

Aadhaar & Blockchain: Opportunities and Challenges for India

by

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B.Tech. Information Technology
Uttar Pradesh Technical University

Submitted to the System Design and Management Program in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Management

at the
Massachusetts Institute of Technology

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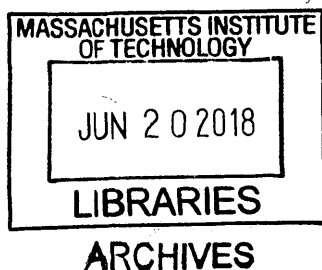

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ABSTRACT

In India, the inability to prove one's identity is one of the biggest barriers that prevents the poor from accessing benefits and subsidies. India is a country with 1.3 billion residents in over 640,000 villages. The Indian government spends \$50 billion on direct subsidies (food coupons for rice, cooking gas, etc.) every year. Both public and private agencies in India require proof of identity before providing services or benefits to those living in India.

Until the introduction of the Aadhaar program, there was no verifiable identity number program that both residents and agencies could use. As a result, every time Indian residents tried to receive benefits, they had to undergo an arduous personal identification process. What made it even more difficult was that the various service providers had different document and information requirements. This made it especially hard for India's poor residents, who often lacked documentation and found it difficult to access services. The Unique Identification (Aadhaar) project was created in order to provide every resident of India with a unique identification number that can be used to access a variety of services and benefits. The project enables residents in India to receive food coupons, receive cooking gas deliveries, open checking accounts, apply for loans, insurance, pensions, property deeds, etc. In addition, the program makes it possible for the Indian government to make sure that welfare benefits go directly to the right person.

Aadhaar is a centralized approach to provide identification and benefits to the citizens of India. It is plagued with some problems typical to a centralized system such as central authority, data privacy etc. In this thesis, we explore the Blockchain technology to improve Aadhaar, a centralized paradigm to a de-centralized one. I have explored the ways in which the current welfare services could be evolved on the re-imagined Aadhaar system with Blockchain.

Thesis Supervisors

Michael J. Casey

Senior Advisor, MIT Media Lab

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List of Acronyms

API	Application Programming Interface
ASHA	Accredited Social Health Activist
ATM	Automated Teller Machine
AVS	Aadhaar Verification Service
B2B	Business-to-Business
BaaS	Blockchain-as-a-Service
BHIM	Bharat Interface for Money
CIDR	Central Identities Data Repository
D.A.O.	Decentralized Autonomous Organization
EDI	Electronic Data Interchange
EPFO	Employees' Provident Fund Organization
FinTech	Financial Technology
HMAC	Hash-based Message Authentication Code
ID	Identification
IDFC	Infrastructure Development Finance Company
IoT	Internet of Things
IRCTC	Indian Railway Catering and Tourism Corporation
KYC	Know Your Customer
LPG	Liquefied Petroleum Gas
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NHS	National Health Service
NPCI	National Payments Corporation of India
OTP	One Time Password
PAHAL	Pratyaksh Hanstantrit Labh
PDF	Portable Document Format
PDS	Public distribution system
PF	Provident Fund
PIN	Personal Identification Number
PKI	Public Key Infrastructure
PoC	Proof-of-Concept
PoS	Proof-of-Stake
PoW	Proof-of-Work
QR	Quick Response
SEC	Securities and Exchange Commission
UAN	Universal Account Number
UIDAI	Unique Identification Authority of India
UPI	Unified Payment Interface
XML	Extensible Markup Language

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1 Introduction

1.1 Motivation

"Identification provides a foundation for other rights and gives a voice to the voiceless."

-- Makhtar Diop, World Bank Vice President for Africa

"Who are you?" may well be the world's most frequently asked question. On a website, in a nightclub, at an airport, or in front of a bank counter, everyone wants us to prove that we are who we say we are.

But 2.4 billion poor people worldwide, about 1 billion of whom are in India, can't answer that question to the satisfaction of authorities. While they certainly know who they are, they are often excluded from property ownership, free movement, and social protection simply because they can't prove their identity. They are more exposed to corruption and crime, including human trafficking and slavery.

Without official identification, a person can struggle to access:

- **Financial services**, such as opening a bank account or obtaining capital and credit
- **Social benefits**, including food vouchers, pensions, or cash transfers

- **Healthcare**, such as health insurance, vaccinations, and maternal care
- **Education**, such as enrolling children in school or applying for scholarships
- **Political and legal rights**, such as voting, filing petitions in courts, owning property, or receiving an inheritance
- **Gender equality**, including prevention of early and child marriage
- **Migration**, including seeking asylum and crossing borders legally and safely

Collectively, the barriers individuals face in turn create larger barriers for the countries they live in. Without strong identification systems, countries can struggle to:

- **Deliver** vital services to people
- **Govern** effectively
- **Eliminate** duplicative or inefficient programs
- **Make efficient use** of limited resources
- **Produce** statistics accurately

1.2 Objectives and Approach

The goal of this research is to explore Aadhaar ecosystem holistically to draw the strengths, shortcomings of the system, and measures to improve using Blockchain. Further, we will explore the use cases to draw the inspirations of a better framework.

The objectives of this research are summarized as follow:

- To analyze the existing Aadhaar ecosystem;
- To evaluate the strengths and shortcomings of the system;
- The analysis to improve the system using decentralized approach of Blockchain.

1.3 Thesis Outline

The remaining chapters of this thesis are articulated as follows:

Chapter 2 – Introduction to Aadhaar: Covers the state of art Aadhaar project's background and facts in this thesis. This chapter also highlights the format of Aadhaar card issued and state-wise enrollment and expenditure in this program since inception from 2009 to till date.

Chapter 3 – Technical overview of Aadhaar ecosystem: This chapter provides an overview of technical architecture, data storage and collections methodologies, data scale, authentication mechanism, and future plans of Aadhaar ecosystem and how Indian government uses it to provide facilities to various beneficiaries.

Chapter 4 – Aadhaar Ecosystem exploration: This chapter discusses the ecosystem in more detail and how Indian government uses it in various sectors such as taxes, education, healthcare etc.

Chapter 5 – Shortcomings of Aadhaar system: This chapter demonstrates the drawback of current Aadhaar system and how it is prone to various shortcoming because of the flaws in the architecture of centralized approach.

Chapter 6 – Blockchain Introduction: This chapter provides a primer on Blockchain definition and principles, types, working, and other important constructs to understand the working.

Chapter 7 – Building a better Aadhaar with Blockchain: This chapter summarizes the improvisations on Aadhaar over Blockchain. It talks about how blockchain could help in improving the existing services across sectors.

Chapter 8 – Conclusions: This chapter concludes the findings from the analysis of Aadhaar ecosystem and exploration of Blockchain.

2 Background

Aadhaar, which means 'foundation' in Hindi, is a 12 digit unique-identity number issued to all Indian residents based on their biometric and demographic data. The process of issuing Aadhaar number and the Aadhaar card as well as managing them is overseen by a body called the Unique Identification Authority of India (UIDAI). The data is collected by the Unique Identification Authority of India (UIDAI), a statutory authority established in January 2009 by the Ministry of Electronics and Information Technology - Government of India, under the provisions of the Aadhaar (Targeted Delivery of Financial and other Subsidies, benefits and services) Act, 2016.

2.1 Overview

With over 1.19 billion enrolled members as of Nov 30 2017, Aadhaar is the world's largest biometric ID system. As of this date, over 99% of Indians aged 18 and above had been enrolled in Aadhaar. World Bank Chief Economist Paul Romer described Aadhaar as "the most sophisticated ID program in the world". It is essentially something that can be used for a variety of purposes, including proof of identity and proof of address, making it easier to open bank accounts or obtain driver's licenses. Most recently, the government also announced that through the BHIM app, users can send and receive money with their Aadhaar number.

Aadhaar is a proof of residence and not a proof of citizenship. It does not itself grant any rights to domicile in India. The primary motivation of Aadhaar is to streamline the various subsidies provided by Government of India to different beneficiaries based on qualifying criteria. The unique ID would also qualify for as a valid ID while availing various government services, like a LPG connection or subsidized ration or kerosene from PDS or benefits under pension schemes, e-sign, digital locker, Universal Account Number (UAN) under EPFO; and for some other services, like a SIM card or opening a bank account. According to the UIDAI website, any Aadhaar holder or service provider can verify an Aadhaar number for its genuineness through a user-friendly service of UIDAI called Aadhaar Verification Service (AVS) available on its website. Also, a resident

already enrolled under National Population Register is not required to enroll again for Aadhaar.

Starting with issuing of first UID in September 2010, the UIDAI has been targeting to issue an Aadhaar number to all the residents that (a) is robust enough to eliminate duplicate and fake identities, and (b) can be verified and authenticated in an easy and cost-effective way online anywhere, anytime. The Government of India recognizes the letter issued by Unique Identification Authority of India (UIDAI) containing details of name, address and Aadhaar number, as an officially valid document. It neither aims to replace any existing identity cards nor is it a cognizance of citizenship. Aadhaar neither confers citizenship nor guarantees rights, benefits, or entitlements. Aadhaar is a random number which never starts with a 0 or 1, and is not loaded with profiling or intelligence into identity numbers that makes it insusceptible to fraud, theft and provides privacy in such perspective.

2.2 Enrollment

As of 15 August 2017, 1.171 billion Aadhaar numbers had been issued. As of this date, more than 99% of the estimated population aged 18 and over had an Aadhaar number assigned, while 73% of 5-18 year olds, and 39% of below 5 year olds had an Aadhaar assigned.

Data below (as of 15 August 2017) is sourced from the State-Wise Saturation Report on the Public Data Portal. Note that the number of Aadhaar numbers "Assigned" in this report appears to be lower than the total issued slightly (likely due to exclusion of invalidated numbers etc.). Percentage figures are with respect to the estimated population in 2017.

Rank	State / Union Territory	Population	No. of Aadhaar Assigned	% of Population
	INDIA	1,319,788,179	1,144,659,906	87%
1	Delhi	18,110,349	20,964,605	116%
2	Goa	1,517,438	1,530,201	101%
3	Telangana	38,042,884	38,222,963	100%
4	Himachal Pradesh*	7,246,418	7,267,906	100%
5	Punjab*	29,344,896	29,278,893	100%
6	Haryana*	27,744,012	27,465,041	99%
7	Kerala	35,043,531	34,675,038	99%
8	Chandigarh*	1,110,820	1,083,585	98%
9	Uttarakhand	10,956,753	10,600,967	97%
10	Lakshadweep	70,214	67,535	96%
11	Dadra & Nagar Haveli	373,636	354,534	95%
12	A & N Islands	414,057	384,330	93%

Rank	State / Union Territory	Population	No. of Aadhaar Assigned	% of Population
	INDIA	1,319,788,179	1,144,659,906	87%
13	Puducherry	1,356,199	1,258,411	93%
14	Chhattisgarh	28,125,421	26,092,397	93%
15	Maharashtra	119,581,739	110,000,073	92%
16	West Bengal	96,775,592	88,763,753	92%
17	Tamil Nadu	75,844,451	69,564,118	92%
18	Jharkhand	36,672,687	33,628,199	92%
19	Karnataka	65,426,566	59,978,411	92%
20	Andhra Pradesh	52,380,243	47,992,380	92%
21	Odisha	44,912,901	40,259,355	90%
22	Gujarat	65,805,207	58,592,706	89%
23	Tripura	4,000,638	3,550,329	89%
24	Madhya Pradesh	80,894,777	71,712,571	89%
25	Sikkim	662,250	575,630	87%
26	Rajasthan	76,802,294	64,219,860	84%
27	Uttar Pradesh*	224,558,257	186,013,511	83%
28	Bihar	117,153,097	93,384,994	80%
29	Daman & Diu	264,721	204,640	77%
30	Manipur	2,966,130	2,157,396	73%
31	Mizoram	1,188,971	820,290	69%
32	Arunachal Pradesh	1,506,749	1,035,882	69%
33	Jammu Kashmir	13,477,325	9,132,765	68%
34	Nagaland	2,158,431	1,165,296	54%
35	Meghalaya	3,230,132	353,833	11%
36	Assam	34,068,394	2,307,506	7%

Table 1: State-Wise Saturation Report on Aadhaar

2.3 Expenditure

From the beginning of the project in 2009 through March 31, 2017, the government spent a total of ₹8,793.9 crore (US\$1.4 billion) on the Aadhaar project.

Expenditure by UIDAI (by year)	
Fiscal year	Expenditure
2009-10	₹262 million (US\$4.1 million)



2010-11	₹2.684 billion (US\$42 million)
2011-12	₹11.875 billion (US\$190 million)
2012-13	₹13.387 billion (US\$210 million)
2013-14	₹15.444 billion (US\$240 million)
2014-15	₹16.153 billion (US\$250 million)
2015-16	₹16.791 billion (US\$260 million)
2016-17	₹11.328 billion (US\$180 million)
Total	₹87.939 billion (US\$1.4 billion)

Table 2: Year-wise expenditure on Aadhaar

The budgeted amount for the project was reduced to ₹9.00 billion (US\$140 million) in FY17-18 from ₹20.00 billion (US\$310 million) in FY15-16, given the high enrolled percentage.


2.4 Format of Aadhaar card

The full Aadhaar card is a color document (referred to as the *Aadhaar letter*), often printed on glossy paper that is also obtainable electronically online. According to the government, a black and white version of the document is valid. It is printed on A4 paper and folded in half in portrait (to produce a front and back) that is approximately 93mm by 215mm once margins are removed. It has a cutoff card sized portion at the bottom with the key information.

இந்திய அரசாங்கம்
Unique Identification Authority of India
Government of India


**NAME
&
ADDRESS**

Signature valid 

QR
Code

உங்கள் ஆதார் எண் / Your Aadhaar No. :
XXXX XXXX XXXX

எனது ஆதார், எனது அடையாளம்



இந்திய அரசாங்கம்
Government of India

Name (regional language)

Name (English)

DOB



DD/MM/YYYY

Gender (Regional and English)

QR
Code

XXXX XXXX XXXX

எனது ஆதார், எனது அடையாளம்


தகவல்

- ஆதார் அடையாளத்திற்கான சான்று. குடியியலுக்கு அல்ல.
- அடையாள சான்றை ஆன்லைன் ஆதர்ப்பு கேவுள் மூலமாகப் பெறவும்.
- இது எலக்ட்ரானிக் செயல்முறை மூலம் தயாரிக்கப்பட்ட கடிதமாகும்.

INFORMATION

- Aadhaar is a proof of identity, not of citizenship.
- To establish identity, authenticate online.
- This is electronically generated letter.


- ஆதார் நாடு முழுவதிலும் செல்லுபடியாகும்.
- வருங்காலத்தில் அரசு மற்றும் அரசு சாரா சேவைகளை பயன்படுத்திக் கொள்ள ஆதார் உதவிகரமாக இருக்கும்.
- Aadhaar is valid throughout the country.
- Aadhaar will be helpful in availing Government and Non-Government services in future.




இந்திய அரசாங்கம்
Unique Identification Authority of India

**Address in regional
language and in English**


XXXX XXXX XXXX



1947



mailto:uidai@gov.in



www.uidai.gov.in

Figure 1: Aadhaar card mock up

Top section (letter)

1. Heading: Unique Identification Authority of India, Government of India. (In state language and English)
2. Enrolment No
3. Full name of Holder (In state language and English)
4. Name of father (or husband)
5. Address
6. Phone number
7. A PDF electronic signature self-signed by the "UNIQUE IDENTIFICATION AUTHORITY OF INDIA"
8. A QR code
9. Download Date and Generation Date
10. Aadhaar No (In state language and English)
11. On the rear, Emblem of the Republic of India and logo of AADHAAR
12. General information about the Aadhaar card: (In state language and English)
 - o Aadhaar is a proof of identity, not of citizenship.
 - o To establish identity, authenticate online.
 - o This is electronically generated letter.
 - o Aadhaar is valid throughout the country.
 - o Aadhaar will be helpful in availing Government and Non-Government services in future.

Bottom section (a cutoff card sized paper)

1. Front heading: Government of India (In state language and English), with Emblem
2. Photograph of the holder
3. Full Name (In state language and English)
4. Date of Birth (In state language and English)
5. Gender (In state language and English)
6. A QR Code
7. Aadhaar No (In state language and English)
8. Rear heading: Unique Identification Authority of India (In state language and English), with logo
9. Name of father (or husband)
10. Address (In state language and English)
11. Aadhaar Number (In state language and English)

The QR Code contains an encoded version of some of the data in XML format in English only:

1. UID - Aadhaar number
2. Full name of holder
3. Gender
4. Year of birth
5. Name of father (or husband)
6. Address
7. Full date of birth

2.5 Aadhaar as digital Identity

A number of features make the Aadhaar card a digital identity, and facilitate digital identity.

1. The document of the card itself is electronic in PDF format,
2. A QR Code provides digital XML representation of some core details of the card.
3. The number and some limited details can be validated online (with the notable exclusion of the name),
4. Updating details can be done electronically using a mobile phone number and/or email as the second factor of authentication,
5. The system collects a photo, all 10 finger scans, and eye scan, however there is no known common usage of this data to date to electronically validate a holder.

3 Technical overview of Aadhaar

3.1 Data collection and storage

Aadhaar collects name, date of birth, gender, address, mobile/email (optional) of every resident (no need to be a citizen), and stores those against the corresponding fingerprints and iris patterns. At the time of writing the thesis, UIDAI had successfully collected and stored more than 1.2 billion records. It's a massive data store of personally identifiable information (PII) stored and managed centrally, by the government. As a deduplication practice, all the biometrics stored are checked against existing ones at the point of enrollment and the 12 digits unique identifier is generated—that's the Aadhaar number. The Aadhaar number is a reference identifier and it does not carry any kind of meaningful data in it.

Aadhaar authentication is the process wherein Aadhaar number, along with other attributes, including biometrics, are submitted online to the Central Identities Data Repository (CIDR) for its verification on the basis of information or data or documents available with it. Aadhaar authentication provides several ways in which a resident can authenticate themselves using the system. At a high level, authentication can be 'Demographic Authentication' and/or 'Biometric Authentication'. During the authentication transaction, the resident's record is first selected using the Aadhaar number and then the demographic/biometric inputs are matched against the stored data which was provided by the resident during enrollment/update process. Fingerprints in the input are matched against all stored 10 fingerprints. Aadhaar authentication API is not open for anyone. First, a person needs to register with the Aadhaar and then keys will be provisioned to his system. Each authentication request must be signed by these keys, so Aadhaar knows from where the requests are generated.

The amazing design principle behind Aadhaar is that it does not try to solve any concrete problems, directly. In India, only 30% of the population has a bank account—Aadhaar does not try to solve it. The Indian government-layered with many intermediaries- is inefficient in distributing subsidies, and often fails to reach the right people with the correct product -- Aadhaar does not try to solve it. What Aadhaar does is, building a solid foundation for others to further build upon. Aadhaar is the identity layer of a larger ecosystem that can be built around it to solve real world problems.

In short—Aadhaar builds a way to uniquely identify the residents in India. Since the identifier is unique, other systems can identify the user and correlate the user across different systems. For example, if you open a bank account with your Aadhaar number—the bank can independently verify your address and trustworthiness by connecting to other systems and correlate using the Aadhaar number.

With Aadhaar, you have nothing to lose. If you just know your Aadhaar number—you just prove the possession with your own fingerprints and iris. Neither a tsunami nor any other natural disaster can take your identity away from you. But, then again Aadhaar is a centralized system. All the centralized systems are honeypots—it's just a matter of time. Whoever hacked into the Central Identities Data Repository (CIDR) can reveal the personally identifiable information of more than 1 billion users.

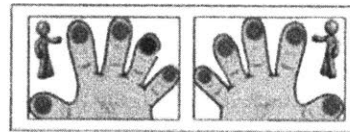
Demographic Data

- Compulsory data:
 - Name, Age/Date of Birth, Gender and
 - Address of the resident.
- Optional data:
 - Mobile number
 - Email address

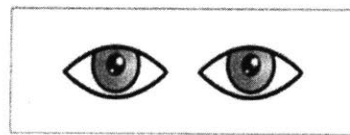
Biometric Data



Photograph



All 10
Fingerprints



Both Iris

12-digit Aadhaar Number

Unique, lifetime, biometric based identity

Figure 2: Data collected in Aadhaar

3.2 Architecture at a glance

The entire technology architecture behind Aadhaar is based on principles of openness, linear scalability, strong security, and most importantly vendor neutrality. The backbone of the Aadhaar technology was developed using the following principles:

Open architecture – Building the Aadhaar system with true openness meant that it relies on open standards to ensure interoperability; the platform approach with open APIs made it possible for the ecosystem to build on top of Aadhaar APIs; vendor neutrality was ensured across the application components by using open and standard interfaces. The identity system was designed to work with any device, any form factor, and on any network.

Design for scale – The Aadhaar system is expected to issue more than 1.2 billion identities, and will continue to grow as the resident population expands. Since every new enrollment requires biometric de-duplication across the entire system, every component needs to scale to very large volumes. This meant that the system needed to be able to handle hundreds of millions of transactions across billions of records doing hundreds of trillions of biometric matches every day. In addition all online services such as Aadhaar authentication, e-KYC services, and update services must work with high availability and sub-second performance. In order to achieve such massive scalability, the program established network and data center load balancing and a multi-location distributed architecture for horizontal scale.

Data Security – The security and privacy of one’s data is a foundation of the Aadhaar system. The system uses 2048-bit PKI encryption and tamper detection using HMAC in order to ensure that no one can decrypt and misuse the data. Resident data and raw biometrics are always kept encrypted, even within UIDAI data centers. In addition, the system does not keep track of any transactional data.

3.3 Data scale

The Aadhaar database includes an iris scan, digital fingerprints, a digital photo, and text-based data for every resident, approximately 3-5MB per person, which maps to a total of 10-15 petabytes of data. This robust system is designed to verify a person’s identity within 200 milliseconds.

The uniqueness of an Aadhaar identity makes it possible to eliminate fake and duplicate accounts, and the online authentication system provides a mechanism for the paperless, electronic and instantaneous verification of a person’s identity.

3.4 Authentication mechanism

The Aadhaar authentication system provides multi-factor authentication, based on “what you have” (something the user uniquely has, such as a mobile phone or laptop that accesses email, etc.) and “who you are” using resident fingerprints patterns, iris scans, a signature, or handwriting. By combining one or more factors, the resident’s authentication could be strengthened. In addition, Authentication User Agency (AUA)-specific factors such as ATM cards or smart cards or passwords may also be used in conjunction with Aadhaar authentication to further strengthen user authentication.

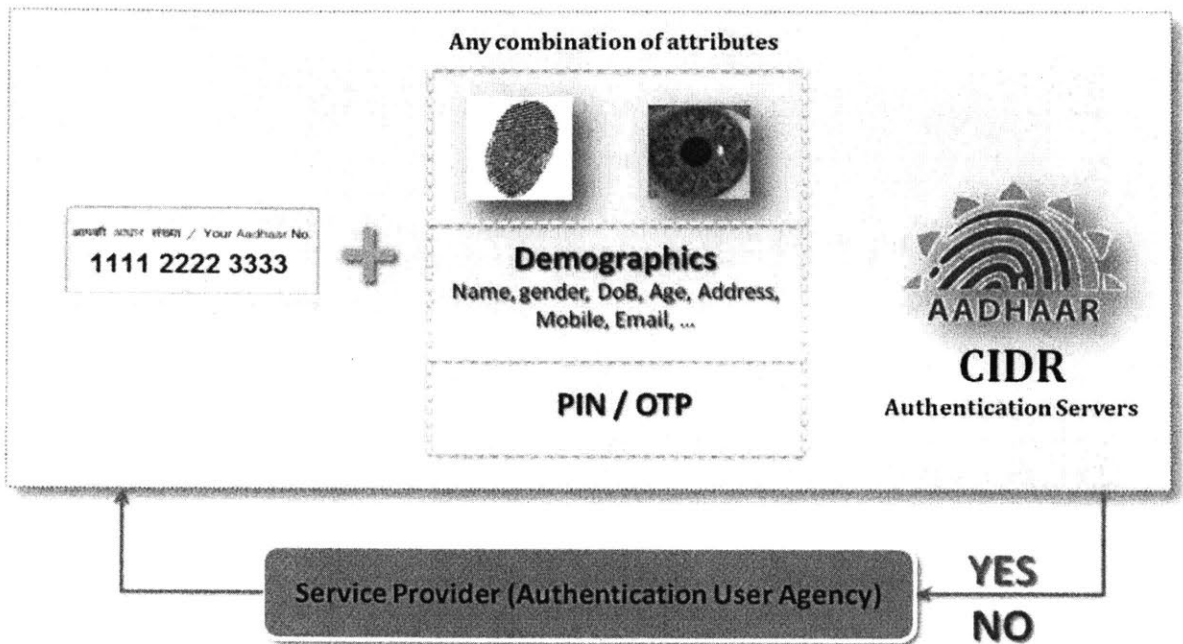


Figure 3: Aadhaar Authentication Overview



Figure 4: Aadhaar in Action

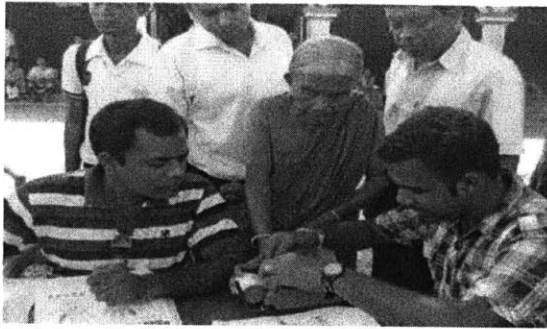


Figure 5: Payments through micro ATMs

3.5 Future Plans

Future plans call for Aadhaar to be used for digital signatures, electronic documents and digital locker services. Also, Aadhaar could also be used for college/university certificates, as well as credit registries. The Aadhaar identity platform and Aadhaar-enabled applications are helping a billion people in India to participate in the digital economy, and benefit from government, public and private sector services that are tailored to them.

4 Aadhaar ecosystem

Over the last few years, Aadhaar has become one of the most important documents to have and though it was initially argued that the mandatory provisions were for welfare schemes, it has been extended to more essential services.

Though, it doesn't replace the existing identification documents, it can be used as a single identification document at healthcare institutions, government bodies, financial organizations, among others that can use it to identify and verify an Aadhaar holder.

4.1 Aadhaar for taxes and finance

The government has made Aadhaar mandatory for opening bank accounts. If a person does not have an Aadhaar card, then the proof of applying for it will have to be submitted — Aadhaar enrollment ID. Also, the UID has to be submitted in the bank within six months of opening a bank account. Failure to submit Aadhaar for all non-small bank accounts will lead to blockage of access to the bank accounts. Cash transactions over Rs 50,000 will also need to be accompanied by Aadhaar details.

PAN will have to be submitted along with Aadhaar number at banks during tax filings or making large transactions. Effectively PAN will become linked with the biometric system. If split transactions appear to be connected and cross the threshold, the provisions will still apply and failure to submit will draw a penalty. This year's budget proposed linking PAN with Aadhaar to crackdown on tax evaders who used multiple tax ids.

4.2 Aadhaar for healthcare and nutrition

The Uttar Pradesh government has made it mandatory for patients to produce Aadhaar for availing free ambulance service. The patient's kin may also provide the Aadhaar upon the ambulance's arrival.

It is also compulsory to furnish Aadhaar for tuberculosis (TB) patients to avail TB treatment under the Revised National Tuberculosis Control Programme (RNTCP). The government provides conditional cash assistance as a benefit. These beneficiaries are TB patients and healthcare providers.

Aadhaar becomes a mandatory requirement for National Health Mission by trained female community health activist ASHA or Accredited Social Health Activist.

4.3 Aadhaar for subsidies/welfare benefits

It is mandatory for Beedi/Iron Ore/limestone workers who want to avail a house subsidy. Supplementary nutrition programs also require mandatory Aadhaar. Aadhaar is compulsory for people who want to avail e-panchayat training benefits.

4.4 Aadhaar for farmers

Aadhaar is mandatory for those who wish to avail benefits of welfare schemes under Integrated Department of Horticulture. Soil Health Management Scheme and Soil Health Card Scheme require Aadhaar. It becomes mandatory for availing benefits under water and social services, Research and Development in Water Sector and National Social Assistance Program.

It is mandatory for farmers wanting to take crop insurance benefit. Aadhaar is also compulsory for people who are eligible for subsidized foodgrains/cash subsidy.

4.5 Aadhaar for education

Students seeking Central scholarships for college studies need to submit Aadhaar. Also Central scholarships and financial support are to be given under National Means-cum-Merit Scholarship only after fulfilling Aadhaar obligations.

It is also required for disabled children between 6-14 years who seek benefits under Sarva Shiksha Abhiyan.

4.6 Aadhaar for employment and vocational training

National Apprenticeship Promotion Scheme, Deendayal Antyodaya Yojana, National Rural Livelihoods Mission require Aadhaar. It is also mandatory to book tickets on Indian Railways' online platform IRCTC for availing benefits and subsidies. It is required for disabled students seeking welfare benefits under National Action Plan for Skill Training of Persons with Disabilities.

4.7 Aadhaar for social and economic empowerment

It is also required for benefits under Grih Kalyan Kendra scheme. Bonded Labor Rehabilitation Scheme requires mandatory Aadhaar registration.

Victims of the Bhopal gas tragedy also need Aadhaar to take their compensation from the government.

4.8 Aadhaar for children

Training under Integrated Child Development Services of the Ministry of Women and Child Development also requires mandatory Aadhaar. Mid-Day meals also make Aadhaar mandatory. Cooks-cum-helpers earning out of the scheme must also register with Aadhaar.

4.9 Aadhaar for women

Janani Suraksha Yojana needs mandatory Aadhaar. Financial support under National Mission for Empowerment of Women will be given after mandatory Aadhaar registration. The same requirement applies to Scheme for Adolescent Women.

Maternity Benefit Program and Integrated Child Protection Scheme have mandatory Aadhaar requirement. The document is compulsory for women who wish to avail vocational training, loans and other schemes from the government. National Awards Scheme for Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry for women below poverty line require mandatory Aadhaar.

4.10 Aadhaar for Provident fund

The Employees Provident Fund Organization (EPFO) allots a Universal Account Number (UAN) in order to facilitate smooth transfer of funds when an employee switches companies. By linking his/her Aadhaar to this UAN, the employee can transfer the Provident Fund (PF) amount directly to the saving account.

4.11 Aadhaar for filing Income Tax (I-T) returns

For the past couple of years, the Income Tax Department has enabled an Aadhaar-based mechanism to digitally sign and submit I-T returns online. This financial year, the government has made it mandatory to link Aadhaar with PAN to eliminate multiple PAN used by individuals. Holding more than one PAN per person is a criminal offence.

4.12 Aadhaar for Pradhan Mantri Ujjwala Yojana

This flagship scheme launched by the central government aims to provide free LPG connection to below poverty line (BPL) families. The scheme uses Aadhaar to verify the claim of the beneficiary and to transfer the subsidy amount.

4.13 Aadhaar for digital payments

The Unified Payment Interface and the recently launched BHIM app support Aadhaar based money transfer. The IDFC Bank has recently rolled out Aadhaar Pay, where the customer's fingerprint is used to pay the merchant.

4.14 Aadhaar for Direct Benefit Transfer

The first major rollout of Aadhaar based service was Direct Benefit Transfer (DBT), a mechanism to hand over the subsidy and welfare amount directly to the beneficiary's bank account, instead of the existing practice of giving banker's cheque or cash.

As of today 92 centrally-sponsored schemes from 19 Ministries are implemented through DBT. The prominent among them are PAHAL for LPG subsidy, cash transfer of food subsidy and MGNREGA.

4.15 Aadhaar for Other Services

Indira Gandhi National Disability Pension Scheme

Indira Gandhi National Old Age Pension Scheme

Indira Gandhi National Widow Pension Scheme

Mahatma Gandhi National Rural Employment Guarantee Scheme

Pradhan Mantri Awas Yojna (Grameen)

BSR Doctoral Fellowship in Sciences

Dr. S. Radharkrishnan Post Doctoral Fellowship In Humanities

Emeritus Fellowship

Kothari Post Doctoral Fellowship in Sciences

National Research Professorship

Ishan Uday Scholarship Scheme for North Eastern Region

National Eligibility Test-Junior Research. Fellowship

P.G. Indira Gandhi Scholarship for Single Girl Child

P.G. Scholarship for Professional Courses for SC or ST candidates

P.G. Scholarship for University Rank Holders

PG Scholarship for GATE qualified PG Students

PMSSS for J and K Students admitted in rest of India

Post Doctoral.Fellowship for Women

Post- Doctoral Fellowship for SC or ST Candidates

Pragati Scholarship for girls Diploma Institutes

Pragati Scholarship for girls in Degree Colleges

QIP for faculty deputed for PhD studies at QIP centers

Saksham Scholarship for differently abled students of Degree College

Saksham scholarship for differently abled students of Diploma Institutes

Scholarship To Universities /College Students

Swami Vivekananda Single Girl Child Scholarship

Artistes Pension Scheme and Welfare Fund

Financial assistance for the preservation and development of Himalayan Cultural Heritage for Himalaya

Financial Assistance for the Cultural Function Grant Scheme CFGS

Financial Assistance for the development of Buddhist / Tibetan Organizations

Financial Assistance to Cultural Organization

International Cultural Relation

Production Grant

Repertory Grant Scheme

Scheme for the Award of Fellowship to outstanding persons in the field of Culture

Scheme for Scholarships to Young Artistes in different cultural fields

Tagore National Fellowship for Cultural Research

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Financial Assistance to Cultural Organization

International Cultural Relation

Production Grant

Repertory Grant Scheme

Scheme for the Award of Fellowship to outstanding persons in the field of Culture

Scheme for Scholarships to Young Artistes in different cultural fields

Tagore National Fellowship for Cultural Research

Maternity Benefit Programme

Inclusive Education for Disabled at Secondary Stage

National Means Cum Merit Scholarship

National Scheme For Incentive For The Girl Child For Secondary Education

Maulana Azad National Fellowship

Merit Cum Means Scholarship For Minorities

Post Matric Scholarship Scheme For Minorities

Pre Matric Scholarship Scheme For Minorities

Housing Subsidy To Beedi Workers

Housing Subsidy To Iron/Manganese/Chrome Ore Workers

Housing Subsidy To Lime Stone and Dolomite LSDM Workers

Rehabilitation Assistance

Scholarship To The Children of Lime Stone and Dolomite LSDM Workers

Scholarship To The Children of Beedi Workers

Scholarship To The Children of Cine Workers

Scholarship To The Children of Iron/Manganese/Chrome Ore Workers

Stipend to children in the special schools under the National Child Labour Project

Stipend to Differently Abled Candidates under Scheme of Vocational Rehabilitation Centre

Stipend To Trainees Under The Scheme Of Welfare Of SC/ST Job Seekers

Post-matric Scholarship for Persons with Disabilities

Pre-matric scholarship for Persons with disabilities

Rajiv Gandhi National Fellowship for students

Scholarship for Top Class Education

Janani Suraksha Yojana

Aam Aadmi Bima Yojana

Life Insurance-linked with Jan Dhan Yojana

Assistance for procurement of modified scooter

Assistance for purchase of Tool Kits

Assistance for treatment of cancer and dialysis

Assistance for treatment of listed serious diseases

Interest subsidy on home loan upto max 1 lakh

Prime Minister Scholarship Scheme

Cash Transfer of Food Subsidy

5 Shortcomings of Aadhaar

In a nutshell, Aadhaar is nothing but centralized database which holds the information of all the Indian citizens, including biometrics that can be used to trace anyone with an Aadhaar identity anytime anywhere. There has been a huge amount of skepticism and debate on the safety and security of the Aadhar database. There are fears that hackers will hack into the database. There are even greater fears that any government or authority with malevolent intent will have access to the personal information and location of every Indian citizen and, therefore, the ability to inflict extreme surveillance and targeted damage.

The government claims that the UIDAI database is in a central server with super-tight security, protected by best-in-class cryptography. There are strong laws around what can be accessed and by whom, for example biometric information is always anonymized. Having said that, these concerns, howsoever paranoid, are real. Unfortunately, hackers are always ahead of the

game, and have broken into the super-secure systems like the NSA (National Security Agency) in the US, and Britain's NHS (National Health Service). And what is to prevent a government from amending the laws and going after its own citizens, using this targeted information?

The few possible shortcomings of Aadhaar are listed below:

Compromising of Individual Privacy

Aadhaar records the biometric data of each individual, by providing him a unique 12 digits numerical. Now as per government rules, this information is linked with users all banks, voter Id, PAN card as we discussed above. Now, imagine, what will happen if this very private information of these users is used for any unintended purpose. There is a big risk of this information being used or leaked in an ill-intentional purpose.

Centralization Power Problems

Aadhaar or Unique Identification Scheme is managed and operated by Supreme Authority of Nation, which can lead to centralization problems. As the centralization of power can manipulate or create unorthodox rules or issues for the population that might affect the nation as a whole. If the government plans on introducing new rules pertaining to seeking more private information of the users in the name of Aadhaar, the people will be forced to share that information and lose their right to privacy.

Misuse of Aadhar in Bank Transactions

As per the change in rules, the government has launched a new scheme, in which all bank accounts need to be linked with Aadhar, which will be used in the processing of ATM, as well as in Credit and Debit Cards. This bit will grant government the access to reach and trace financial transaction of the masses in the country, which can be misused by the government. Such identification can be used in transaction forge, which can cause a huge loss for many Indian citizens.

Uneasy to Use

Aadhaar card download is without a doubt a useful futuristic scheme launched by the government. But in a population, where over 30 percent people are illiterate and are still caught up in a rural lifestyle, using Aadhaar card and operating all its news rule can be challenging for these people. Many rural villagers find its offering more of a bane than a boon. Aadhaar card download is definitely turning out to be a hit in the urban sector, but what about the rural region of the country.

Foreign Handling

Aadhaar Project is operated and managed by private companies. This project was introduced to entertain the development and research which were being conducted by these foreign companies. This news definitely opens ours to the potential risk of data erosion of Indian population private information to foreign bodies, who may use it in any which way they want.

Aadhar has so many benefits, that its potential risks rather seem insignificant. A genuine citizen of the country would eventually have nothing to hide from his/her country or government anyway. Today every individual in the country can verify the details of another person by verifying their Aadhaar online. Unlike other identity proofs like passport, voter ID etc., the Aadhaar card offers citizens freedom to check the basic details of their workers through an easy verification process online, which only demands their Aadhaar card number.

6 Blockchain Technology

Blockchain, mostly known as the backbone technology behind Bitcoin, is one of the emerging technologies currently in the market attracting lot of attentions from enterprises, start-ups and governments. Blockchain has the potential to transform multiple industries and make processes more democratic, secure, transparent, and efficient.

6.1 Blockchain definition and principles

At its core, blockchain is a distributed ledger technology that “leverages the resources of a large peer-to-peer network to verify and approve transactions”. These transactions are recorded chronologically in blocks, and the blocks are linked together cryptographically and stored permanently on the blockchain, creating an immutable chain. There is no single copy of the blockchain; rather, copies are distributed globally across the participants in the network and updated simultaneously. This ensures that the ledger cannot be manipulated by any single party without the consensus of the majority in the network. The type of information stored in the transactions can be varied (e.g. currency, intellectual property, identity data, location data, etc.), making blockchain technology highly customizable for different applications.

In their article, Lansiti and Lakhani espoused five basic principles underlying blockchain technology. They are:

1) Distributed database

The information contained within the blockchain is not controlled by any single party. Every participant in the network is able to access the entire database and its complete history. Since all the information is accessible, participants can also verify the records of transactions directly, without the need for an intermediary.

2) Peer-to-peer transmission

Communication within the network occurs directly between participants instead of through a central node or intermediary. Each participant constitutes a node, and each node stores and sends information to all other nodes.

3) Transparency with pseudonymity

All transactions and their associated values are visible to participants with access to the blockchain network. Every participant is assigned a private key and a public key. The private key is used to generate digital signatures and should never be disclosed, while the public key is an alphanumeric address that is used for transactions. This allows transactions to be traceable

to the public address of participants, but they can choose how much of their identity information to share.

4) Irreversibility of records

Once a transaction has been verified and approved by the network, it will be recorded in the database and updated across all nodes. At this point, the records cannot be altered as they are linked to every preceding transaction record (hence forming the 'chain'). The process of adding transactions to the blockchain is accomplished by a subset of participants (known as 'miners') that compete to solve difficult mathematical problems. Computational algorithms are used to ensure that the records are permanent, in chronological order, and accessible to all participants on the network.

5) Computational logic

The digital nature of the ledger allows transactions on the blockchain to be programmed using computational logic. Hence, users can build algorithms and rules to automatically trigger transactions between different nodes when certain criteria are met. This provides the basis for using smart contracts in blockchain.

6.2 Understanding the concept

“A Blockchain is a digital, immutable, distributed ledger that chronologically records transactions in near real time. The prerequisite for each subsequent transaction to be added to the ledger is the respective consensus of the network participants (called nodes), thereby creating a continuous mechanism of control regarding manipulation, errors, and data quality. Simply put, Blockchain is a protocol for exchanging value over the internet without an intermediary.

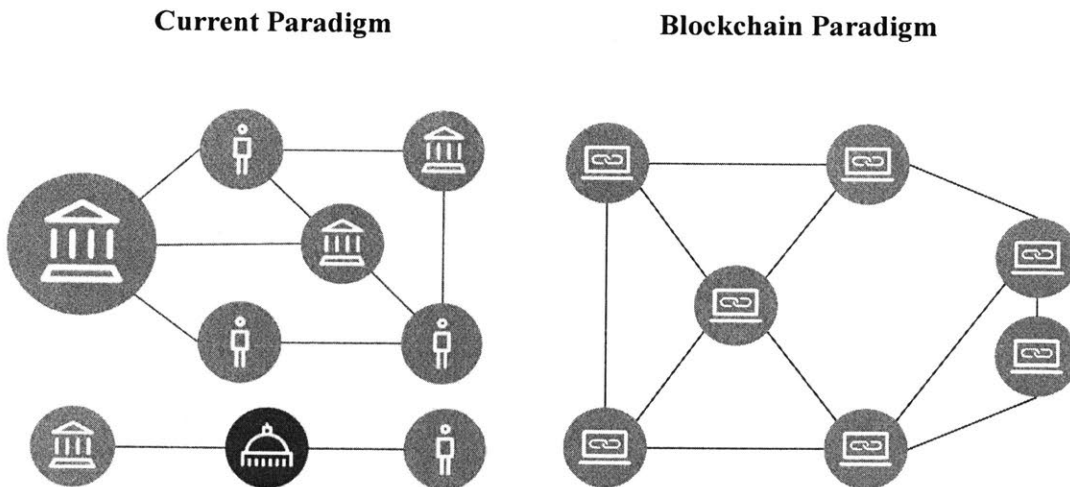


Figure 6: Traditional database vs. Blockchain base distributed ledger

	Current Paradigm	Blockchain Paradigm
Central authorities	transfer actual value between two parties	Distributed nodes that maintain a shared source of information
Multiple intermediaries	required to facilitate of assets and create trust	Trust enabled by cryptographic algorithm

Table 3: Current vs Blockchain paradigm

The immutability of a Blockchain makes it nearly impossible for changes to be made once established, which increases confidence in data integrity and reduces opportunities for fraud. The immutability and irreversibility feature of a Blockchain comes from the underlying data structure which is called a Merkle tree or Hash tree.

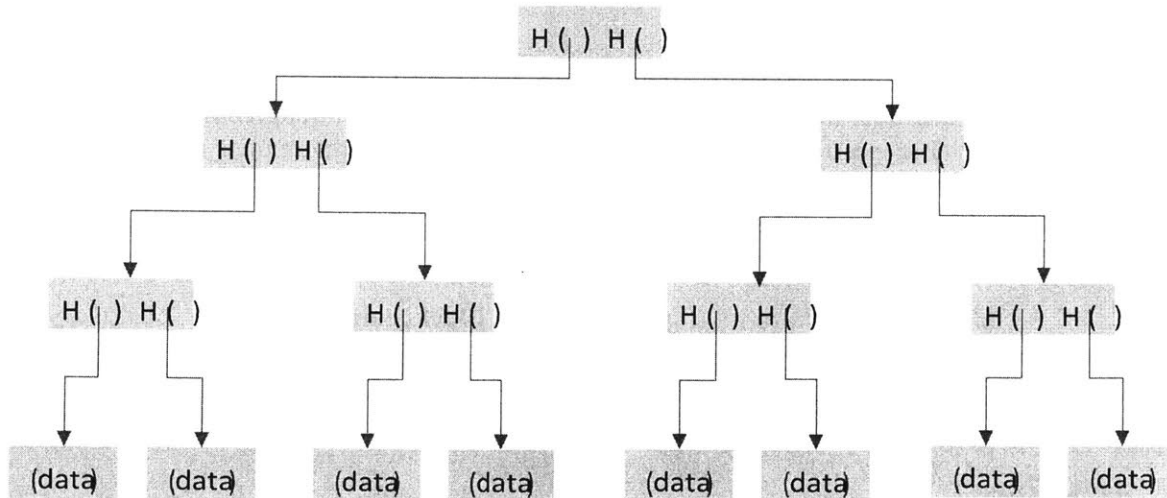


Figure 7: Merkle Tree

Merkle Tree is at the heart of the Blockchain Technology

The cryptographic security in Blockchain comes from a binary data structure with hash pointers. Merkle tree, or hash tree, as it is called, is a distributed data structure where data blocks are grouped in pairs and the hash of each of these blocks is stored in a parent node. This grouping of hash codes continue till the root node. This gives rise to the immutability of a Blockchain as tampering of any block will lead to tampering of all the preceding hashes till the root node, which is tamper proof. The other advantage of the Merkle tree is the proof of membership/ownership as knowing the root member is enough to know all the members in the tree. As a result, hash tree provides faster processing of

Types of Blockchain

All Blockchain types can be classified into three categories: public, permissioned, and private. A public Blockchain is one where anyone can read or write on the platform, provided they can show proof of work. A data as compared to the traditional binary tree permissioned Blockchain offers selective transparency where only selected nodes have the rights to access and provide consensus on that transaction. The third Blockchain type is a private Blockchain where only chosen players have the rights to join the network, which creates a closed loop environment.

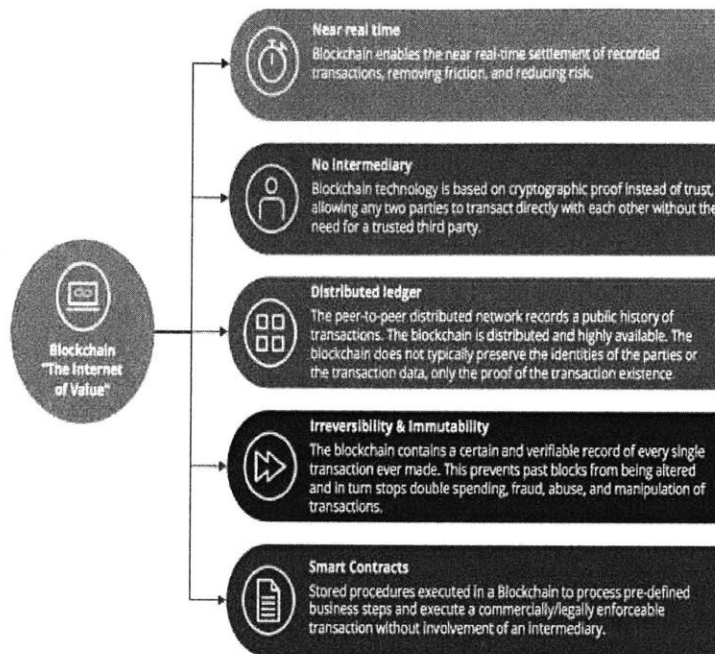
Public Blockchain	Permissioned Blockchain	Private Blockchain
Fully decentralized and Transparent - Anyone can read, send transactions & participate in the consensus process	Quasi decentralized where consensus is controlled by preselected set of nodes and Read permission is restricted to participants	Centralized—requires 'high trust' entity where Write permissions are centralized to one entity and Read to all participants

Table 4: Types of Blockchain

Inherent features of Blockchain

Blockchain, by virtue of its design and architecture, offers some inherent benefits long sought after by the industry. The distributed nature of Blockchain brings a lot of transparency in processing, and thereby reduces the need for manual verification and authorization.

Key Features of Blockchain



Source: Deloitte U.K



Figure 8: Key Features of Blockchain

Benefits of using Blockchain

The benefits of using Blockchain vary from case to case. However, in most cases, Blockchain becomes a good fit when there is a lot of data shared across multiple parties with no trust mechanism among the participants.

Benefits of Blockchain

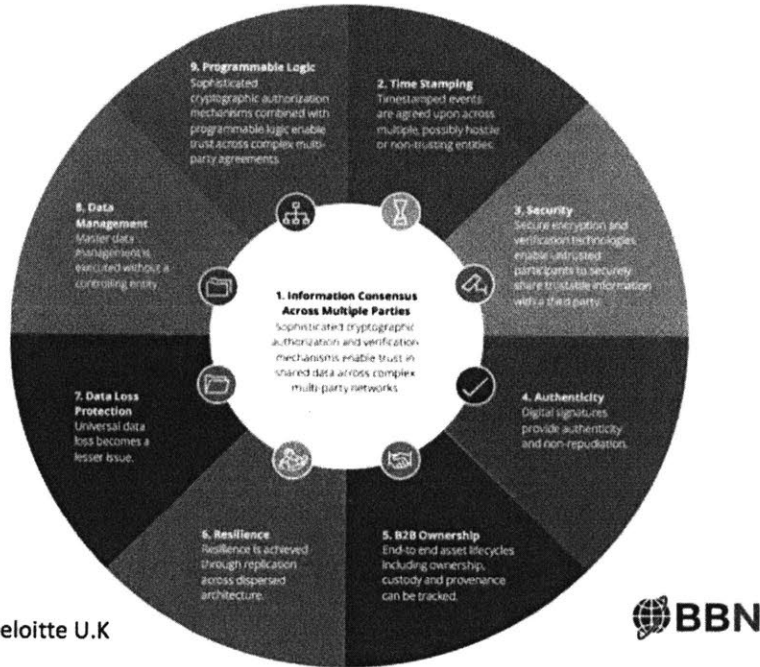


Figure 9: Benefits of Blockchain

6.3 How blockchain works

As its name implies, a blockchain is made up of a chain of blocks. Each block consists of data of transaction records and the corresponding information contained within each transaction. Every transaction (and hence block) has a timestamp associated with when it was recorded to the blockchain. Subsequent blocks require the identifier (or hash) of the preceding block, and this is the link that chains all the blocks together (see Figure 10).

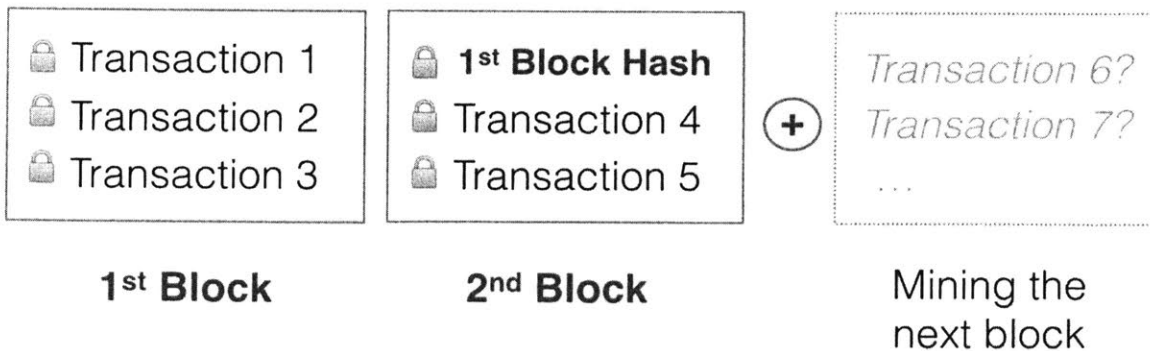


Figure 10: Blocks in a blockchain

In order to add new blocks to the blockchain, they must be ‘mined’. A common way to do this is through a proof-of-work (PoW) system, where miners perform computationally costly tasks

to participate in what essentially constitutes a lottery for the right to add the next block to the chain. Miners compete to solve the ‘puzzle’, and the successful miner broadcasts its proof-of-work to the other miners for verification. Consensus is achieved once there is a slight majority (51%), after which the new block is added (see Figure 11).

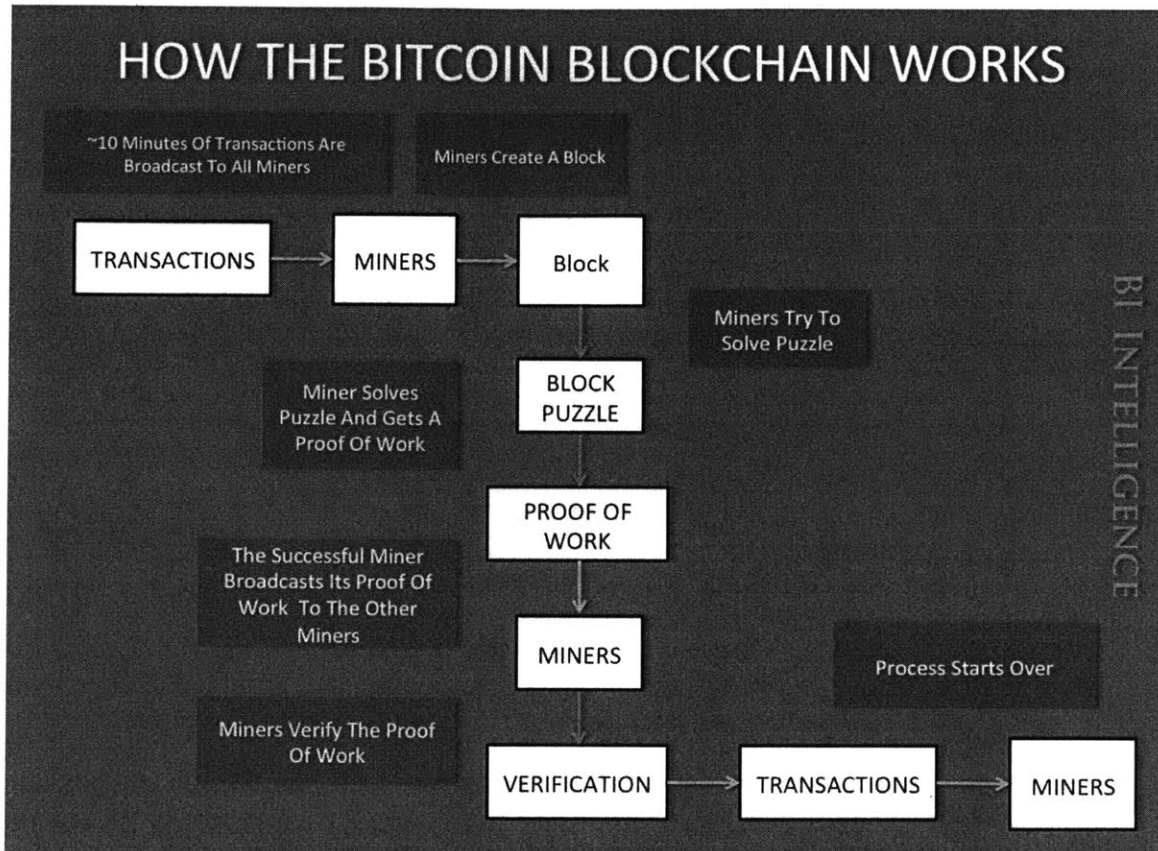


Figure 11: Blockchain mining procedure

Once a block is successfully added, it is propagated to all nodes in the network to ensure that they are all updated with the latest blockchain. In addition, a reward is allocated to the miner for the work performed. This is usually in the form of a cryptotoken tied to the blockchain (e.g. Bitcoin or Ether). Hence, transactions that are carried out on the blockchain will incur a cost in order to incentivize miners to commit computing resources to solve the puzzles. As the chain becomes longer and more computing power has been devoted to support it, it becomes more difficult to tamper with a past transaction. This is because all the subsequent blocks will have to be amended and consensus must be achieved, which will require a disproportionate amount of resources.

6.4 Advantages of blockchain

As mentioned, it becomes more difficult to reverse a prior transaction as the blockchain grows longer. This is an inherent advantage of blockchain technology – its **immutability**. Once a transaction is recorded and propagated to the network, it becomes permanently stored on the blockchain and can be accessed subsequently for verification. This provides an audit trail for

reliable verification. Since each block is linked to the preceding block, this also discourages rogue parties from manipulating the transaction records as they would require massive computing power to change all the subsequent records and obtain a majority consensus. This is succinctly summarized by Tapscott, who states that “to steal anything of value, a thief would have to rewrite the entire history on the blockchain. Collective interest ensures the blockchain’s safety and reliability”.

Catalini and Gans add that blockchain technology can reduce two key costs – the **cost of verification** and the **cost of networking**. Whenever an exchange of value occurs, key attributes of the transaction need to be verified by the parties involved. This usually involves a trusted intermediary, such as a central bank or financial institution in financial transactions, or a third party like eBay or Airbnb in an exchange of goods or services. These intermediaries typically charge a fee for providing verification services. In addition, many also require some form of information disclosure from the parties involved (e.g. social security number, credit card information). This increases the risk of data leakage should any of the intermediaries’ security be compromised. Blockchain can circumvent this by securely storing key transaction attributes on a distributed ledger and allowing them to be verified at a future time without incurring additional cost. This helps to improve market efficiency as “credentials, reputation systems, provenance and other attributes of individuals, goods and services can be more cheaply tracked with higher integrity throughout the economy”.

The cost of networking can be reduced by combining blockchain’s distributed ledger technology with a native cryptographic token such as Bitcoin. The token can be used as an incentive to grow and secure a new platform, and an entire marketplace can be bootstrapped without the need for a costly intermediary. This can allow participants to achieve large-scale consensus on the allocation of scarce resources. For example, a ride-sharing marketplace could be created to directly match drivers to riders, where payments are settled via a cryptotoken and reputations are maintained through transaction attributes stored on the blockchain. This would increase competition with traditional ride-sharing intermediaries such as Uber and Lyft, and they would be pushed to innovate and find other ways to add value. This architectural change is a good thing according to Catalini, as “in the long run, consumers are likely to benefit not only from the resulting lower costs and increased competition, but also from the new types of applications and services that could not be provided in a cost-effective manner without the technology”.

6.5 Limitations of blockchain

Although blockchain technology has the potential to disrupt a wide range of industries and fundamentally change the way we approach exchanges of value, it has not achieved widespread adoption yet. There are some limitations that need to be overcome before blockchain can become more scalable. The proof-of-work protocol used to generate blocks is **computationally wasteful** by design. Although this may help to preserve the integrity of the blockchain by deterring attacks, a large amount of resources and energy need to be committed. As the chain grows longer, even more computational power is required, exacerbating the problem. This could preclude certain applications of blockchain, for example in Internet of Things (IoT) devices. Standard IoT devices would not have the requisite processing power to participate directly in a blockchain, so a workaround needs to be developed in order to scale up adoption.

As larger blockchains require more resources, **processing speed** is also adversely affected as more time is required to verify and approve transactions. For comparison in a financial application, an established intermediary like Visa can process more than 50,000 transactions per second at peak, whereas Bitcoin can only process 7 transactions per second. Hence, 20 blockchain's computational efficiency must be increased significantly before it can seek to challenge the incumbents.

Even though blockchain technology relies on consensus of the majority to ensure security of the system, it is not completely immune to **security breaches**. Exploiting the need for consensus, it is plausible that a single rogue entity could garner enough share of the network to achieve 51% majority, when it would then be able to introduce its version of the blockchain and validate it. Although this is unlikely due to the distributed nature of blockchain, it is not impossible especially as computational requirements grow, making it commercially viable for only a small number of influential participants to continue mining for reward. Another problem that could arise is if users are able to exploit security flaws in the code underlying a blockchain. This occurred when a hacker exploited a weakness in the code of the Decentralized Autonomous Organization (D.A.O.) – a blockchain-based venture capital fund – and was able to siphon one-third of the cryptocurrency that it had raised from investors. Although the flaw was fixed subsequently, it has affected confidence in blockchain's viability on a larger scale. To overcome some of these limitations, alternative protocols such as proof-of-stake (PoS) have been proposed over proof-of-work. In proof-of-stake, miners do not compete to solve the computational puzzle; instead, they are chosen deterministically based on their relative wealth (or stake) in the cryptotoken. Proponents argue that this wastes less resources, can result in faster transactions, and can decrease the likelihood of a 51% attack.

7 Aadhaar 2.0: Blockchain-ing Aadhaar

Blockchain was initially designed to solve the double spending problem of Bitcoin—peer to peer payment system. But since then, its applications have gone far beyond its original intended use. Following lists out some of the key properties of a public blockchain.

- Decentralized
- No trusted authority
- Immutable records
- Auditability

We can incorporate the above properties of blockchain—to make Aadhaar more transparent and publicly auditable. The Aadhaar system can publish all the changes against each user record to the blockchain. No need to reveal the data or the Aadhaar number—we can use the hash of both and record it in the blockchain. Now, whoever receives data from the CIDR can validate the hash of that data against the hash stored in the blockchain. If that matches—we know that there are no internal handling of the data. If not, someone has played with it. In this way, each individual can monitor changes happening against their Aadhaar record and immediately question the authorities. This will make Aadhaar more transparent, even though all the user records are maintained centrally.

Now, if Aadhaar was built on a Blockchain, most of the concerns we discussed above could be assuaged. The database would be immensely difficult to hack: besides getting around the state-of-the-art cryptographic protection, the hackers would need to hack into multiple nodes or

servers, rather than just one. The distributed consensus nature of the blockchain would prevent malicious attacks, until 51% of the nodes would be compromised.

Similarly, a properly designed Aadhaar-on-blockchain would potentially allay the ‘surveillance’ fear: think of the blockchain having multiple nodes—the UIDAI, a court, a few ministries, Parliament, or any other such entity. For any data to be compromised or any malevolent attempt to happen, again multiple entities would have to agree to it and authenticate it, rather than one central authority! Again, but its very nature, all records will be immutable and for a record to be changed, the entire blockchain would need to be compromised, which is difficult to do. The system could harness other benefits of blockchains like smart contracts, for example, to execute certain events automatically.

I am sure that there are perhaps large technology challenges to be addressed for this to happen, but these would be surmountable. One could make a large private or permissioned blockchain (when a group of participants are given the express authority to provide the validation of blocks of transactions in the blockchain network), for example, which would be custom built to requirements. While blockchain is an emerging technology, it is almost tailor-made for massive applications like this one, and many countries have embraced this by putting assets and identity on blockchains. Estonia, while a tiny country, in fact, has all assets and identities on a blockchain network, and markets itself as ‘country as a service’!

Aadhaar is a very important and critical initiative. It must not be weakened by the privacy doubts surrounding it, or by the fear of vulnerability to its hacking. We must wrest the initiative that the Supreme Court judgement gives us. Let’s seriously explore blockchain and see what we can retrofit, or perhaps even think of Aadhaar 2.0 on blockchain.

7.1 Potential use cases for Indian government

Central and state governments are awash in data. The emergence of electronic databases, as opposed to file folders and filing cabinets, dramatically improved the efficiency and cost of managing all that information. But it took the Internet to unlock the greater value by making the data more accessible and transparent. The creation and exchange of that ocean of information take place via a tsunami of transactions each year: collections, disbursements, transfers, procurements, sales, fees, fines, certifications, approvals, and many more. Wherever those transactions involve, or could involve, a digitization of assets and decentralized exchange, there exists a potential blockchain opportunity.

Government’s responsibility—fiduciary, legal, and to the taxpayer—creates an incentive for ensuring accurate transfers of value between relevant stakeholders—within and between agencies, between the government and third parties, and between government and the citizenry. This is true at the central and state levels from congressionally allocated funds down to the road grader purchased by a small municipality. In an era of cost pressures, agencies that ensure data integrity while reducing internal cost and friction could emerge as exemplars, improving their reputations to boot. With major investments in accountable property systems already under way as a result of congressional attention, being audit-ready should be a continuous reality, not a series of individually arrived-at milestones or a source of uncertainty.

Across those many transactions and business events, numerous use cases for blockchain present themselves; for many others, there will be other enabling technologies adopted instead. Where the value provided by a blockchain approach exceeds the costs of adoption, in terms of

enhanced efficiencies, greater security, and/or reduced latency, an agency should further explore adoption. The great challenge in both government and industry is rapidly identifying those use cases in which the value added is both explicit and provable, in situations where the level of trust is typically higher than between parties exchanging open-source cryptocurrencies. For the purposes of considering where blockchain could likely be adopted within and across government, three business values of blockchain—recordkeeping, value transfer, and smart contracts—provide broad cases for possible adoption. When there is the need to do one or more of these three things, blockchain may emerge as part of the solution.

Value transfer	<ul style="list-style-type: none"> • Low-cost and near real-time • Without an intermediary • Beyond “money” 	<p>Examples</p> <ul style="list-style-type: none"> • Domestic and international remittance • Internal payments settlement • Clearing and settlement of securities • Exchange of low liquidity assets
Smart contracts	<ul style="list-style-type: none"> • Software protocols • Based on ledger content • Execute when the conditions are met 	<p>Examples</p> <ul style="list-style-type: none"> • Digital cheques/IOUs • Automatic financial instruments • Parametric insurance contracts • Automated market making
Recordkeeping	<ul style="list-style-type: none"> • Create immutable record • Under agreed consensus protocol • Without reliance on a trusted third party 	<p>Examples</p> <ul style="list-style-type: none"> • Digital certificate of ownership for physical assets • Transaction validation of digital assets • Financial accounts

Source: Deloitte analysis.

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Figure 12: Blockchain delivering value in three primary areas

The map in figure 12 displayed many of the announced areas in which public sector leaders are considering using blockchain—including, in particular, digital currencies and the payments industry. The government must wrestle with these applications simply to continue to keep pace and interact with the commercial sector, as evidenced in the regulatory guidance. Since the general press on blockchain covers these applications comprehensively, we’ll focus more on three areas in which government’s current active interest in blockchain potentially leverages the use case characteristics and business values such as management, land registration, and voting.

Identity management: Digital identity is both a use case for blockchain and the enabler that allows each of the other assets discussed for blockchain integration to exist. Whether cryptocurrencies or cars, each asset needs to be rendered digitally to be transacted on a blockchain, and the owner or transactor also needs a digital identity to engage in those transactions. The magnitude of this challenge is recognized by public sector actors around the world—a world in which one-fifth of the world’s population lives without a legal or officially recognized identity.

Existing pain points:

- Lack of standards for establishing digital identity

- Differing attestation processes and identity “entry points” prevent economic engagement and can hinder public sector service provision

Blockchain value proposition:

- A secure, self-sovereign identity could enable efficient transactions across a wide variety of asset classes
- Individual and explicit control over which identity elements are shared for which purposes

Land registration: Deeds and titling not only provide critical protection for homebuyers in developed nations—they serve as a basis for investment and economic growth across many developing nations. By securing a unique and non-corruptible record on a blockchain and validating changes to the status of that record across owners, a reliable property record can be created, whether for a piece of land that heretofore had no owner or as a link between systems.

Existing pain points:

- License and registry processes are paper-based and fragmented, making transactions costly, inefficient, and vulnerable to tampering
- In the United States, landowners spent \$800 million in 2014 and '15 on title insurance to cover risks associated with real estate titles

Blockchain value proposition:

- A decentralized, standardized system for land registration records could reduce the number of intermediaries required, increase trust in identity of transacting parties, increase process efficiencies, and decrease time and cost to process
- Recording property rights via blockchain would enable \$2–4 billion in annual cost savings in the United States alone for title insurers through a tamper-proof ledger

Voting: This critical and legitimacy-granting public function has been the source of much activity among those working with blockchain. Citizens can cast votes the same way they initiate other secure transactions and validate that their votes were cast—or even verify the election results. Potential solutions are currently working to blend secure digital identity management, anonymous vote-casting, individualized ballot processes (for example, a vote “token”), and ballot casting confirmation verifiable by (and only by) the voter.

Existing pain points:

- High costs related to ballot printing, electronic voting machines, maintenance, etc.
- Increasing threats of cyberattacks compromising election results
- Lack of transparency due to a centralized process of election results audit
- Voting delays or inefficiencies related to remote/absentee voting

Blockchain value proposition:

- Potential cost savings through blockchain-enabled voting

- Potential for enhanced security and auditability of votes
- Potential for greater participation in elections, including remotely
- Greater transparency meeting citizens' needs

Healthcare

Managing of health records is another use case that can be developed for some Indian states.

Every time you visit a hospital for the first time, a new registration and file with your medical consultation and details are created. What if the next time you visit another doctor or hospital, your records by whoever you give permission to access? This would be possible if doctors and hospitals were connected on a blockchain and were able to share and access data from each other based upon request and consent from patients. There could be an access and sharing fee which also could be tracked on the blockchain. This solution could bring down medical costs and delays in time to treatment.

Greenpower sharing

The steady drop in prices of solar energy over the past decade or so has triggered a demand from electricity users for green energy, especially with the realization that one of the countries ripe for its wholesale adoption is India.



Figure 13: Solar panels installed atop a house in India

Imagine you are living in an urban setting where rooftop solar panels generate electricity. What if some houses or offices generate more power than they require and can share it with users in

their local community which can be tracked and transacted on a blockchain? A system like this is very apt for India, considering the power deficit situation and the costs of wheeling power over long distances. Systems like this are already being trialed in Australia, Europe and the US. The Brooklyn Micro-grid, developed by energy services company LO3 Energy, is an example of peer-to-peer green energy microgrid working on the blockchain.

Benefit Distribution System

Let's talk benefits before moving to subsidies. State governments across India, at some point in time or other, have announced benefits like cycles, TVs and laptops to its citizens. But often, these distribution schemes do not reach all the eligible citizens because of various issues.

Think of a system where items like cycles and laptops are tokenized and distributed via a private ledger and distributed to eligible citizens. The departments related to schemes, the vendor and banks can all be on the blockchain. All data is shared on a common ledger that can be accessed by all parties and cannot be modified without a consensus.

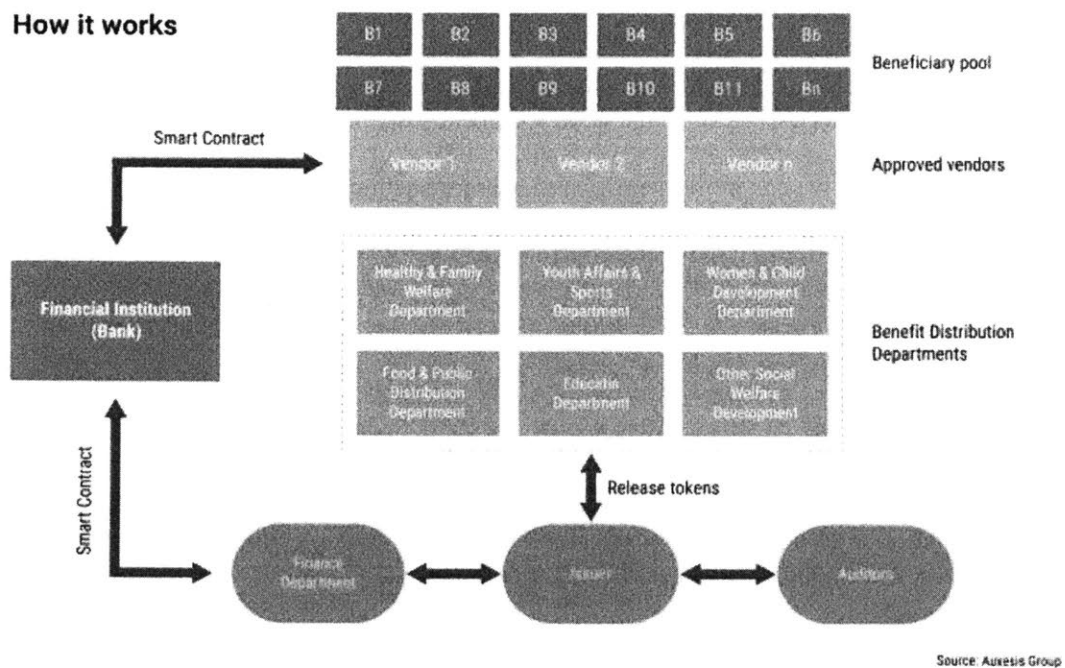


Figure 14: Benefit distribution system on a blockchain

Take an example of Bihar which under the previous term of Janata Dal (United) saw thousands of bicycles being given free to girl students. With a blockchain-based distribution, the government – or rather, the education department – would issue a finite number of tokens of appropriate value based on the calculation done by finance departments. These tokens would be distributed to citizens based on eligibility criteria and they, in turn, could give the tokens to vendors in return for a bicycle. The vendor would do so only after authenticating the citizens' identity and eligibility. Next, the vendor will be able to cash the tokens for the value set by the government's finance ministry from banks.

Each of the ‘actors’ in this example are on the blockchain and the transaction will not be complete without each of them giving their assent. Each transaction will be available on the open ledger and the details of each record can be verified. Now, extend this example to subsidies or employment guarantees. Any subsidy or a payment under the Mahatma Gandhi National Rural Employment Guarantee Scheme can be tracked in a similar manner plugging leakages in welfare distribution.

Digital ID Management

Remember submitting your ID proof and then an address proof for starting a bank account, getting a mobile number, applying for a gas connection or an internet connection?

Indian citizens always keep a bunch of IDs photocopied because one never knows when they will need them, especially when every time some agency says a particular ID is not valid. It is strange that one has to resubmit his KYC documents twice for separate accounts in the same bank. A friend who recently moved cities he cannot change the correspondence address on his bank account because the only address proof he has in his new city of residence is his house lease. This is despite his account being eight years old and the bank having his permanent address (in a third city) on record! I am not even going into the risk of paper IDs, which can be copied and misused in all kinds of ways.

Imagine your personal ID is securely and stored on a central blockchain which can be accessed by various parties once the access request is authorized you.

With Blockchain, we can store identity and share it securely as and when required and requested. Even though there are some concerns to identity management even on the blockchain, it is better to have some control over identity management by the user than have a completely centrally controlled system. To be sure, Aadhaar does exactly this but with one crucial difference: the data is centrally stored.

Humanitarian Aids

Blockchain technology can also improve humanitarian assistance. Fraud, corruption, discrimination and mismanagement block some money intended to reduce poverty and improve education and health care from actually helping people.

For instance, in early 2017 the U.N. World Food Program launched the first stage of what it calls “Building Block,” giving food and cash assistance to needy families in Pakistan’s Sindh province. An internet-connected smartphone authenticated and recorded payments from the U.N. agency to food vendors. This was successful in ensuring the recipients got help, the merchants got paid, and the agency didn’t lose track of its money.

The blockchain system will reduce the overhead costs from 3.5 percent to less than 1 percent. And it can speed aid to remote or disaster-struck areas, where ATMs may not exist or banks are not functioning normally. In urgent situations, blockchain currency can even take the place of scarce local cash, allowing aid organizations, residents and merchants to exchange money electronically.

Blockchains can even help individuals contribute to aid efforts overseas. In another instance, Usizo, a South Africa-based blockchain platform, enables anyone help pay electricity bills for community schools. Donors can track how much electricity a school is using, calculate how much power their donation will buy and transfer the credit directly using bitcoin.

Despite being a relatively young technology, blockchain promises to reduce overheads, increase security for aid providers and beneficiaries, and ultimately ensure more funds are redirected to end hunger. As a foundational technology akin to the internet, blockchain has the potential to improve many strands of humanitarian operation. Together with the digital shift, blockchain can facilitate faster intervention in some of the world's most difficult operating environments. For vulnerable countries lacking financial infrastructure, blockchain could help humanitarian actors roll out life-saving cash assistance in matter of days should disaster strike.

Helping small businesses

Blockchain systems can also help very small businesses, which are often short of cash and also find it expensive – if not impossible – to borrow money. For instance, after delivering medicine to hospitals, small drug retailers often wait up to 90 days to get paid. But to stay afloat, these companies need cash. They rely on intermediaries that pay immediately, but don't pay in full. A \$100 invoice to a hospital might be worth \$90 right away – and the intermediary would collect the \$100 when it was finally paid.

Banks aren't willing to lend money in places where fraudulent invoices are common, or where manufacturers and their customers might have inconsistent and error-ridden records. A blockchain system reduces those concerns because these records must be authenticated before being added to the books, and because they can't be changed.

Insurance

Most people in the India (and developing world) lack health and life insurance, primarily because it's so expensive compared to income. Some of that is because of high administrative costs: For every dollar of insurance premium collected, administrative costs amounted to \$1.60 in India. And many people who live on less than a dollar a day have neither the ability to afford any insurance, nor any company offering them services.

In India, for example, only 15 percent of the population has health insurance. Even those people pay higher relative premiums than in developed countries. As a result, people in India pay a much greater share of their health care costs out of their own pockets than do people in high-income industrialized countries.

Because blockchain systems are online and involve verification of transactions, they can deter (and expose) fraud, dramatically cutting costs for insurers. Using a blockchain-based micro insurance service, customers can pay small amounts for health and life insurance, with claims verified electronically and paid quickly.

8 Conclusion: Moving forward

Blockchain today may be compared to what the Internet was in the early 1990s. While we have witnessed how the ‘Internet of Information’ has changed our society over the past two decades, we are now entering a phase where Blockchain may do the same by ushering in a new paradigm comprising ‘Internet of Trust’ and ‘Internet of Value’. The state of governance could be the firsts to be impacted by wider adoption of Blockchain and its associated Distributed Ledger Technologies. The extent of this impact is contingent on how nimbly the public sectors capitalize on this technology and the nature of support it garners from wider stakeholders.

Blockchain has the potential to optimize the delivery of public services, further India’s fight against corruption, and create considerable value for its citizens. By maintaining an immutable and chronologically ordered record of all actions and files (“blocks”) linked together (“chain”) in a distributed and decentralized database, Blockchain creates an efficient and cost-effective database that is virtually tamper-proof. By doing so, blockchain promises to create more transparent, accountable, and efficient governments. It is thus unsurprising that blockchain is already beginning to generate considerable interest.

Earlier this year, the Reserve Bank of India’s Institute for Development and Research in Banking Technology published a white paper on the applications of blockchain to the banking and financial sector in India and concluded, “the time is ripe for its adoption”. In April, the government also constituted an inter-disciplinary committee to examine the role of virtual currencies, such as Bitcoin, in India and submit a report by July. Blockchain’s applications in the public sphere, however, have yet to catch the eye of the Indian government. This is baffling; the technology is not only promising, but has even begun to be utilized by governments globally.

Across the world, innovation-friendly governments are launching blockchain-based programs to enable them to get a head start on the future of government. Last year, future-friendly Dubai announced the adoption of a roadmap, Dubai Blockchain Strategy 2020, for the Emirate’s adoption of blockchain technology to improve the delivery of government services. Dubai’s government estimates it stands to save nearly \$1.5 billion and 25.1 million hours in document processing time. For India, a country ranked 130th on the World Bank’s Ease of Doing Business Index (the United Arab Emirates ranks 26th), the benefits of blockchain are obvious and endless.

In addition to creating a more efficient government, blockchain can also help create a more honest government. A public blockchain, like the one Bitcoin uses, records all information and transactions on the decentralized database permanently, publicly, and most importantly, securely. By allowing governments to track the movement of government funds, blockchain can hold state and local actors accountable for any misappropriations.

Blockchain not only deters corruption through accountability, but it can also do so by bypassing the middleman entirely. Earlier this year, the World Food Program began testing blockchain-based food and cash transactions in Pakistan’s Sindh province. Refugees in Jordan’s Azraq camp are now using the same technology, in conjunction with biometric registration data for authentication, to pay for food.

With Aadhaar cards becoming nearly ubiquitous in India, adopting blockchain could be the next logical step in India’s pursuit of becoming a digital economy. Blockchain can play an important role in storing individuals’ data, helping conduct secure transactions, maintaining a permanent and private identity record, and turning India into a digital society.

Blockchain, however, is not a panacea. While it can help enhance the delivery of government services, it cannot replace an inefficient system. Although it can deter corruption by making governments more accountable and transparent, it cannot prevent the entering of false information into the network. Yet, it presents the government with a powerful opportunity. By embracing blockchain, it can create a bureaucracy that focuses on innovation and experimentation, a government that seeks to maximize efficiency and governance, and an economy sustained on the promise of technology.

By embracing blockchain, India can embrace its digital future.

Appendix A: Aadhaar linked Government services

Government Scheme	Ministry	Description
Death Certificate	Ministry Of Home Affairs	It is mandatory for residents of all states except Jammu and Kashmir, Assam and Meghalaya for which a date will be notified separately.
Pradhan Mantri Matru Vandana Yojana (PMMVY)	Ministry Of Women And Child Development	Provides partial compensation for the wage loss of pregnant and lactating mothers. In cases where the parents don't have an Aadhaar, they'll have to register for one within 90 days of registration at Anganwadi Centers or Primary Health Centres. Aadhaar is mandatory for this scheme in all states and union territories, except Assam, Meghalaya and Jammu and Kashmir.
Bank accounts	Ministry Of Electronics And Information Technology	Under the Prevention of Money Laundering Rules (2005) Aadhaar needs to be linked by all bank accounts by the end of the year, failing which the accounts will become inoperative
Central Sector Scheme of Counselling, Retraining and Redeployment for separated employees of the Central	Ministry Of Heavy Industries And Public Enterprises	The scheme provides opportunities of self and wage employment to employees or dependents of the Central Public Sector Enterprises who are separated under the

Public Sector Enterprises (CPSEs)		Voluntary Retirement Scheme (VRS) or the Voluntary Separation Scheme (VSS) or have been retrenched due to closure or restructuring of the enterprises, by providing short-duration skill development training programmes to equip them for self or wage employment. Aadhaar is mandatory for this scheme in all states and union territories, except Assam, Meghalaya and Jammu and Kashmir
Central Sector Scheme of Research, Development and Consultancies on Generic issues related to Public Sector Enterprises	Ministry Of Heavy Industries And Public Enterprises	The Scheme offers training programmes on capacity building and skill development for the executives and employees of the Central Public Sector Enterprises and State Level Public Enterprises to reduce their skill gaps and to upgrade their capacity. It is offered through various national institutes such as Indian Institute of Management (IIM), Indian Institute of Technology (IIT), Indian Institute of Public Administration, Administrative Staff College of India (Hyderabad), Institute of Public Enterprises (Hyderabad), and Lal Bahadur Shastri National Academy of Administration at Mussoorie. Aadhaar is mandatory for this scheme in all states and union territories, except Assam, Meghalaya and Jammu and Kashmir.
Central Sector Scheme of Extra Mural Research	Ministry Of Ayurveda, Yoga And Naturopathy, Unani, Siddha And Homoeopathy (Ayush)	Grant-in-Aid to the Public and Private Research Institutions to cover the expenditures incurred towards payment of remuneration to the individuals who are hired

		exclusively under the research projects, and also payment of fee, travelling allowance and dearness allowances to the Principal Investigator and the Co-Investigators who are already employees of the Research Institutes.
Family Planning Indemnity Scheme (FPIS)	Ministry Of Health And Family Welfare	In the event of operative complications or death during an individual's sterilization procedure, the family will be provided a compensation under the said scheme.
Ensuring Spacing of Births (ESB) Scheme	Ministry Of Health And Family Welfare	Under the family health mission, services of ASHAs are utilised for counselling newly married couples to ensure spacing of 2 years after marriage and couples with 1 child to have spacing of 3 years after the birth of 1st child. The scheme is operational in 18 States (EAG, North-Eastern and Gujarat and Haryana).
Post-Abortion IUCD (PAIUCD) Incentive Scheme	Ministry Of Health And Family Welfare	Under the family health mission, compensation is provided to individuals who chose to get an IUCD inserted at government centres.
Post-Partum IUCD (PPIUCD) Incentive Scheme	Ministry Of Health And Family Welfare	Under the family health mission, compensation is provided to individuals who chose to get an IUCD inserted post delivery at government centres.
Enhanced Compensation Scheme for Sterilisation	Ministry Of Health And Family Welfare	Under the family health mission, compensation is provided to various people involved in the sterilisation process, including the individual undergoing the vasectomy/tubectomy.
Scheme for Promotion of International Co-operation in AYUSH	Ministry Of Ayush	Under the scheme, financial assistance is provided to the individuals for presentation of AYUSH related scientific research papers in international conferences,

		workshops and seminars by reimbursing the expenditures incurred on their air-travel, accommodation, delegation registration fees and other expenses. Aadhaar is mandatory for this scheme in all states and union territories, except Assam, Meghalaya and Jammu and Kashmir.
Revised National Tuberculosis Control Programme (RNTCP)	Ministry Of Health And Family Welfare	The scheme provides conditional cash assistance to eligible TB patients, private health care providers and treatment supporters. Aadhaar is mandatory for this scheme in all states and union territories, except Assam, Meghalaya and Jammu and Kashmir.
Central Sector Scheme of Co-operative Education and Training	Ministry Of Agriculture And Farmers Welfare	Provides training on co-operative education to middle level and senior level personnel of the co-operatives, State Governments as well as various co-operative institutions and also to the other individuals with an objective of strengthening the process of development of co-operatives as self-reliant and self-regulated viable economic enterprises.
Pradhan Mantri Bhartiya Jan Aushadhi Pariyojana	Ministry Of Chemicals And Fertilizers	The scheme aims to make quality medicines available at affordable prices for all, particularly the poor and disadvantaged, through outlets called “Jan Aushadhi Medical Store”, so as to reduce out of pocket expenses in healthcare.
Scholarship to the Scheduled Tribe Students for studies abroad	Ministry Of Tribal Affairs	The financial assistance is offered through Ministry of External Affairs.

Deendayal Antyodaya Yojana – National Urban Livelihood Mission (DAY-NULM)	Ministry Of Housing And Poverty Alleviation	Aims to reduce poverty and vulnerability of the urban poor households by providing access gainful self-employment and skilled wage employment opportunities and by facilitating access to suitable spaces, institutional credit, social security, employment opportunities and skills.
Fertilizer Subsidy Schemes	Ministry Of Chemicals And Fertilizers	(i) Urea subsidy MH 2852 payment for Import of Urea; (ii) Urea subsidy MH 2852 payment for Urea freight subsidy; (iii) Urea subsidy MH 2852 payment for Indigenous Urea; (iv).Nutrient based subsidy policy MH 2401 payment for City Compost; (v) Nutrient based subsidy policy MH 2401 payment for imported P and K fertilizers; (vi) Nutrient based subsidy policy MH 2401 payment for indigenous P and K fertilizers.
Scholarship to the students of National Institute of Pharmaceutical Education and Research (NIPER)	Ministry Of Chemicals And Fertilizers	Provides financial assistance in the form of scholarships, stipends or House Rent Allowances is given to the students pursuing Master of Science in Pharma or Junior Research Fellows or Senior Research Fellows in NIPER, for which Grants-in-Aid are given to various NIPER Institutes operating across the country for implementation of the Scheme.
Atal Pension Yojana (APY)	Ministry Of Finance	The scheme is focused on all citizens in the unorganized sector, who join the National Pension System (NPS) administered by the Pension Fund Regulatory and Development Authority (PFRDA).

<p>National Mission on Agriculture Extension and Technology (NMAET) - Sub-Mission on Seeds and Planting Materials (SMSP)</p>	<p>Ministry Of Agriculture And Farmers Welfare</p>	<p>The scheme includes seed village programme of cereals, pulses, oilseeds, fodders and green manure crops by providing foundation seeds or certified seeds input subsidy. It also includes certified seed production of the commodities under Seed Village Programme by providing foundation seeds input subsidy, seed certification charges, seed processing and seed storage. The government also provides training, cash subsidy and subsidized seeds under the scheme.</p>
<p>Fellowships to Outstanding Persons in the field of culture</p>	<p>Ministry Of Culture</p>	<p>Under the scheme upto 400 fellowships (200 junior in the age group of 25-40 years and 200 Senior in the age group of above 40 years) are given every year to outstanding persons in the fields of art and culture. Online applications are invited every year and fellows are selected on the basis of assessment of project proposals/interview by a committee constituted by the ministry. Junior fellows are given fellowship at Rs. 10,000/- per month and Senior fellows at Rs. 20,000/- per mont for a period of 2 years. Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.</p>
<p>Scholarship to Young Artistes in different cultural fields</p>	<p>Ministry Of Culture</p>	<p>The two year scholarship seeks to give assistance to young artistes (of Indian Nationality) of outstanding promise for advanced training within India in the field of Indian Classical Music, Indian Classical Dance, Theatre, Mime, Visual art,</p>

		Folk, Traditional and Indigenous Arts and Light Classical Music. Each scholar receives Rs 5000/- every month during the course of the scholarship. Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.
Public Distribution System (PDS) Kerosene and Domestic LPG Subsidy Scheme	Ministry Of Petroleum And Natural Gas	Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.
National Award for Road Safety	Ministry Of Road Transport And Highways	The scheme provides cash award and appreciation certificate to individuals and also to the organizations, to encourage and recognize the best work done in of the areas of road safety. Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.
Salary of teachers under the Scheme for Providing Quality Education for Madrasas (SPQEM)	Ministry Of Human Resource Development	The Aadhaar requirement is for the salary of teachers employed at Madarasas. It is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.
Scheme for the Development of Silk Industry	Ministry Of Textiles	Under the scheme, the Central Silk Board releases central share of subsidy (in cash or kind) under Direct Benefit Transfer to the bank accounts of the Sericulture beneficiaries through its field units or the State Sericulture Departments including the States' share wherever applicable. Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.

Sub-Mission on Agricultural Mechanization scheme (SMAM)	Ministry Of Agriculture And Farmers Welfare	The scheme provides - a. Financial Assistance for Procurement of Agriculture Machinery and Equipment; b. Establish Farm Machinery Banks for Custom Hiring; c. Establish Hi-Tech, High Productive Equipment Hub for Custom Hiring; d. Promotion of Farm Mechanisation in selected villages; e. Financial Assistance for Promotion of Mechanized Operations/hectare Carried out Through Custom Hiring Centres, and; f. Promotion of Farm Machinery and Equipment in North-Eastern Region. Aadhaar is required for this scheme in all states and union territories except Assam, Meghalaya and Jammu and Kashmir.
Faster Adoption and Manufacturing of (Hybrid and) Electrical Vehicles in India (FAME-India)	Ministry Of Heavy Industries And Public Enterprises	The scheme provides incentive to the customers by registered dealers on the purchase of hybrid or electric vehicles. The dealers submit their claims monthly to their respective Original Equipment Manufacturers who in turn submit their claims to the Department through National Automotive Board (NAB).
National Mission on Oilseeds and Oil Palm (NMOOP)	Ministry Of Agriculture And Farmers Welfare	Scheme aims at increasing production of oilseeds and vegetable oils by providing inputs subsidy to the farmers under two components of the Scheme, namely, areas expansion inputs and production inputs.
Seekho aur Kamao	Ministry Of Minority Affairs	“Seekho aur Kamao (Learn & Earn) works towards skill development of minorities. The scheme aims at upgrading the skills of minority youth in various

		modern/traditional skills depending upon their qualification, present economic trends and market potential, which can earn them suitable employment or make them suitably skilled to go for self-employment. The scheme is implemented through selected expert Project Implementing Agencies (PIAs). The scheme ensures placements of minimum 75% trainees, out of which at least 50% placement is in organized sector.
Merit-Cum-Means Scholarship Scheme	Ministry Of Minority Affairs	The scholarship is awarded for graduate/post-graduate studies. Students from Muslim, Sikh, Christian, Buddhist, Jain and Zoroastrian (Parsi) families with annual income of their parents/guardian from all sources not exceeding Rs. 2.5 lakh are eligible.
Post-Matric Scholarship Scheme	Ministry Of Minority Affairs	The scholarship is awarded for studies in India in a government or private higher secondary school/college/university. Students from Muslim, Sikh, Christian, Buddhist, Jain and Zoroastrian (Parsi) families with annual income of their parents/guardian from all sources not exceeding Rs. 2 lakh are eligible.
Pre-Matric Scholarship Scheme	Ministry Of Minority Affairs	The scholarship is awarded for studies in India in a government or private school from Class 1 - 10. Students from Muslim, Sikh, Christian, Buddhist, Jain and Zoroastrian (Parsi) families with annual income of their parents/guardian from all sources not exceeding Rs. 1 lakh are eligible.

Incentive to build a Individual Household Toilet (IHHT) under Swachh Bharat Mission	Ministry Of Urban Development	An incentive of up to Rs 4000/- is provided for construction of one unit of Individual Household Toilet (IHHT), which can be done by the Self Help Group, Health ward Committee, Contractor or the individuals seeking cash incentive.
State Extension Programmes for Extension Reforms under ATMA	Ministry Of Agriculture And Farmers Welfare	The scheme provides financial assistance in the form of awards to farmers and annual contingency to Farmer Friends.
National Handicraft Development Programme (NHDP)	Ministry Of Textiles	Various schemes under the programme provide benefits and financial benefits to artisans.
Agri-Clinics and Agri-Business Centres (AC&ABC)	Ministry Of Agriculture And Farmers Welfare	The centres provide paid services for enhancement of agriculture production and income of farmers.
Self Employment Scheme for Rehabilitation of Manual Scavengers (SRMS)	Ministry Of Social Justice And Empowerment	The scheme provides grants to National Safai Karamcharis Finance and Development Corporation.
“Per Drop More Crop” component of the Prime Minister Krishi Sinchayee Yojana (PMKSY)	Ministry Of Agriculture And Farmers Welfare	It provides subsidised micro-irrigation system and other services to farmers.
Mission for Integrated Development of Horticulture (NHM, HMNEH, NABM)	Ministry Of Agriculture And Farmers Welfare	After making a notification regarding three of its six sub-schemes a month before, the ministry made Aadhaar mandatory for the other three as well. These include - National Horticulture Mission (NHM), Horticulture Mission for North East & Himalayan States (HMNEH), National Agroforestry & Bamboo Mission (NABM).
Schemes to aid the students in education, and research in science and technology development within the age group of 10 to 32 years	Ministry Of Science And Technology	Central Sector Scheme to aid the students in education, and research in Science and technology development. Different programmes under it include - DISHA

		Programme, INSPIRE Award, INSPIRE Scholarship, INSPIRE Internship, INSPIRE Fellowship.
Bonded Labor Rehabilitation Scheme	Ministry Of Labor And Employment	The scheme provides cash and non-cash benefits for the rehabilitation of bonded laborers.
Journalist Welfare Scheme through Press Information Bureau	Ministry Of Information And Broadcasting	The scheme provides one time ex-gratia relief on urgent basis to journalists and their families. The deadline to enroll was extended in a later notification dated September 5, 2017.
Pradhan Mantri Ujjwala Yojana (PMUY)	Ministry Of Petroleum And Natural Gas	The scheme provides Liquefied Petroleum Gas (LPG) to households below the poverty lines.
Compensation for Bhopal Gas victims	Ministry Of Chemicals And Fertilizers	Aadhaar is mandatory to receive the cash compensation given to victims in the Bhopal Gas tragedy.
Scheme of Assistance to Disabled Persons for assistive devices (ADIP)	Ministry Of Social Justice And Empowerment	Aims to help people with disabilities for purchase and, or, fitting of aids and appliances, assistive devices.
National Water Mission	Ministry Of Water Resources, River Development And Ganga Rejuvenation	The scheme works towards conservation of water, minimizing wastage and ensuring its distribution.
Skills Training of Persons with Disabilities	Ministry Of Social Justice And Empowerment	Provides skills training for people with disabilities. Benefits include transport cost, boarding and lodging cost, conveyance cost and cost for post placement support.
Sarva Shiksha Abhiyan	Ministry Of Human Resource Development	Aims at universalizing elementary education in India.

Operation of certain schemes through eligible NGOs	Ministry Of Social Justice And Empowerment	The schemes provide assistance to NGOs working for the welfare of the scheduled castes/other backward classes and those working for the prevention of alcoholism and substance abuse.
Schemes for the Protection of Civil Rights Act, 1955 and the Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989	Ministry Of Social Justice And Empowerment	Under the various schemes, SC/ST victims of atrocities receive relief and rehabilitation and people from the community that are involved in inter-caste marriage receive incentives.
Mid Day Meal Scheme	Ministry Of Human Resource Development	The scheme provides food to children studying in classes I to VIII in government or government aided schools or Special Training Centres (STC) or Madrasas or Maqtabas supported under Sarva Shiksha Abhiyan.
Accredited Social Health Activists (ASHA)	Ministry Of Health And Family Welfare	Under the National Health Mission, voluntary community health workers known as ASHA are given performance based incentives.
Scholarships for students whose parents work in certain professions	Ministry Of Labor And Employment	Provides scholarships to the children of beedi workers, cine workers, iron-manganese-ore workers and limestone and dolomite workers. It also provides a stipend to children in special schools under the National Child Labor Project.
National Career Services	Ministry Of Labor And Employment	Helps find jobs, provides skills training to increase employability of people with disabilities and SC/ST candidates.
Scheme for Adolescent Girls	Ministry Of Women And Child Development	The scheme provides food, healthcare and life skills education for adolescent girls.

Support to Training and Employment Programme (STEP) Scheme for women	Ministry Of Women And Child Development	The scheme aims to provide employable skills to women that are 16 years and older.
Ujjawala Scheme	Ministry Of Women And Child Development	The scheme works towards the prevention of trafficking and rescue, rehabilitation, and reintegration of victims of trafficking for commercial sexual exploitation.
Swadhar Greh Scheme	Ministry Of Women And Child Development	The scheme targets female victims of unfortunate circumstances who are in need of institutional support for rehabilitation. It is a sub-scheme of a centrally sponsored umbrella scheme called "Protection and Empowerment of Women".
Maternity Benefit Programme	Ministry Of Women And Child Development	Pregnant women and lactating mothers who are 19 years or above and up to two live births, are provided a cash incentive.
Remuneration under the Integrated Child Development Scheme (ICDS)	Ministry Of Women And Child Development	ICDS is a programme that works towards a safe and secure environment for children. All staff members employed by this scheme now require an Aadhaar number for remuneration.
Inclusive Development of Disabled at the Secondary Stage under Rashtriya Madhyamik Shiksha Abhiyan	Ministry Of Human Resource Development	Provides assistance for the inclusive education of the disabled children in classes IX-XII. Girl child with special needs can avail a Rs 200 stipend under the scheme.
Saakshar Bharat	Ministry Of Human Resource Development	Programme for adult education.
Soil Health Management Scheme and Soil Health Card Scheme	Ministry Of Agriculture And Farmers Welfare	The schemes come under the National Mission for Sustainable Agriculture and provide uniform approach to collect soil samples and do testing at the laboratories.

Training under e-Panchayat Mission Mode Project	Ministry Of Panchayati Raj	e-Panchayat is an e-governance scheme for Panchayats.
Centrally Sponsored Scholarship Schemes for SC/OBC	Ministry Of Social Justice And Empowerment	The scheme provides scholarships for high school and college education of SC/OBC students.
Incentive for construction of Individual Household Latrine (IHHL)	Ministry Of Drinking Water And Sanitation	Provides incentive to all Below Poverty Line (BPL) households, Above Poverty Line households (APL) restricted to SCs/STs, small and marginal farmers, landless labourers with homestead, differently abled and women-headed households for the construction of bathrooms in rural areas.
Honorarium for staff of National Mission of Empowerment of Women (NMEW)	Ministry Of Women And Child Development	Provides health care, social empowerment and education and other services for empowering women. An Aadhaar number is mandatory for all workers to receive their honorarium under the scheme.
Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY)	Ministry Of Rural Development	DDU-GKY is a skills training and placement programme focused on rural poor youth.
National Means-cum-Merit Scholarship Scheme (NMMSS)	Ministry Of Human Resource Development	The scheme offers scholarships to 9-12 class students from economically weaker sections in government schools.
Annual Grant to Grih Kalyan Kendras	Ministry Of Personnel, Public Grievances And Pensions	Grih Kalyan Kendra is a welfare society for central government employees.
Conduct of Yoga Classes at Grih Kalyan Kendras	Ministry Of Personnel, Public Grievances And Pensions	Grih Kalyan Kendra is a welfare society for central government employees.

Integrated Child Development Services (ICDS) Scheme training beneficiaries	Ministry Of Women And Child Development	Anganwadi provides food, pre-school education and primary healthcare to children under 6 and their mothers. An Aadhaar number is mandatory for all beneficiaries including staff at the Anganwadi Training Centers (AWTCs) or Middle level Training Centers (MLTCs), guest faculty or resource persons and trainees who are enrolled in the AWTCs or MLTCs for training courses.
National Apprenticeship Promotion Scheme (NAPS)	Ministry Of Skill Development And Entrepreneurship	The government provides employers 25% of the stipend paid to apprentices under the scheme. People enrolling as trainees or apprentices require an Aadhaar number.
Mission for Integrated Development of Horticulture (NHB,CDB,CIH)	Ministry Of Agriculture And Farmers Welfare	Individuals who want to avail subsidies under National Horticulture Board, Coconut Development Board & Central Institute for Horticulture, Nagaland, sub-schemes of Mission for Integrated Development of Horticulture need an Aadhaar number.
Pradhan Mantri Awaas Yojana – Gramin (PMAY-G) programme	Ministry Of Rural Development	The rural housing scheme aims to provide housing for all in rural areas by 2022.
Restructured Weather based Crop Insurance Scheme (RWBCIS)	Ministry Of Agriculture And Farmers Welfare	The programme insures farmers against crop failure - the cost is split by the centre and state governments.
Pradhan Mantri Fasal Bima Yojana (PMFBY)	Ministry Of Agriculture And Farmers Welfare	The programme insures farmers against crop failure - the cost is split by the centre and state governments.
Targeted Public Distribution System	Ministry Of Consumer Affairs, Food And Public Distribution	An Aadhaar number is mandatory to receive subsidized food grains and ration cards.

Supplementary Nutrition Program offered at Anganwadi Centres	Ministry Of Women And Child Development	Anganwadi provides food, pre-school education and primary healthcare to children under 6 and their mothers. Those who seek support from the Supplementary Nutrition Program offered at anganwadi centres require an Aadhaar number.
Workers and helpers involved in the Integrated Child Development Services (ICDS) Scheme [Anganwadi Services]	Ministry Of Women And Child Development	Anganwadi provides food, pre-school education and primary healthcare to children under 6 and their mothers. All those working in an anganwadi centre must have an Aadhaar number.
Employees' Pension Scheme (EPS)	Ministry Of Labour And Employment	People enrolled in the Employees' Pension Scheme have to use their Aadhaar number to avail the central government's contribution to their pension.

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