ Biometric Design Standards for UID Applications, Version 1.0 December 2009, Prepared by UIDAI Committee on Biometrics

and with no additional difficulty...[and] showed that their iris images and fingerprints could be de-duplicated as accurately as those of adults.”²⁷]

From a policy standpoint, enrolling younger children means that a child’s ID is not linked to its parents’ ID in the database, which could have increased the risk of duplicates and fakes among UID’s for children^{28 29}. Unlike other biometrics, the iris is fully formed by the 8th month of gestation, and remains the same throughout one’s lifetime³⁰. Because children under the age of 14 make up approximately 30% of the population, this was an important factor in ensuring maximum inclusion and the highest integrity of the system.³¹ Every iris is unique, even those of identical twins, and interestingly enough, iris recognition technology is not sight dependent, so even the blind could be enrolled.

From a security standpoint, iris was beneficial because it could not be altered in the way that facial features could, and could not be masked in a way that fingerprints could be if they had cuts or bruises. Iris would also help with expediting the de-duplication process since it can be de-duplicated faster than fingerprints. Finally, iris was also becoming increasingly common in national security and military and border control applications, and having the database established with all three biometrics could prove to be very valuable later on. Although at the present time, it is not certain exactly how the Government of India will utilize UID to advance security interests, its ability to verify identity is an undeniable security benefit.

²⁷http://uidai.gov.in/images/FrontPageUpdates/role_of_biometric_technology_in_aadhaar_jan21_2012.pdf

²⁸ Ensuring Uniqueness: Collected iris biometrics for the Unique ID Mission, no date.

²⁹ If children records are linked to parents’ IDs with no biometric, it would create an environment where parents could easily add “fake” or “nonexistent” children to their record, thereby increasing their entitlements to rations, etc.

³⁰ Source: John Daugman, “How Iris Recognition Works”, IEEE, January 2004. Fingerprints do not become stable until the age of 10.

³¹ http://en.wikipedia.org/wiki/Demographics_of_India

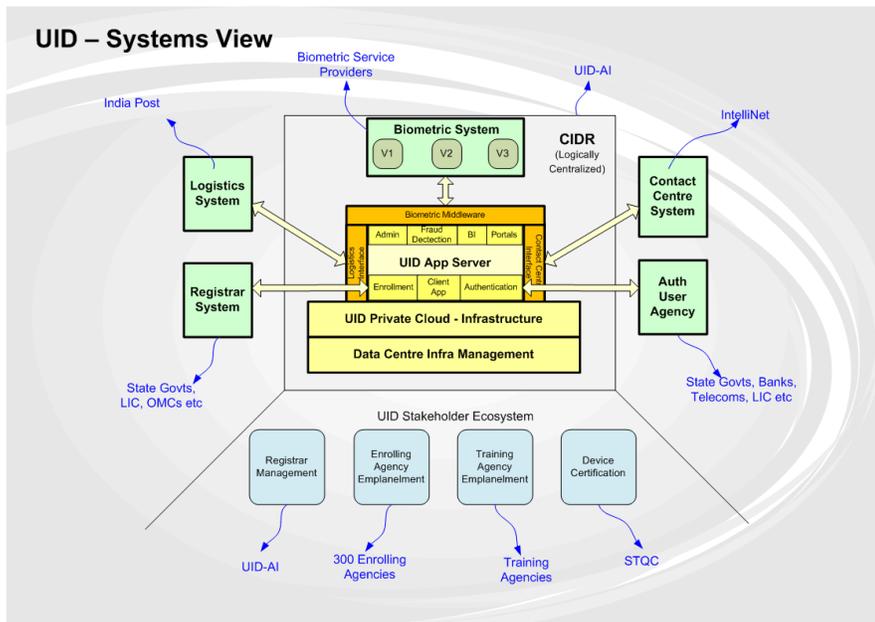


Figure 1: UID Systems Architecture

At the system level, the way the biometric data would be processed was also carefully considered. Unlike Andhra Pradesh, which relied on a single biometric and a single processing system, the Central ID Repository (CIDR) is actually composed of three Automated Biometric Identity Subsystems (ABIS) that run simultaneously. This increases the accuracy and reduces the false match rate since a single enrollment could be checked and verified against multiple systems. It also reduced the reliance on any single vendor and gave the UIDAI the ability to test and introduce new solutions on the fly.³²

The three Automated Biometric Identity Subsystems (ABIS) are operated by outsourced Biometric Service Providers (BSPs), which maintain their own database of proprietary fingerprint and iris image templates. Each ABIS independently de-duplicates across the entire range of enrollment data, and maintains a complete gallery of all enrollments. Each ABIS is vendor independent and upgradeable. Since performance is the arbiter by which allocation to each ABIS is assessed, there is a strong incentive to provide the most thorough, accurate, and efficient ABIS. The performance of each ABIS is assessed every 10 million de-duplications, and data is reallocated per the performance of the ABIS. (The information collected is standards-based and stored as such at the UIDAI level. Each ABIS converts those records into proprietary templates³³. If a new vendor needs to be brought in at a later stage, it would receive a copy of the enrollment records to convert and store for de-duplication.) There is also a demographic de-deduplication to reduce errors.

A layer called the UID Middleware resides between the three ABIS systems and the main application. The role of the UID Middleware is to continuously monitor accuracy,

³² http://uidai.gov.in/index.php?option=com_content&view=article&id=153&Itemid=13

³³ Source: UIDAI Presentation, "What is Unique about India's Unique ID Program?"

performance, and foster better decision-making across all three ABIS systems. As an enrollment record comes in, a Reference ID is attached to the request and the record is searched against the ABIS Systems. After analyzing the multi-modal data from the different systems, the server provides a scaled fusion score, indicating the similarity of the record to existing entries. A fusion score of 0 indicates the least level of similarity, whereas a fusion score of 100 indicates the highest level of similarity. The tri-ABIS system is unique to the UID project, and is one of the elements that ensures extremely high accuracy rates.³⁴

The Central Identity Repository (CIDR), where the ABIS and UID Middleware reside, also hosts both core application and supporting applications. Examples of core applications are enrollment and authentication services. User management, roles and access control, status reporting, and business process automation are controlled by the Administrative application. Examples of supporting applications are applications necessary to administer, analyze, report and detect fraud. These supporting applications interface with the Logistics Provider, providing letter printing and delivery, query and status updates, as well as the portal for internal administrative and information access.³⁵

Enrollment applications support requests for de-duplication and providing the unique identification number. The enrollment applications also have their own features and workflows that maximize data quality and lower the chance for errors on the back-end. Among these are:

(Excerpted from Role of Biometric Technology in Aadhaar Enrollment Report issued by UIDAI, January 2012)

- 1. Each biometric capture device is required to have a built-in auto capture capability which ensures that biometric images are captured only when deemed to be a valid fingerprint slap or iris image and are of sufficient quality.*
- 2. Biometric data quality is measured using standardized automated algorithms, and thresholds are utilized to decide whether a captured sample is insufficient quality to warrant immediate re-capture.*
- 3. The enrollment client performs a number of consistency checks. For instance, it makes sure that each biometric capture attempt comes from the same resident (instead of coming from operator, family member or previously enrolling resident).*
- 4. The client software confirms that all 10 captured fingerprints are distinct as well as the two irises are distinct. It ensures that no repeated biometrics is captured.*
- 5. The captured biometric is checked against that of the operator and the residents who enrolled previously on the same computer to avoid any chance of mix-ups.*
- 6. Any biometric exceptions such as missing fingerprint or iris are logged and supervisor verification is required. In extreme cases such as missing both hands*

³⁴ http://uidai.gov.in/index.php?option=com_content&view=article&id=153&Itemid=13

³⁵ Ibid.

and/or missing both eyes, an additional photograph of the hand and face is taken for proof of disability.

7. *Operator overrides of the policies set in the software are logged to facilitate further investigation of the capture process and operator actions.*
8. *The images from all attempts (up to four) are included in the resident data packet and sent to server for processing.*

These procedures are set to maximize data quality and data integrity. Although in theory it is possible to collect a face image from one person and irises from another and fingerprints from a third, in practice there is no incentive to do so since the next time the people tried to register legitimately, they would be flagged as a duplicate in the system and would not be allowed to enroll. The only way to potentially get around the system is to enroll fake identities under the “exception” category, but this too, is likely to be limited since the enrollment agent/operator also has to submit their biometric to authorize the transaction and the submissions are tracked³⁶.

Authentication applications authenticate the identities and the information used to establish identities, such as the biometric and demographic data. Once received, the data is matched against the biometric database. To further detect fraudulent entries, a Fraud Detection application determines fraudulent registrations and duplicate entries.³⁷

Certification of Biometric Equipment

One of the most basic principles behind biometric technology performance is quality control. Poor quality data will yield very high error rates. Being able to ensure high quality capture means a lower false reject rate (in this case, this means false matches which need to be manually resolved) and a lower accept rate (which are false non-matches, or duplicates, that the system accepts for enrollment).

To ensure that the devices used for biometric capture are reliable and would meet the high quality capture and interoperability requirements, the UIDAI established a certification process via the Standardization Testing and Quality Certification (STQC) Directorate, an

³⁶ According to an article in The Times of India on April 27, 2012, an operator named Mohammed Ali was responsible for processing approximately 30,000 enrollments in just a six month period, an exceptionally rapid pace that raised warning flags. Approximately 870 of the enrollments were enrolled under the physically-disabled category, and a probe has indicated that the enrollments completed under the physically-disabled category provided fake details and fraudulent addresses. By exploiting a glitch in the system, operators at 20 enrollment centers managed to enroll 30,000 people by authorizing the enrollments under Mohammed Ali's login information. It is unclear as to whether a number of these enrollments, if any, made their way into the system as valid enrollments. To assuage any concerns about potential damage to the integrity of the database, the deputy director general of the UIDAI, Ajay Bhushan Pandey, maintained that all loopholes had been fixed, and that all enrollments would be verified to determine if any similar scams have occurred in other parts of India. Source <http://timesofindia.indiatimes.com/city/hyderabad/Aadhaar-scam-did-not-stop-with-kingpin/articleshow/12916396.cms>

³⁷ http://uidai.gov.in/index.php?option=com_content&view=article&id=153&Itemid=13

office of the Department of Information Technology for the Government of India, to provide quality assurance and provisional certification.

For fingerprint, the devices for enrollment are tenprint slap live scans, on which a user places the four fingers from each hand, and then the two thumbs. For authentication, single finger readers are sufficient. For iris enrollment, the devices are typically handheld and mobile, which allows the user to hold it up to his/her eyes similar to binoculars. This helps to ensure that regular light does not filter through and the iris is captured properly.

To obtain certification for enrollment, suppliers have to submit various documentation including three sets of biometric devices and a test kit for image quality. The STQC Directorate conducts a comprehensive evaluation and if the device is found to be adequate, a Provisional Certificate, valid for 6 months, is issued. After successful completion of further tests in a controlled lab, a Certificate of Approval is granted. This has a 3-year validity period. For enrollment, certification is available for fingerprint scanners, iris cameras and face cameras. For authentication, certification is available only for fingerprint scanners at this time.

The testing of the biometric device is designed to determine a number of metrics. Robustness is measured by subjecting the devices to simulated environmental conditions like temperature, humidity, and dust. Other tests ensure consistency and output compliancy. For authentication, the supplier device must be on the FBI Certified Product List or equivalent and deliver a false reject rate (FRR) of 2% for a FAR of .01% on a sample size of 1500 residents.³⁸ The testing procedures for authentication follow well-established NIST global standards around image quality and performance³⁹.

The entire test and certification process takes approximately 4-6 weeks after all necessary information and inputs have been provided to the STQC. In the event that any device is non-compliant or fails, the supplier is informed and testing stops. In the event of failure or non-compliance, it is incumbent upon the supplier to take corrective action on the device and system level.

As of December 28, 2011, there were 27 biometric enrollment device suppliers with either Provisional Certificates or Certificates of Approval, and 2 biometric authentication suppliers with Provisional Certificates of Approval⁴⁰.

³⁸ Source: STQC UIDAI BDCS-03-02 Procedure for Obtaining Biometric Device Certification: Authentication. It is important to note that there is a tradeoff relationship between the FAR and the FRR curves. For the purposes of authentication, the designers of UID decided that it is more important to prevent a false impersonation (FAR) than to ask a person to redo the biometric “read” (FRR).

³⁹ Source: STQC UIDAI BDCS(A)-03-09 Issue 1 Test Methods and Procedures for Biometric Devices (Authentication).

⁴⁰ <http://www.stqc.gov.in/content/bio-metric-devices-testing-and-certification>

The Rollout: Registrars and Enrollment Agencies

In addition to the UID Authority itself, State and Union governments also play an enormous role in the rollout of the UID program. The UIDAI is responsible for setting the standards and processes for enrollment, but it is the responsibility of the States and the Union Territories to identify Registrars and provide the resources necessary to fulfill on the enrollments. State departments, such as the Rural Development Department or the Civil Supplies and Consumer Affairs Department act as partners with the UIDAI and sign MOUs that articulate the States' commitment to "enhance efficiency in delivery of government benefits and services through accurate identification of beneficiaries and to have uniform standards and processes for verification and identification of beneficiaries."⁴¹

The Registrars in turn, have typically outsourced the enrollment function to Enrolling Agencies to carry out the enrollment functions⁴². The Enrolling Agencies' collect demographic and biometric data from residents, which is subsequently passed on to the Registrars and then to the UIDAI Central ID Repository⁴³. Enrolling Agencies are responsible for maintaining enrollment centers; some of these are mobile centers that function almost as camps and move from one place to another to facilitate ease of access. Enrolling agencies must meet general eligibility criteria as outlined in the Request for Empanelment issued by the UIDAI, and are then assessed on a four-level technical⁴⁴ and financial maturity basis. They receive certification from the UIDAI, which is called empanelment.

In order to be eligible for empanelment, an entity must be a company or organization, such as an NGO, microfinance institution, government, Public Sector Units, or a consortium of companies (maximum of four companies), which are registered in India and have been in existence for at least two years. Enrolling Agencies must be non-political and non-denominational with absolutely no political or religious affiliation. As of December 22, 2011,

⁴¹ As of December 14, 2011, 35 Memorandums of Understanding have been signed between the States and the UIDAI. Source: http://uidai.gov.in/index.php?option=com_content&view=article&id=148&Itemid=169

⁴² In order to be hired by a Registrar, the Enrolling Agencies must go through a procurement (RFQ) process, and only empanelled enrolling agencies are eligible to respond.

⁴³ It should be noted that in principle no breeder documents are required for enrollment. However, in order to verify the demographic information that is being supplied, either an identification card or utility bill is needed, or a person can be accompanied by an "introducer", who must be registered as such. "Introducers" can be village elders or other known person, and their "introductions" are tracked to minimize fraud.

⁴⁴ From a technical standpoint, all organizations are empanelled under Level T1, or the entry level, assuming that general and basic eligibility criteria are met. Level T2, or the skilled level, when 25 enrollment operators who are trained and certified in UID enrollment are employed. If an organization has completed 50,000 biometric enrollments in the last three financial years, that organization is automatically empanelled into Level T2. Level T3, or the experienced level, is reserved for organizations employing 75 enrollment operators and supervisors who are trained in UID enrollment and that have enrolled one million citizens, resulting in UID issuance. The T4, or audited level, is reserved for those T3 organizations that have been successfully audited to ensure adherence to enrollment processes, quality of enrollment data, percentage of successful enrollments, people aspects, and other enrollment related functions.

there were 174 empaneled enrollment agencies for the UID program⁴⁵. It is important to note that enrollment agencies are paid only for successful UIDs generated and not the number of enrollments conducted.

Upon enrollment, the records are sent to the CIDR as stated earlier; results are communicated via a letter delivered by India Post. If a letter is undeliverable, it is returned to the UIDAI, and the affected resident may request a letter at a later date through special request of the Contact Center. There is currently a 60-90 day lag in the distribution of the letters and UID numbers. To cut down on the delivery time, the UIDAI indicated recently that it will first email or SMS the UID. The UIDAI successfully tested an application which would deliver Aadhaar numbers via SMS.⁴⁶ In addition, the UIDAI has partnered with Telecommunications Consultants India Limited (TCIL) to expedite the distribution of Aadhaar letters.⁴⁷

Some agencies are taking advantage of the enrollment process that is being set up for UID and “piggy-backing” to enable enrollment for their own purposes. For example, the Targeted Public Distribution System, has developed an arrangement with the UIDAI and the National Informatics Centre (NIC) whereby the data captured during enrollment would also be used for the issuance of computerized ration cards. The NIC will develop a software application that the Registrars would then implement via the Enrollment Agencies. The goal of this arrangement is “to ensure proper identification of beneficiaries and correct recording of transactions between the Fair Price Shops (FPS) and beneficiaries”.⁴⁸ That the PDS can leverage the UID enrollment process for its purposes, saves money and time, and more importantly, streamlines the identity management of the population.

Exception Handling

With any biometric or citizen identification system, it is important to consider challenges associated with capturing biometric data. As stated earlier, fingerprints of day laborers can get worn and difficult to capture. Iris capture is not without its challenges either. Indeed, India’s population contains 15 million of the world’s 37 million blind people, often related to cataracts⁴⁹. While blindness as a standalone condition does not prohibit iris capture, cataracts do affect the ability to properly capture the iris. Additionally, an unfortunate number of the population lack eyes due to disease or accidents.

⁴⁵ Source: List of Empaneled Agencies. Retrieved from <http://uidai.gov.in/registrar-link-2.html>

⁴⁶ <http://www.hindustantimes.com/India-news/NewDelhi/To-check-delays-Aadhar-no-will-be-sent-by-SMS/Article1-837111.aspx>

⁴⁷ <http://frontierindia.net/news/aadhaar-numbers-to-be-notified-by-e-mail-or-sms-before-card-dispatch/>

⁴⁸ Source – Department of Food Distribution Annual Report
<http://fcamin.nic.in/annual%20report/annual-2010-11.pdf>

⁴⁹ http://articles.timesofindia.indiatimes.com/2007-10-11/india/27977420_1_avoidable-blindness-ophthalmologists-eye-diseases

The underlying premise of UID is of course, inclusivity for all, and as such, Failure to Enroll is not an option. In the case that biometrics are not able to be captured, photographs of the biometric exception are taken, and the Enrollment Operator notes the biometric exception in the forms submitted. Lastly, the Enrollment Agent Supervisor signs off on the biometric exception with his or her fingerprint. While the enrollment of some citizens may present significant challenges, such as those with no eyes and no fingers, as stated earlier, the number of such cases is minimal.

On the back end, potential duplicate entries are first processed by the biometric software to determine if the issue is process related or not. If not, the duplicate entry is manually adjudicated and a human expert makes a final determination as to the legitimacy or illegitimacy of a duplicate entry⁵⁰. As stated, rejections are not allowed based on the failure to sufficiently capture the biometrics.

Accuracy

In January 2012, the UIDAI issued a report on the accuracy and performance achieved by the UID system based on the 84M UID numbers that had been issued as of December 31, 2011. The UID Authority released the report in the hopes of dispelling concerns and misinformation on the accuracy and reliability of the system. Indeed, the report states that “the results lay to rest unfounded claims that the underlying technology is untested, unreliable and based on unproven assumptions. Based on the analysis, it can be stated... that the UIDAI enrollment system has proven to be reliable, accurate and scalable to meet the nation’s need of providing unique Aadhaar numbers to the entire population. It is now safe to conclude that the system will be able to scale to handle the entire population.” The UID has concluded, and the technical community believes, that the UID system can scale to handle the entire population.

The three key metrics of the system’s performance that the UIDAI committee analyzed were Biometric Failure to Enroll, False Rejection Rate and False Accept Rate.

Biometric Failure to Enroll. As stated earlier, one of the cornerstones of the UIDAI program is inclusion for all. By definition then, the system was set up so that no legitimate person would be rejected for a UID number. Moreover, one of the main reasons for the use of iris and fingerprint biometrics is to minimize the failure to enroll. In fact, the report found that the total *biometric* failure to enroll rate was 0.14%. This means that 0.14% of the population does not have usable fingerprints and irises. As already stated, these biometric exceptions are photographed and handled in accordance to procedures dictated by the UIDAI. At a rate of 1M enrollments per day, these exception cases amount to 1400 per day. This requires 3-4 people to manually process these enrollments, which is considered to be a manageable task.

⁵⁰ Ibid.

False Rejection Rate. The false rejection rate is the measure by which a duplicate hit is returned by the system in error. Out of 4M submissions against the 84M record database, only 2309 were deemed to be false rejects, or 0.057%. According to the report, at a run rate of 1M enrollments per day, this amounts to 570 cases per day that need to be adjudicated. The UIDAI committee expects that this number will continue to be manageable even at full capacity (1.2B enrollments).

False Accept Rate. This is the rate at which duplicate identities will be registered into the system. To compute this risk, 31,399 known duplicates were searched against the 84M record database. The system correctly identified all but 11 of them, translating into a False Accept Rate of 0.0353%. Extrapolating this figure to the entire 1.2B population yields a total of 423,000 potential duplicates that could be issued once everyone was enrolled, a figure that is considered to be extremely low risk when compared to the overall benefits that the UID would provide.

One of the interesting analyses that the report provides, relates to the duplicates and why they had occurred in the first place. For approximately 20% of the duplicates found by the system, multiple attempts of the same modality (i.e., fingerprints) were submitted for two different individuals. For another 20% of the duplicates, different modalities were captured from different people. It is clear that these cases require improvement to the enrollment software and more attention to the enrollment process on the operator side. Given the size that the database has yet to achieve, the UIDAI is expected to continue to look for new ways to enhance performance, improve biometric capture quality and streamline the exception handling process. The UIDAI believes however, that “based on the trend, the UIDAI expects the accuracy of the system to remain within the same order of magnitude... It is now safe to conclude that the system will be able to scale to handle the entire population.”⁵¹

It would also be interesting to see a similar analysis around authentication, that is, once the population is enrolled, what are the failure rates at the point of service. These applications, however, are only just coming online (see next section) and so, as of this writing, despite the huge promise of UID, it is too early to tell what the real impact on the people and the programs that will rely on the program will be.

Authentication Applications

Ultimately, one of the main objectives of the UID program is to be able to accurately identify people at various points of service and enable them to receive the services they are entitled to. Most of the visible effort to date has been around the enrollment and database

⁵¹ “Role of Biometric Technology in Aadhaar Enrollment,” Unique Identification Authority of India. January 2012.

setup. However, in order to allow agencies to use UID as a verification of identity, the UIDAI also created an online-based authentication system that utilizes demographic and biometric data. The authentication system allows an agency to establish that the person is who they claim to be by submitting the person's biometric to the Central ID Repository and receiving a yes/no answer; eligibility for a given program is done at the agency level.

In order to authenticate against the UID database, an agency or company must become a recognized Authentication User Agency (AUA). AUAs are entities using Aadhaar authentication as part of their service delivery cycle for customers, beneficiaries, employees, or associates. It is the principal entity that sends the authentication request to enable day-to-day business functions. The Department of Civil Supplies is an example of an AUA – it seeks to authenticate people before dispensing monthly rations.⁵²

The process of becoming an AUA is extensive. First, an entity must identify the service delivery areas for which they would like to authenticate people. The AUA can authenticate for numerous purposes such as verifying a person's information and to ensure proof of presence at the time of service delivery. AUAs carrying out direct cash disbursement can utilize the Aadhaar Payments Bridge (APB), a platform that was developed with the National Payments Corporation of India (NPCI) as a mechanism of posting payments directly to beneficiaries, in order to avoid state level disbursement of government to person payments (G2P). The APB acts as an aggregator for various government entitlements. Once an account is credited, beneficiaries can withdraw money using the Aadhaar Enabled Payment System (AEPS).⁵³

AUAs must use certified Point of Sale (POS) devices and certified applications. The applications must be developed using the UIDAI's published APIs (Application Programming Interfaces) and they must be tested by the UIDAI's technology center prior to implementation. The AUA is responsible for establishing and maintaining the systems, processes, infrastructure, connectivity and security protocols to ensure continuous compliance with UIDAI standards and specifications.⁵⁴

Once the AUA is in place, the information and authentication requests are transmitted to and from the CIDR by registered Authentication Service Agencies (ASAs). The ASAs play the role of "enabling intermediaries" and have an established secure connection with the CIDR. The ASA can also make authentication requests to further its own business and service functions. The National Payments Corporation of India (NPCI) mentioned earlier, is an example of an ASA.⁵⁵

⁵² http://uidai.gov.in/index.php?option=com_content&view=article&id=193&Itemid=236

⁵³ http://www.cgap.org/gm/document-1.9.55370/Overview_G2P_Payments_Sector_India.pdf

⁵⁴ http://uidai.gov.in/index.php?option=com_content&view=article&id=193&Itemid=236

⁵⁵ http://uidai.gov.in/index.php?option=com_content&view=article&id=192&Itemid=235

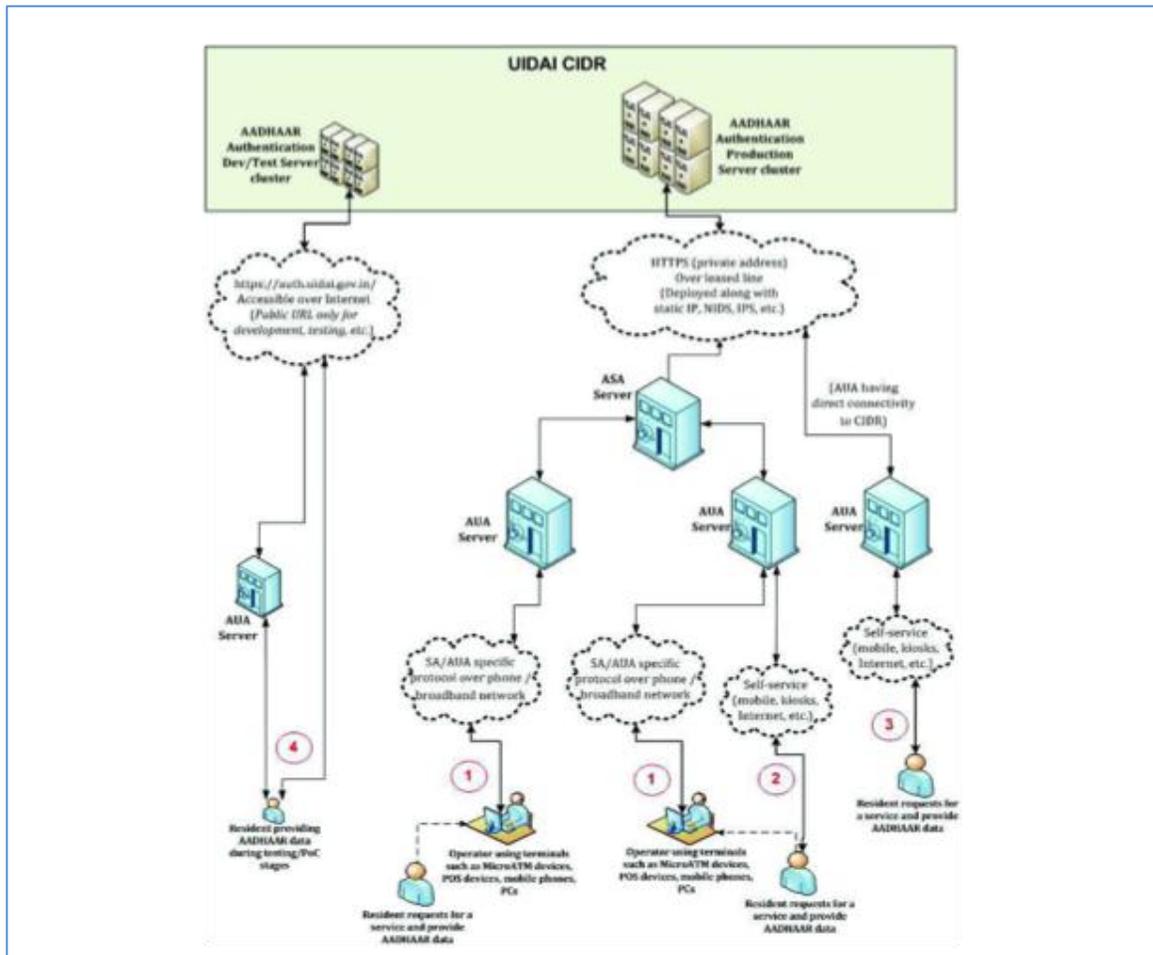


Figure 2: UID Authentication Scenarios⁵⁶

The responsibilities and obligations of the ASAs are also important and extensive. They must ensure that they are compliant with UIDAI specifications and standards and they are responsible for ensuring that any AUAs they support also comply. The ASA verifies the compliance of each authentication request before sending to the CIDR. Lastly, the ASAs are subject to sporadic audits from the UIDAI or agencies appointed and approved by the UIDAI.⁵⁷

While this setup may seem complex, the relationship between the UIDAI, ASAs and AUAs, is designed to provide scalability, accountability and technical compliance at every link in the chain. The arrangement creates an endless array of possibilities for the use of the UID number, whether for the public or private sector. In fact, one of the first authentication applications was for the delivery of LPG canisters. A pilot project started in conjunction with the NREGA is working to allow people to open bank accounts and transfer funds to

⁵⁶ Taken from Aadhaar Authentication API Document

⁵⁷ Ibid.

beneficiaries under the employment guarantee scheme. And according to Nandan Nilekani in a recent news article, three states so far have recognized the UID as proof of identity for various government services⁵⁸.

[It is important to note that authentication requests to the UID database come from agencies for the initial enrollment into programs that they run (banking, ration card, pension programs, etc.). Subsequent transactions within those agencies (such as verifying identity at workplaces under employment guarantee programs) are handled within the ecosystem of that particular agency. UID creates the enabling environment for these agencies to serve the people, but ultimately the direct service comes from the individual agencies or private sector entities.]

Maintaining and Updating the Database

By allowing the unique identification number to fulfill the Know Your Customer (KYC) norms for services such as banking, taxation, insurance, social security delivery, and other critical functions, it becomes absolutely necessary to maintain and update the information contained in the CIDR and to have a secure process for doing so.

The two types of demographic and biometric data stored in the CIDR are either timeless information such as gender and birthdate or data that changes with circumstance and age. Ensuring that the latter is continuously updated is of paramount importance in maintaining the integrity of the database.

Residents can provide updates to information stored in the CIDR via multiple modes of access. Registrars could carry out updates using enrollment equipment, and an online portal for residents, managed by the UIDAI, could allow updates to be made easily and efficiently in cases of low sensitivity. In cases of highly sensitive update requirements, the portal directs residents to their nearest enrollment center.

Data updates could also potentially be achieved utilizing mobile phones. Although biometric identification and other important information could not be updated through a mobile phone, less important information such as email address could be updated via a PIN system. UIDAI is not charging residents to update their records, but they do intend to develop a compensation program to determine the maximum rate that a registrar can charge.⁵⁹

⁵⁸ <http://economictimes.indiatimes.com/news/politics/nation/UID-project-to-face-first-major-test-next-month/articleshow/10548693.cms>

⁵⁹ According to UIDAI Updation Document on UIDAI web site.

S.No	Field / Data	Permanent enrolment centers	National updation agency	Online portal	Contact Centre	FPS, BC etc. with PoS-like Devices	Mobile Phones
1	Name	Y	Y	Y	Y	N	N
2.1	Address - Proof of Address based	Y	Y	Y	Y	N	N
2.2	Address - Introducer based	Y	Y	N	N	N	N
3	Date of Birth	Y	Y	Y	Y	N	N
4	Gender	Y	Y	Y	Y	N	N
5	Relative Name / UID	Y	Y	Y	Y	N	N
6	Phone	Y	Y	Y	Y	Y	N
7	Email	Y	Y	Y	Y	Y	Y
8	Consent for FI	Y	Y	Y	Y	N	N
9	Consent for data sharing	Y	Y	Y	Y	N	N
10	Photograph	Y	Y	N	N	N	N
11	Fingerprint	Y	Y	N	N	N	N
12	Iris	Y	Y	N	N	N	N
13	Biometric Exception	Y	Y	N	N	N	N

Figure 3: The chart above shows where each data item can be updated.⁶⁰

Enabling Inclusion: Future Applications

Currently, millions of citizens across India who lack identity documents are unable to participate in various simple banking services, such as obtaining a bank account. Without proper and legitimate papers, these citizens exist as the unbanked of India. Lacking such access to basic financial institutions has far reaching consequences for citizens as well as for the financial sector. An added benefit of creating a unique identification database is that it would provide those with UID numbers access to day-to-day banking functions, as well as allowing banks to avoid the hassle of either asking for supportive documentation or turning away citizens with no identification whatsoever. The State Bank of India recently issued an Expression of Interest for this purpose. Already, the UIDAI has begun implementing an Aadhaar-based payment system in 50 districts across India.⁶¹

To financial service providers, the UIDAI project represents an enormous opportunity to extend financial inclusion to the poorest citizens of India. Currently, just 25% of Indians have bank accounts⁶². With the UIDAI enrollment, the opportunity to provide bank accounts to all has suddenly become possible. Every citizen enrolled for a UID can consent

⁶⁰ Ibid

⁶¹ <http://www.business-standard.com/india/news/aadhaar-based-payment-system-in-50-districts/471880/>

⁶² <http://uidai.gov.in/images/FrontPageUpdates/discussionpaperonaadhaarbasedfinancialinclusion15oct.pdf>

to providing his/her information to be used for opening a bank account. As a fully legitimate substitute for KYC regulations, a UID ensures that the cost and effort currently expended during the customer acquisition process is drastically reduced. Having the UID as a means of authentication also eliminates the need for smart cards for the most basic customers who will not be using ATM machines, etc., another significant reduction in cost from an operational perspective⁶³. The financial incentives provided by the UIDAI to enroll residents (Rs. 50 per enrollment) also serve as an incentive for banks to act as Registrars in the enrollment process. For customers with low revenue potential, banks can actively manage the costs of serving them by only providing essential services.

From the perspective of education, UID authentication could also act as an enabling tool to monitor children in India. The Right of Children to Free and Compulsory Education Act ensures that every child aged six to fourteen has the right to free and compulsory education until the completion of elementary school. Currently, the Primary Education System in India faces inflated enrollment figures at the elementary school level. The effects of this inflated enrollment include lack of books, meals, scholarships, and uniforms. A UID based system would allow the government of India to accurately assess enrollment needs across all areas. Multiple enrollments would be eliminated, and UID portability would ensure that migrant children are admitted to schools in various districts.

Another area where the benefits of a unique identification number are plainly evident is public health. India faces a number of challenges related to public health. Because much of the population remains unidentified, there is no target population whose needs can be assessed and addressed via rural and urban health care systems. The lack of an identified target population also contributes to poor tracking of health conditions and an inability to introduce national health insurance schemes on a scalable level. The government cannot track newborn children or ensure vaccination for them, and only 47% of Indian women give birth in institutions⁶⁴. The need to have infrastructure in place that can track disease and mortality is absolutely critical to ensuring positive health outcomes and increasing life expectancy for India's population. The current method of capturing data on disease conditions involves sporadic national or state surveys. The health insurance program for the poor (called RSBY) already uses a biometric based smart card and adding UID-based authentication could provide useful information to India's population on routine disease conditions and possible epidemics.

The UID will of course help to put accountability into the huge subsidy schemes run by the government, among which is the National Rural Employment Guarantee Scheme (NREGA), which provides guaranteed employment of up to 100 days per household. The NREGA has met many of its milestone goals, but is still plagued by corruption and diversion of funds. Reports from every state of workers being denied guaranteed wages

⁶³ This benefit is also a drawback; having a non-card based system means that authentication is reliant on internet connectivity, for example.

⁶⁴ http://uidai.gov.in/UID_PDF/Working_Papers/UIDandPublicHealth.pdf

represent a particular challenge for NREGA. This is primarily due to stolen identities and people “double-dipping”, as well as unverifiable records and weak accountability systems⁶⁵. If work sites verify the identity of their workers, and those were ticked off against a database of eligible people, this problem would be overcome. The UID enables this as attendance could be recorded utilizing biometric identification and workers could be paid through UID certified bank accounts. Reported work hours of both workers and their official supervisors would need to match, and fraud such as ghost beneficiaries or officials over reporting hours would be eliminated.

On the PDS side, because the UID can be authenticated online and in real-time, any Fair Price Shop (FPS) can confirm the identity of any beneficiary in real time, ensuring that the rations go to the correct person. To prevent fraud, the Government of India can utilize UID authentication as a barometer by which to measure out future allocations to a particular FPS. In other words, to ensure that FPS managers authenticate their beneficiaries, allocations of supplies will be determined by how many beneficiaries have been authenticated. An FPS with fewer authentication requests will receive fewer supplies. This gives FPS managers within the PDS an extremely strong incentive to properly authenticate their beneficiaries. It also allows more flexibility in the way the PDS is administered. For example, the government could create an online food account, whereby residents could choose to obtain entitlements on an as needed basis, or enable electronic based benefit transfers, thereby allowing the government to impart goods entitlements directly to residents, and tailor those entitlements more directly.

Finally, the UID could also insert greater accountability into the supply chain, and enable farmers to have access to information on grain requirements, and better manage distribution and storage. By having specific information on who and how many people need what types of food aid and where they are located, the government could assess the supply and demand curve across numerous states, and work to ensure adequate availability. The UID project will also cut down on rampant electoral fraud by ensuring that people are who they say they are, and that single individuals do not cast multiple votes. Lastly, on a very basic level, the UID project will serve as a barometer by which to measure population levels and growth. Through increased vigilance and better documentation, state and federal governments will be able to better keep track of illegal immigrants, and will better be able to foresee terrorist threats and manage internal security. The possibilities that the UID engenders are truly endless.

Already, according to a study conducted by NYU Stern Professor Arun Sundararajan and Professor Ravi Bapna of the University of Minnesota, the UID is demonstrating its potential for inclusion and is having an impact on people’s ability to access services and gives the

⁶⁵ <http://www.righttofoodindia.org/data/gbpant07orissa-social-audit-interim-report.pdf>

previously undocumented access to the mainstream system for the very first time. A press release⁶⁶ dated 24 April 2012 highlight the results of the initial phase of their study:

Fewer than 30% of Indian households have even one resident with any one form of portable ID; those households with portable ID have substantially higher incomes and likelihood of a college-educated resident than those without.

The remaining households are forced to rely on documents like ration cards of the government funded...NREGA cards, which have limited geographic portability and do not easily facilitate inclusion among those without portable ID....

The UID rollout is creating an entirely new segment of "included" residents, those who are attaining portable ID for the first time ever. If enrollments continue according to projections, the professors estimate that this segment will number around 300 million people (25% of the population) by the end of 2012 and continue to grow in 2013.

Early UID adopters represent a segment distinct from the 18% of the population that rely on the NREGA program...The early adopter profile validates Aadhaar's potential beyond its use for welfare disbursements and suggests considerable promise for early UID-enabled commercial services, in which numerous pioneering corporations (like ICICI and Visa) are investing.

All this being said, it cannot be stressed enough however, that despite the great potential that the UID presents, the program is still in its nascent stages and it remains to be seen how these authentication options ultimately come on line and to what extent they interface with, and rely upon, the UID database.

Relationship to other Indian ID programs

The process for obtaining ration cards under the original Andhra Pradesh program that is referenced earlier and that is the subject of the Annex, has been integrated into the UID process. Identity verification for other government services is also now beginning to be established through the UID process, including NREGA and programs for old age pensions and scholarships⁶⁷. Other programs, such as the World Food Programme project in Orissa, that utilized iris, continue to operate but it is expected that they too, will ultimately rely on the UID for verification of identity.

⁶⁶ <http://www.marketwatch.com/story/indias-unique-identity-uid-reaching-underprivileged-households-that-have-no-existing-id-according-to-first-round-of-nationwide-survey-results-led-by-nyu-stern-professor-2012-04-24>

⁶⁷ <http://ibnlive.in.com/generalnewsfeed/news/govt-to-expand-aadhaar-based-payments-scheme-to-50-districts/976290.html>

As the program gets rolled out, however, one of the biggest sources of confusion remains the government's original policy decision to separate the UID mandate of issuing identification numbers, from the National Population Register's (NPR) mandate to issue national identity cards to Indian citizens⁶⁸. The result has been the two programs essentially competing with each other to enroll as many people and in effect, creating two databases.

One main issue is that as the UIDAI enrolls people, numbers may be issued to non-citizens. From the UID perspective, their mandate is strictly to provide ID numbers to all Indian residents. Other agencies, including the NPR, would have to conduct their own adjudication, leveraging the UID database to establish the identity of people applying for benefits including national ID cards. Ultimately, it is an issue of purpose and mandate. NPR views its mandate from a security and immigration perspective, which could be at odds with a philosophy of inclusion and mobility of identity.

Recently, in an effort to establish a compromise between the two agencies and to speed up the enrollment process, the Congress-led UPA government voted to allow the UIDAI to continue the enrollment process for an additional 400M people beyond the 200M already enrolled. The UID will continue to enroll the population in its stronghold areas of operation, while NPR will continue to focus on enrollment in the coastal areas. Recently, the Economic Times of India reported that Aadhaar numbers were a prerequisite for NPR enrollment⁶⁹. Since Aadhaar is a prerequisite to any NPR enrollment, NPR enrollments are carried out through the UID system, utilizing Aadhaar as a prerequisite. As a result, there is no worry of duplicative enrollments.



As part of the compromise agreement between the two agencies, the UID is reviewing its enrollment procedures in response to the security concerns raised by the NPR, specifically relating to the “introducer” model and the potential that some people may provide

⁶⁸ This mandate was covered by an Act of Parliament, which enabled the NPR to collect biometric data with the UID as an additional identifier.

⁶⁹ http://articles.economictimes.indiatimes.com/2012-04-17/news/31355572_1_aadhaar-uidai-biometric-data

introduction letters in exchange for bribes⁷⁰. Evidently, the UID vs. NPR debate has yet to be settled.

In some ways, the dispute is misguided. It is important to understand again, however, that the UID is an identity infrastructure designed to establish a person's identity, not to confer rights and privileges. NPR is an example of an agency that would establish an individual's right to citizenship in the country and all the benefits that go along with that. The authentication mechanism at the time of service would still occur via the UID system.

Another concern as the use of the UID gets rolled out for authentication application is the use of the fingerprint for authentication. Given that such a large portion of the population are day laborers and therefore have poor fingerprints, it will be interesting to see whether iris will become the biometric of choice in the long run for authentication, or if there will be another way to overcome this potential challenge.

Source: The Daily Mail, 29 January 2012.

Section 3: Implications for other countries

The India UIDAI project has received enormous attention around the world. For one thing, it has given other governments the confidence that they too, can implement a similar program. Media reports mention Mexico, Brazil and Argentina, as but a few that have been contemplating changes to their national ID program plans based on the UID. Indonesia also has recently revamped its national ID system to include face and iris, similar to the UID. And the UIDAI itself is assisting the Government of Papua New Guinea in starting its own national ID scheme using biometrics⁷¹. Of course, this is no surprise. The India UID⁷² project is ambitious not only for its size and scope, but it is one of the first national ID projects to have been designed in a way that has the potential to touch every aspect of a society. This perhaps is one of the main implications for other countries who may be contemplating national ID programs, or ones who already have them in place. There are several other specific areas that have the potential to greatly impact the way other countries think about and roll out national ID programs:

- **Unlike many legacy national ID programs, the UID is designed from the ground up to support authentication applications.** The government is providing the tools to enable public and private sector entities to utilize the system with biometrics. Most other national ID schemes may use an ID card for authentication, but without biometrics, there is no proof of identity. And almost no other government, with the possible exception of South Africa, which recently opened its national ID system to banks to address bank-related identity fraud⁷³, is actually using the national ID infrastructure to

⁷⁰ http://articles.timesofindia.indiatimes.com/2012-02-01/india/31012083_1_biometric-uidai-unique-identification-authority

⁷¹ www.hindustantimes.com/India-news/NewDelhi/India-gives-globe-tips-on-UID/Article1-813421.aspx

⁷² "India's high-tech ID project to create employment and business boom", Reuters, November 7, 2010

⁷³ <http://www.southafrica.info/services/consumer/bankprint-081111.htm>

support private and public institutional needs to verify identity. The fact that the Indian government invested in establishing the protocols, the APIs and the structure for certification and empanelment, provides a structure for maximum participation, making it possible for thousands of authentication points to communicate with a central ID repository. And in turn, because so many agencies and private sector entities will be relying on the UID to provide services to the people, not having a UID will be a major inconvenience. This is the main driver for inclusion. Also, because the UID will link to the passport, driver license, PAN (tax ID) card, bank accounts, voter ID, etc. it will be very difficult for a person to operate with different names or addresses. What many do not realize is that the UID is being superimposed on a number of applications, and instead think that the UID is the starting point for these applications to be developed. The genius then of the UID (and of course the main argument against it) is that as an infrastructure for identification and verification, it is detached from any specific service. This aspect of the UID contributes to the program's novelty, and ultimately, to its universal applicability.

Countries with existing national ID systems, would do well to create these types of protocols for the purpose of authentication. This could unleash tremendous progress in establishing transparency, accountability and trust in government and act as a source of revenue for the government if set up correctly. With nearly 114 countries projected to have a national ID system in place by 2015, only a handful are shaping their plans in a way that allows the government to be this type of "identity service provider".

- **Because the UID is essentially a portable number, it can be exploited on a mobile phone, overcoming many of the traditional infrastructure challenges that have hampered other systems.** The cloud-based authentication of the UID ensures easy integration into an online management information system (MIS), which can be accessed from any mobile phone. This unique aspect of the UID is particularly useful as more and more people around the world gain access to cell phones and other mobile technology. As mobile phone growth explodes in Africa and elsewhere, the value of a portable number increases exponentially. With nearly 6 billion mobile-cellular subscriptions as of December 2011, global mobile-cellular penetration has reached an astonishing 87%. More importantly, 79% of the developing world has mobile-cellular subscriptions, and mobile exposure is occurring at a torrid pace.⁷⁴ There is enormous potential in utilizing the mobile phone infrastructure to verify identity at point of service. Several studies are already underway on how best this can be done. The easiest to envision would be a biometrically-enabled Bluetooth point of sale device which could use the mobile phone to transmit an authentication request to a central server and authorize a transaction. There are several makers of such point of sale devices already. Recently, Nandan Nilekani mentioned that the UIDAI is working with the STQC to certify a mobile scanner that can be plugged into most electronic devices – scanners, laptops, phones, smartphones, and tablets⁷⁵. The open architecture that the UIDAI is

⁷⁴ <http://www.itu.int/ITU-D/ict/facts/2011/material/ICTFactsFigures2011.pdf>

⁷⁵ <http://businesstoday.intoday.in/story/nandan-nilekani-uid-controversy/1/22422.html>

developing will allow authentication unencumbered by the burdens of traditional infrastructure.

With a mobile phone, people can be authenticated from remote villages, for small size transactions, and for a myriad of purposes where previously a computer terminal with electricity and broadband was required. In this way, the UID can supplement existing infrastructures and help them expand into more rural areas and touch many more people, with no need for cards or other offline identifying mechanisms. This leap also makes it possible to deliver health care, mobile banking, online food ration accounts, conditional cash transfers, etc. to individuals based on their identity. It also makes it possible for the first time to analyze *who is not* getting a particular service, for which they may be entitled. Delivering government services on the mobile platform is made possible by knowing who is on the other end. From an election standpoint, this can also mean verifying people at polling stations and ensuring that they do not vote more than once, even if they have multiple cards or argue that a polling station list is inaccurate. It is important to note that not only is mobile technology much of the driving force behind Aadhaar, it is Aadhaar that has become a catalyst for an increase in mobile technology growth across India. Aadhaar has highlighted deficiencies of connectivity in certain areas, and as the UID program reaches critical mass, a small fissure has emerged between rural and urban governments. Three central ministries have conveyed reservations with real time online authentication, saying that rural areas do not possess the connectivity necessary to efficiently process online Aadhaar authentication requests, and should instead rely on offline smart card based authentication. Despite these reservations, the UIDAI believes that smart card based authentication is not cutting edge or efficient enough for Aadhaar, suggesting that it smart cards introduce a whole new set of challenges like card management, procurement and management of card readers, etc. (More on this issue later.) Rather than focus on a small part of the country's lack of connectivity, UIDAI officials believe that advances in connectivity will spread to those less connected areas.⁷⁶

- **Multiple biometrics promote inclusion and maximize usage of the UID.** One of the main reasons for including iris biometrics upon enrollment was the significant increase in accuracy, but the added benefit of maximizing inclusion among the people is not to be underestimated. Most national ID systems rely on fingerprints only, and in the developing world in particular⁷⁷, this can propagate a situation of under registration or under utilization of the system as many people doing physical labor would not be able to be enrolled, or the quality of their enrollments would be low, subsequently hampering the ability to authenticate them for services. A secondary biometric alleviates this issue assuming both could also be used at the point of service.

⁷⁶ http://articles.economicstimes.indiatimes.com/2012-04-17/news/31355572_1_aadhaar-uidai-biometric-data

⁷⁷ Countries in sub-Saharan Africa have more than 60% of the workforce working in agriculture. Source: The Data Report 2010, Monitoring the G8 Promise to Africa

- **Industry standards enable scalability and minimize project risk.** The insistence on biometric standards for the collection of the information means that future changes and accommodations in technology will be possible. It also unleashes the possibilities for innovation around applications that can leverage the UID. Many national ID programs use proprietary systems, which make it very difficult and expensive to upgrade and expand. And finally, the use of three backend database systems assures that the government is not reliant on any particular vendor.

Other aspects of the UID program should be more carefully considered.

- **The UID registry only provides numbers and no cards.** To some, this is the biggest flaw in the program, since people may expect to have a physical card as a result of the enrollment process and may expect to be able to use the card for obtaining benefits. Because the process is separated, it is possible that some people will have a UID but no national ID card. There is also the practical question of what happens when people forget their UID number.

A system that relies on a number only and no card must also be able to support online authentication at all times. In many developing countries, cell phone coverage may be ubiquitous, but not always reliable. The UIDAI's hope is that by the time the enrollment process is complete, mobile network coverage will be more reliable in India, but ultimately this may not be the case in other countries, and a method of offline authentication would be needed. The other important point in the India case is that the UID was created as an identity platform for others to use to verify beneficiaries. Any agency can leverage the UID system to authenticate a person, but is responsible for their own adjudication in terms of eligibility of benefits and can issue a card for their program as needed. For example, even in India, under the RSBY program, a card is issued to accommodate the fact that only 10% of the hospitals have internet connectivity.

The trade off of a card-based system is of course expense and management.

Identification cards need their own security protocols for usage, and typically need be regularly provisioned, either for renewals or replacements because they have been lost or damaged. It should also be noted that a card alone does not verify the identity of the bearer; only biometrics can do that. And finally, from a pan-government perspective, a multi-purpose card would necessitate an even greater level of government cooperation and coordination which may not be realistic. The truth is, despite how attractive the concept of a multi-purpose card is, less than a handful of countries in the developing world have managed to implement one. In all likelihood, India, like most countries, will develop a range of cards that allow for online as well as offline authentication. Already, there are several successful card-based solutions for health insurance and cash transfers; up to now, these have been taking place outside the UID framework.

- **The backend database is managed by three non-Indian outsourced Biometric Service Providers.** This arrangement was intended to get the UIDAI through the first 200M enrollments. The government has long-planned to issue a Managed Service

Provider contract to one large system integrator to handle the CIDR, but this process has been delayed due to budgetary reasons. In any event, it is intended that the managed service provider will be responsible for keeping the UID network up at all times and establishing a network operations center, along with a data recovery site. The managed service provider will integrate all the applications and plan outbound logistics for delivery of the Unique ID number. It will also manage the logistics network for the UID letter dispatch center. And finally, the company will be required to possess a pan-India virtual private network for providing network services, and so taken together, it implies that the company will be fully established as a local Indian entity.

Regardless of whether it is done by a local company or not, an outsourced model may not be acceptable to some countries, which have heightened sensitivities from a security or privacy standpoint. On the other hand, with strict data protection policies and personnel clearance requirements, it is possible for governments who may not have the in-house technical expertise to acquire these types of technologies. Given limited capacities in most developing countries, it is important to weigh the trade-offs and establish strict protocols against the misuse of information.

- **The turf war between the UID and the NPR is having negative consequences for the overall objective.** Opponents of the UID are suggesting that the system presents security issues and adds additional layers of unnecessary cost. This may also potentially make it more complicated to keep the list of households and individuals that are eligible for different programs. Governments should be very careful to establish jurisdiction for national ID programs and set them up in a way that they work across all government agencies – from a budgetary and legal authority perspective. There should also be very clear guidelines as to the responsibility of the entity carrying out enrollments, versus the entity conducting adjudications and provision of benefits. As implied earlier, having multiple cards exacerbates the identity management problem, but it is rare that multi-purpose cards live out their potential. Only a handful of governments, including Malaysia and Germany, have been able to successfully deal with this issue.

Multilateral funding agencies, NGOs and other stakeholders should also consider these points as they recommend and fund identity programs. The basis for national ID systems in many countries may be civil registries, but often times with no birth certificate or breeder document, it is very hard to come up with a high integrity civil registry. A UID-type system which acts as a central identification authority means that any person can be enrolled. However, it also means that the person will only have one identity for life. This should not be taken to mean that a birth registration exercise is not important or relevant; indeed finding a way to enroll an infant at birth will ensure inclusion for the rest of his/her life (the UID system is only enrolling children from the age of 5). This topic is beyond the scope of this paper, but one that warrants further exploration.

The international community should also recognize the importance of the authentication aspect of the UID program. Oftentimes programs are very focused on registration and card issuance/production, but as stated earlier, building an authentication mechanism will allow

for many of the economic and social development goals to actually become realized. If ID cards are merely used as flash passes, it is not possible to quantify who does and does not get services, it is not possible to track the progress of beneficiaries, and it is not possible to assign accountability for targeted funds.

With only 200M enrollments complete, the UID has a long way to realize its goal of inclusion for all. But the potential is huge. By helping to lay the foundation for electronic payments and mobile banking, the UID program can save the government more than \$20B a year. Put another way, these savings from fraud and waste can go towards increasing the per capita income of the poor by 15-20%⁷⁸. Much of the success will of course be predicated on whether the promise is fulfilled, whether people will indeed use the UID for what it was intended for, whether public and private institutions rely on it for verifying daily transactions, and how the policy issue with NPR ultimately gets resolved. To a large degree, the success will also depend on the human factors and surrounding manual processes that cannot be circumvented. At the end of the day, UID is an enabling platform for various stakeholders to either embrace or reject. What we may ultimately see is some kind of hybrid where front-end agencies use the UID platform to avoid doing their own enrollment and for verifying eligibility, but ultimately establish a local or card-based authentication mechanism using PIN numbers or iris biometrics to overcome some of the technical challenges with fingerprints and lack of internet connectivity. Regardless of how it plays out, the UID has to a great extent already established itself as a model of increased transparency and accountability that the entire global community can learn from.

⁷⁸ Source: McKinsey E-Payments Summary Report, 2010.
http://online.wsj.com/public/resources/documents/McKinsey_EpaymentReport_ExecSummary.pdf

Annex: The Case of Andhra Pradesh⁷⁹

With nearly 85M people according to the 2011 Census of India, Andhra Pradesh is India's fourth largest state by area and fifth largest by population⁸⁰. In Andhra Pradesh, as in India's other states, the government runs an extensive Public Distribution System (PDS) in conjunction with the national Ministry of Consumer Affairs, Food and Public Distribution. The PDS is a food security program, which includes at its heart, ration cards, which are distributed to people based on their economic situation to buy food grains, sugar, oil and other food basics. The national government provides the procurement and allocation of the goods, but the state governments are responsible for the distribution of goods via its network of approximately 499,000⁸¹ Fair Price Shops and for overseeing and issuing ration cards, which can be used at the Fair Price Shops.

Over the years, there have been many complaints about the PDS system – from the quality of the food grains in the ration shops, to the large number of bogus cards in the system, middlemen who consume stock meant for the poor and the fact that because of the corruption and abuse in the system, many people for whom this program was intended to reach were not being served. In fact, according to a study released by the Planning Commission in March 2008, only 42% of the subsidies issued by the national government for the PDS program actually reached the target audience⁸².

To the government of Andhra Pradesh, the failure to deliver the promised benefits of aid subsidy programs represented a failure to properly provide for the citizens of the State. On a financial level, the failure of subsidy schemes represented many millions of dollars in wasted taxpayer money. The fact that there were 86M ration cards distributed for a population of 83M, and that these ration cards were for many people their only source of identification for other welfare schemes, such as pension payments, and housing vouchers, the implications of the fraud were tremendous. In an effort to bring more efficiency and effectiveness to the Public Distribution System, in 2005 the government of Andhra Pradesh decided to embark on an ambitious program to enroll eligible citizens and issue ration cards utilizing iris biometrics. The government set up 1800 enrollment centers around the State. In addition to the iris⁸³, a family photo, as well as demographic details were recorded. However, the initial back end technology solution was not designed to scale properly and after a few thousand enrollments the system essentially failed as millions of duplicate enrollments made it into the database.

⁷⁹ Content from this section relied heavily on confidential interviews with industry sources familiar with this project.

⁸⁰ http://www.censusindia.gov.in/2011-prov-results/data_files/india/Final%20PPT%202011_chapter3.pdf

⁸¹ http://fcamin.nic.in/dfpd/EventListing.asp?Section=PDS&id_pk=1&ParentID=0

⁸² http://en.wikipedia.org/wiki/Public_Distribution_System

⁸³ Iris capture was done using a single iris camera. This meant that each iris had to be captured individually. Dual iris cameras were not yet available on the market at that time.

The complicity of the enrollment operators in various fraudulent practices also caused major issues. In some cases, phony cards were generated for non-existent families by copying the photo and iris of genuine beneficiaries. In another example, the iris of one person in a family was often paired with others in the same family. This simple act of replication within a family sped up the enrollment process for the enrollment operator but wreaked havoc on the integrity of the database. Furthermore, operators would often match a random iris with a random photo in order to create bogus ration cards. Individuals also enrolled multiple times to have access to more benefits than they were entitled to. There were also questions raised about the usefulness of the system given that the FPS shops were not equipped with readers to validate the authenticity of the cards or authenticate the identity of the cardholder.

In 2008, the project was overhauled and a new contract was established for the deduplication of the iris database and for managing the enrollment of the remaining citizens (only a portion of the population was enrolled in the first round). This time, as opposed to an SDK (software development kit)-based solution that had to be built from the ground-up and was not designed for such a large-scale operation, the new team implemented a highly scalable and robust solution. The new solution was built specifically to handle the high throughput and large database size that this project required. The iris technology itself was also more mature by that point, as were the capture devices.

All the records from the old system were converted. Once the new system was operational, it took a period of two months for the new system to de-duplicate the 86M demographic database as well as the 56M iris database that had been established until that time. This equated to 6.26 quadrillion iris matches. The effort was supported by a massive field operation that involved 500 government officials and thousands of field operators. A central online iris enrollment application with various quality control checks disallowed the fraudulent submissions of the earlier version of the system. As people came to enroll, they were issued a temporary receipt with a photo; once the enrollment was validated against the central database, the card was prepared and provided back to the enrollment center for distribution. The clean database supported the ration card program but was also checked against the pension program and the system for housing beneficiaries⁸⁴.

With the work about 60% complete (the last point at which data is available for the project), over 7M duplicate ration cards, 255K duplicate pensioners and 347K duplicate housing beneficiaries were discovered. This equated to an estimated savings of \$6M per month on the ration cards, \$1.6M per month from pensioners and a one-time savings of \$5M in housing. At a cost of \$10M for the backend software, the system paid for itself within a month.

The program had received enough notice that by March 2010, when the UID program was getting under way, Andhra Pradesh was chosen as one of the locations for the Proof of

⁸⁴ There were 6.8M and 6.4M records in the pension and housing databases, respectively.

Concept study⁸⁵, and by January 2011, the enrollment process for the ration cards in Andhra Pradesh was integrated with the UID process.⁸⁶

Lessons Learned

Despite all the problems, the Andhra Pradesh biometrics project ultimately proved that biometrics could be applied in a large-scale environment. However, this project also demonstrated that the mere use of technology does not guarantee success. There were critical factors relating to system design, workflow, policy and individual considerations that played into the program's outcomes.

Technology. From a very high-level system design standpoint, a biometric framework has four main aspects: enrollment, database management, exception handling and verification. Each of these has unique elements that have to be carefully considered. For example, it is critical from a multi-biometric perspective that all biometrics captured from one individual are linked correctly in that particular record and not mismatched. On the database side, particularly for a project the size of Andhra Pradesh, the system must be designed to manage proper throughputs and to accommodate scalable workflows. The technology that was originally selected was clearly not appropriate for this use. The original workflow as well could not support real time responses, which contributed to opportunities for fraud.

Operator Controls and Incentives. On the enrollment side, quality control is absolutely critical to the accuracy of the results that the system will generate. This includes the quality of the data and also the integrity of the data, and having checks and balances in place to prevent operator error and fraud. As implied before, quality control includes operator errors, whether purposeful or not. In fact, one clear lesson is the need for appropriate incentives for high-quality enrollment, including payment only for actual cards or benefits issued.

Policy. On the policy side, there was not sufficient clarity as to which families should be included or excluded in the ration card program. This resulted in the genuinely poor being excluded at higher rates. There were also no controls in terms of the use of a singular identity for multiple programs, so people were able to game the system by using different identities in each of the aid subsidy programs. Again, the later system that was implemented addressed some of these issues and exposed the importance of interoperability and mobility of identity, a concept which came to the forefront in the later UID program.

These are but a few of the factors and lessons learned from the Andhra Pradesh case, of course from a technology perspective, but also in terms of system design, policy and individual level considerations. In fact, much of the fallout from this program in Andhra Pradesh, both positive and negative, helped pave the way for the Universal ID (UID)

⁸⁵ http://uidai.gov.in/images/FrontPageUpdates/uid_enrolment_poc_report.pdf

⁸⁶ <http://www.hindu.com/2011/01/25/stories/2011012560030300.htm>

program currently underway in all of India today, setting the stage for what is already the largest biometric registry ever created. The UID Authority seems to have absorbed many of these lessons into their system design and will allow the UID to ultimately reach its objective of providing a universal identity for all Indians.

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