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ARTHUR D LITTLE

India's Digital Public Infrastructure

Accelerating India's Digital Inclusion

February 2024

Foreword

India's digital journey, beginning with Aadhaar in 2009, has been transformative. It started with addressing a fundamental problem: three out of four people in India didn't have formal identification. This meant they had limited access to basic services like opening a bank account or getting a SIM card. Aadhaar was our first step, but the journey evolved into something much bigger.

It was about creating a digital identity system that empowered individuals to authenticate their identity easily and securely, wherever they were. This evolution wasn't just about technology, it was about reimagining how we interact with and within our digital ecosystem.

The move from traditional ID methods to a comprehensive digitized system marked a significant shift. It required the collective efforts of the public and private sectors working together. The pace at which India achieved this milestone has been remarkable, condensing decades of progress into a mere fraction of the time.

The concept of Digital Public Infrastructure (DPI) that emerged has since grown beyond Aadhaar. It has become a catalyst for further innovations, with platforms like UPI and the growth in digital finance just scratching the surface of what's possible.

The nasscom-Arthur D. Little report titled "Digital Public Infrastructure of India - Accelerating India's Digital Inclusion" is a great summary of the journey so far, the impact these DPIs have had, and will have on the economy. I'm excited by the fact that many multilateral development agencies have adopted the mission of 50 in 5 i.e., 50 countries adopting DPI in 5 years.

What excites us most about DPIs is not the technology itself but what it enables people to do. This digital journey is about transforming challenges into opportunities and leveraging technology to empower people. And this is only the beginning, and the path ahead is filled with promise!

Nandan Nilekani

Co-Founder & Chairman of Infosys Technologies Limited

Founding Chairman, Unique Identification Authority of India (UIDAI)

Foreword

The world has witnessed India's massive transformation over the last several years, driven by digital revolution at the core of its economic growth, with a vision to make India into a digitally empowered society and knowledge economy. India is leapfrogging from offline, informal, low-productivity to a single, online, formal, high-productivity mega economy.

The foundation of this digital revolution has been strengthened by the Digital Public Infrastructure (DPIs) or India Stack, enhancing the ability of the country to use digital technologies at a population scale to change the society. DPIs form the cornerstone to shape this "tech-ade" and ultimately drive the "India@47" growth path.

The DPI model is unique, interoperable, collaborative, equitable, with the inclusive principle that every citizen in the most inaccessible corner of the country has the same opportunity as everyone else.

The Nasscom-Arthur D. Little report titled **"Digital Public Infrastructure of India - Accelerating India's Digital Inclusion"** is a first-of-its kind report, providing a holistic view of the Indian DPI ecosystem, analysing the past, present, and the future impact that these DPIs will have on the Indian and global economy.

Staying true to the fundamental principle of creating impact to over 1 billion Indians, the report highlights the significant contribution made by DPIs to the Indian economy. And with the maturing adoption of many of these entities, it is projected to yield substantial economic and social impact on a broader scale, creating a widespread revolution which covers every aspect of our society and economy.

India is currently the global leader in developing DPIs, using it to implement widespread adoption of digital payments, data-sharing infrastructures, bolstering domestic businesses and spurred entrepreneurship in the country. This has been due to the relentless support by the government and enabled by the IT intellectual capital and start-up ecosystem, a combination which has made DPI a success.

Not limited to India, the success of these DPIs has been gaining global recognition as well and have the capability to solve key global challenges including key UN Sustainable Development Goals, creating a lasting impact across the globe and with an aim to take this model to 50 countries in five years.

This report highlights the possibilities of the vast potential that DPIs hold in revolutionizing the entire Indian economy and the world and paints a hopeful picture of an interconnected, open, inclusive world with infinite possibilities, empowering each and everyone across the globe.

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President, Nasscom

Satya Easwaran
Partner, Arthur D. Little

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Executive Summary

1. Over the past decade, India has emerged as one of the fastest growing economies in the world and is set to become the 3rd largest in the world before the end of this decade.

2. This massive economic transformation has been powered by digital public infrastructure (DPIs) that have facilitated the development of necessary government services & platforms and these in turn have powered market innovations in both public and private sectors, and enabled creation of inclusive ecosystems.

3. India's DPI foundational stack has been built on 3 core guiding principles- they have open APIs, are interoperable and based on consent, and consist of 3 layers based on identity, payments and data which have facilitated the development of necessary government services & platforms. Private players have also participated by building business models using some of these DPIs. The foundation of DPIs is based on the underlying principle of trust on the infrastructure and stakeholders.

4. **DPI Maturity Framework –**

- To analyse the impact of DPIs on India's economy, Arthur D. Little has designed a **'Maturity Framework'** built on components such as – Recency, Indirect benefits, Direct benefits in transaction value and volume, Total Addressable Market (TAM), and reach of each DPI as a % of TAM.
- When evaluated methodically, there is a clear clustering of **'matured digital entities'** with successful mass adoption and larger economic impact & **'budding digital entities'** with successful proofs of concept and ready for mass adoption.

5. **Indian DPIs – Impact on India in 2022 –**

- We estimate matured digital entities (Aadhaar, UPI & FASTag) to have enabled value creation of **~0.9% to India's GDP in 2022.**
- Apart from economic value add, DPIs also contribute to financial benefits, ecological benefits and process efficiencies and convenience for the citizens.

6. **Indian DPIs – Global Impact Potential –**

- UPI & Aadhaar are being **adopted by other countries globally to solve similar social & economic challenges.** Presently, over 30 countries are either adopting or in early discussions to implement UPI, Aadhar, and Beckn in their respective countries for boosting social & financial inclusion.

Executive Summary

7. **Indian DPIs – Impact potential by 2030 –**

By 2030, we believe that the economic value add from DPIs has the potential to increase **~3X-** from current 0.9% to 2.9-4.2%, driven by-

- Existing digital entities that will evolve to deliver superior user experience, utilizing new age tech of AI, Web 3 and others. Aadhar is expected to continue to be a major contributor as use cases expand to broader range of services.
- Enhanced impact of budding DPIs such as ABDM (better healthcare for citizens of the country, resulting in increased labour productivity) and ONDC (incremental growth in retail spending of the country).

8. **Key challenges** in DPI adoption include lack of interconnectedness among government ministries, lack of real time data availability, limited language expansion for users to access in preferred languages, and future partnerships beyond government services.

9. **Key imperatives for the stakeholders to achieve the 2030 DPI potential–**

- **For Government agencies,** imperatives to be cognizant of include proactive policy support & regulatory clarity, promotion on the usage of existing digital ecosystem through offline workshops and awareness campaigns, setting up task force to drive adoption of newer digital entities, and partnering with corporates and start-ups to launch sandbox for fostering innovation. Importance of cybersecurity and data privacy are paramount for success.
- **For Startups and SMEs,** it includes building business models to capitalize on the full-scale adoption of existing digital infrastructure, building business models to help drive the adoption of existing DPIs, experimenting with the new-age technologies like Gen-AI, NLP, Web 3 to integrate and improve the digital ecosystem.
- **For Corporates and Big Tech,** imperatives include capitalizing on the future demand of digital & build the necessary infrastructure layer, setting up accelerator programs to foster innovation in digital to solve citizen problems, and keeping a global mindset to solve when building solutions.

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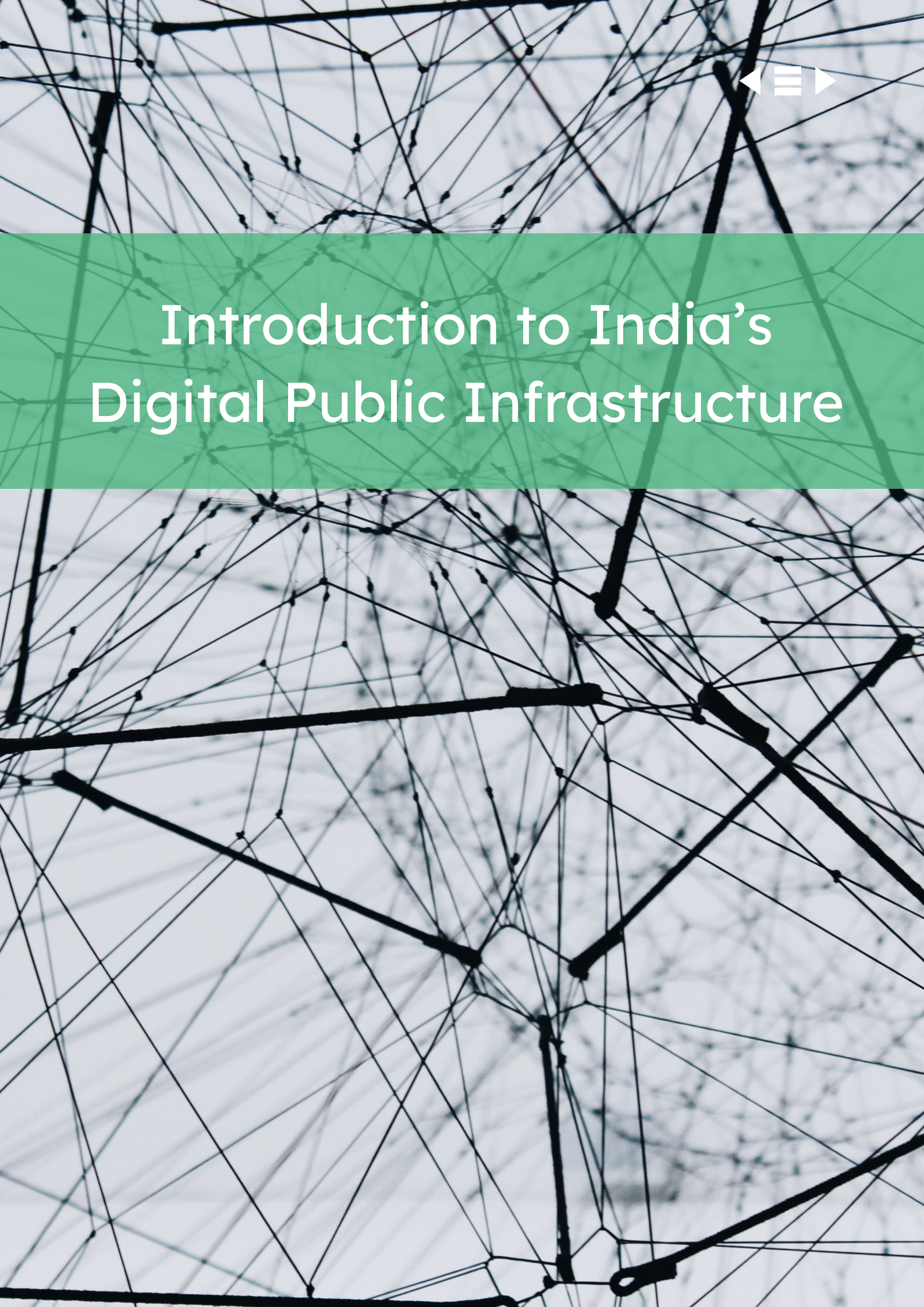


Introduction to India's Digital Public Infrastructure

Chapter #1

Introduction to India's Digital Public Infrastructure

1.1 a. Introduction

Digital India in this Techade

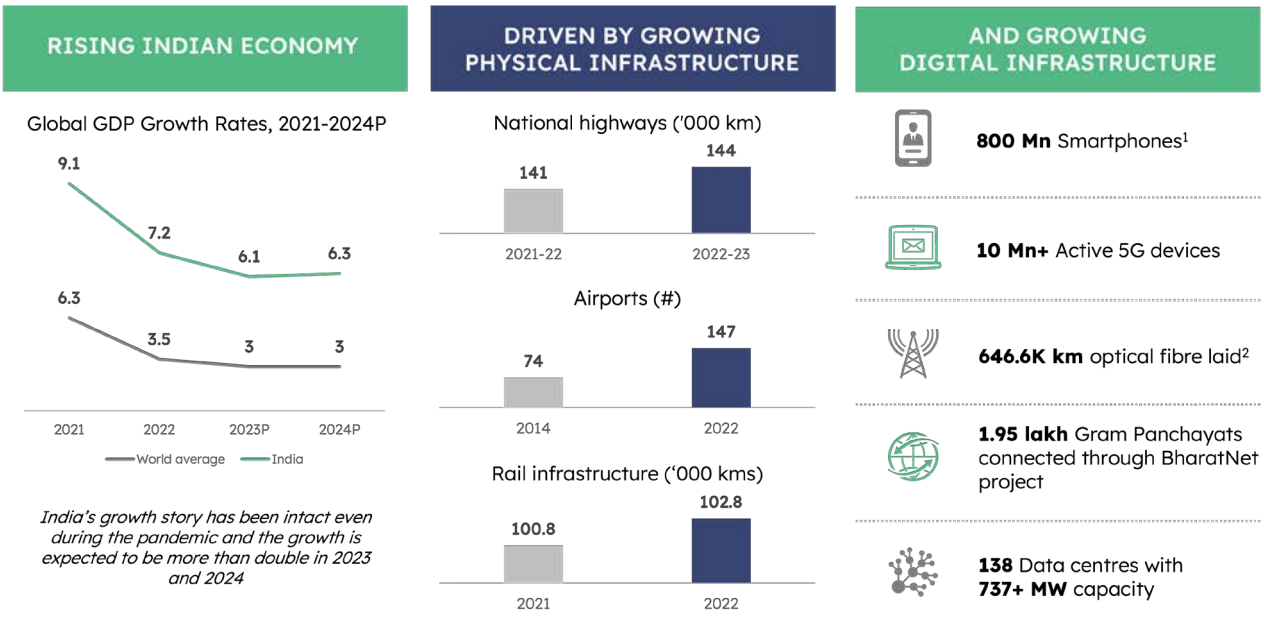
In a rapidly increasing digital world, the growth in India's digital prowess clearly stands out, while maintaining its vast diversity. With a growing young population and massive digital transformation, Indian government announced the "Digital India" initiative to not only encourage its citizens to increase digital adoption, but also transform the economy into a digitally empowered one.

The "Digital India" initiative drives progress and prosperity through technology, revolutionizing citizen engagement and connectivity. It prioritizes Digital Public Infrastructure (DPIs) to enhance efficiency and stimulate innovation in both the public and private sectors. With robust digital frameworks, India lays a strong foundation for accelerated growth and technological advancements, reflecting its commitment to utilizing digital infrastructure for economic development and societal well-being.

Unlocking the Techade of India

In the past decade, India has experienced an extraordinary digital revolution, marking a period of unprecedented growth and success. With a rapidly expanding digital ecosystem, India has emerged as a global leader in harnessing the power of technology.

India is one of the fastest growing economies in the world

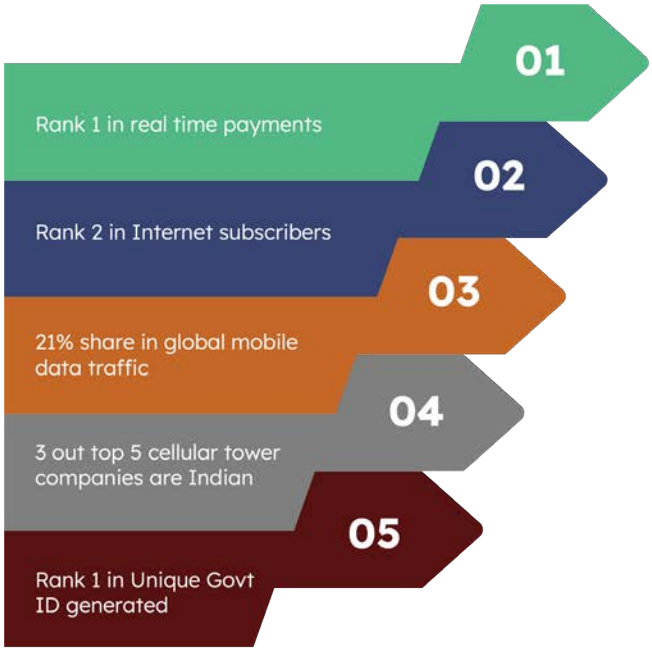


[1] As on Dec 2022
[2] As on Oct 2022

Source: IMF World Economic Update, morth.nic.in, Binswanger Anarock report, https://usof.gov.in/en/bharatnet-project, Arthur D. Little, nasscom analysis

Internet penetration has soared, opening new opportunities for connectivity and access. The digital economy has blossomed and is poised to become a significant contributor to India's GDP. Moreover, India's commitment to digital innovation is evident in its deployment of numerous digital public entities, solidifying its position as a trailblazer in the digital realm. This exceptional progress showcases India's unwavering dedication to shaping a vibrant and inclusive digital future.

Driven by its remarkable digital transformation journey in the last two decades



UPI payments crossed **9.3 bn in volume and ₹14.75 lakh crore in value**[1]

865.9 Mn internet subscribers[3]

20-25 GB data consumption per person per month

India is home to 7.4 lakh telecom mobile towers[2]

1.4 Bn Aadhaar generated[3]

1.1 b. Vision and Scope of the Indian DPIs

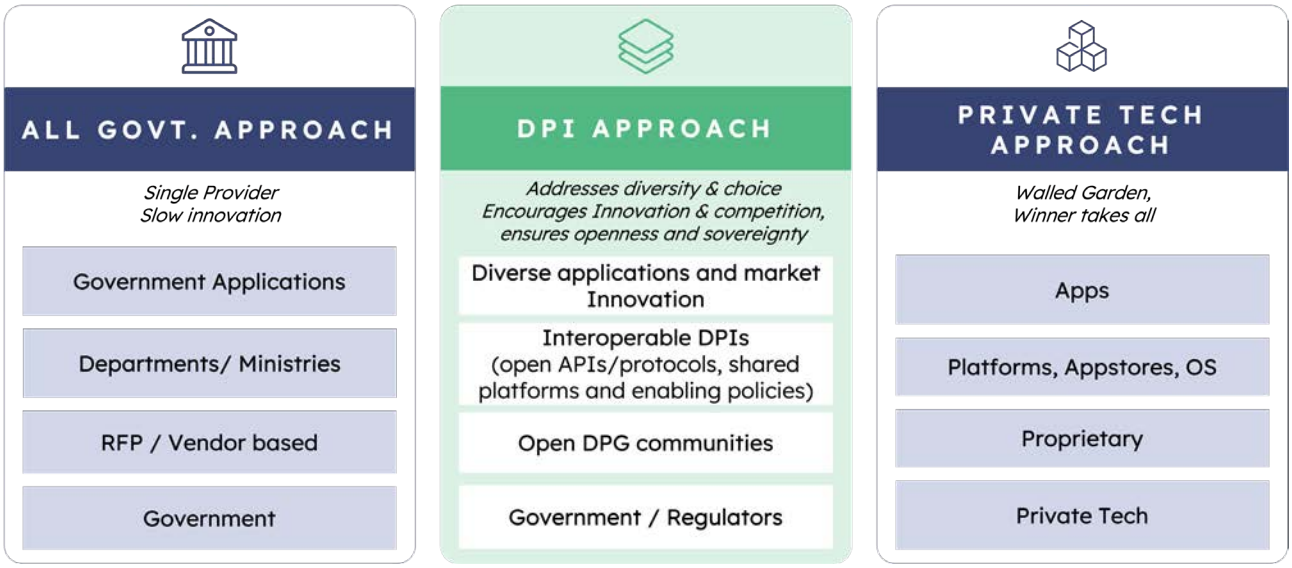
Vision for creating DPIs

In the pre-digitized era, on one side, there was the presence of government with its internal applications and public systems, which led to innovation at its own pace. On the other end, we witnessed the emergence of private tech organisations, who with their own apps, platforms, operating systems etc. created a "walled garden" controlling the user's access to network-based content thus providing access to only select applications.

[1] As on June 2023
[2] As on Dec 2022
[3] As on 28 July 2023

Source: TRAI, UIDAI, NPCI, CoWIN, Secondary news reports, nasscom

India's Digital Public Infrastructure (DPIs) are key building block enabling this transformation

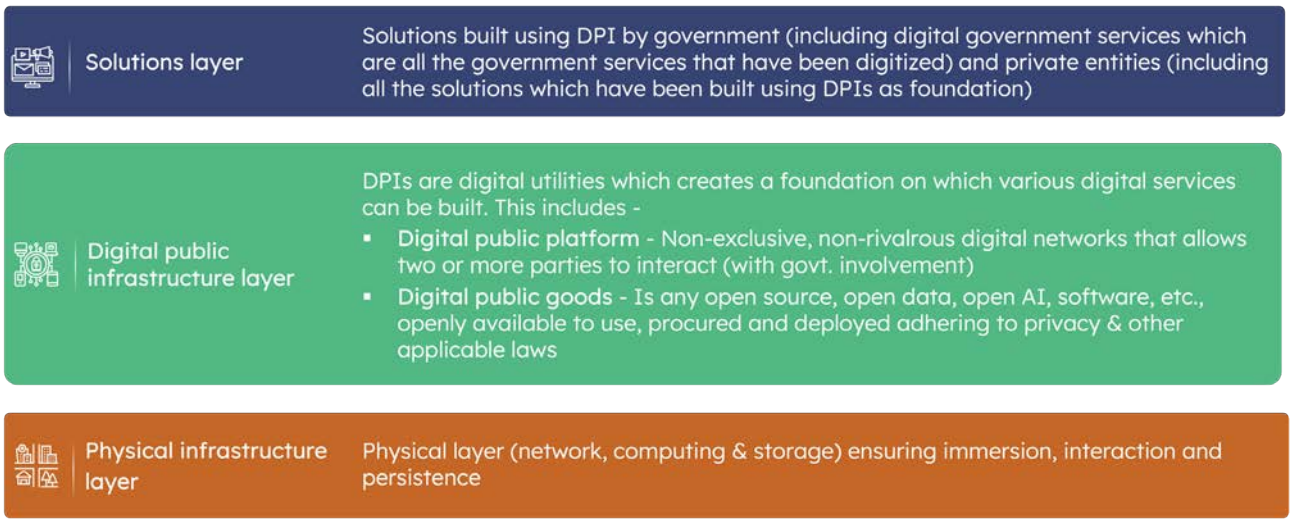


A differented approach was followed, which required the buy-in from the government and the technological prowess promised by the tech giants. In the "DPI Approach", the govt worked with stakeholders to design "interoperable DPIs", enabling other companies to build their own solutions, leading to an ecosystem solving citizen-centric problems.

DPI Framework and Universe

In the pursuit of a digitally empowered nation, India has crafted a visionary framework that lays the foundation for comprehensive digital transformation. At the core of this framework lies a strategic alignment of multiple layers, each contributing to the seamless integration of digital services, platforms, and infrastructure.

To streamline the process, India has crafted a visionary framework, 'Digital India Framework'



Source: Adapted from multiple secondary sources including presentations by Dr. Pramod K Varma, State of India Digital Economy report - ICRIER, Arthur D. Little, nasscom analysis

The Digital India framework consists of 3 layers, which include

1. **Solutions Layer -** Solutions built using DPI by government (including digital government services which are all the government services that have been digitized) and private entities (including all the solutions which have been built using DPIs as foundation). The digitization of government and private services empowers citizens through the conversion of traditional service delivery into efficient digital formats. This streamlines access to essential public services, ensuring convenience, transparency, and inclusivity.

2. **Digital Public Infrastructure Layer -** DPIs are digital utilities which create a foundation on which various digital services can be built. These refer to the solutions and systems that enable the effective provision of essential society-wide functions and services in the public and private sectors and include -

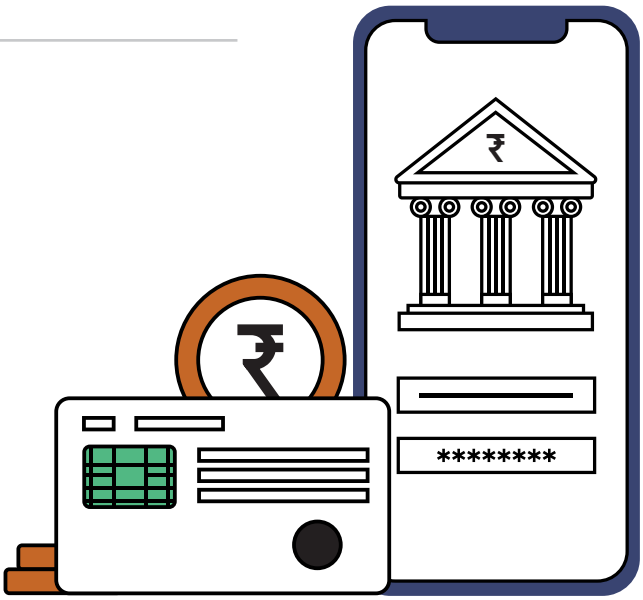
   a. **Digital public platform -** Non-exclusive, non-rivalrous digital networks that allows two or more parties to interact (with govt. involvement). These are sector specific platforms, enabling public service delivery and serve as catalysts for collaboration, fostering seamless communication and engagement.

   b. **Digital public goods -** Any open source, open data, open AI, software, etc., openly available to use, procured and deployed adhering to privacy & other applicable laws.

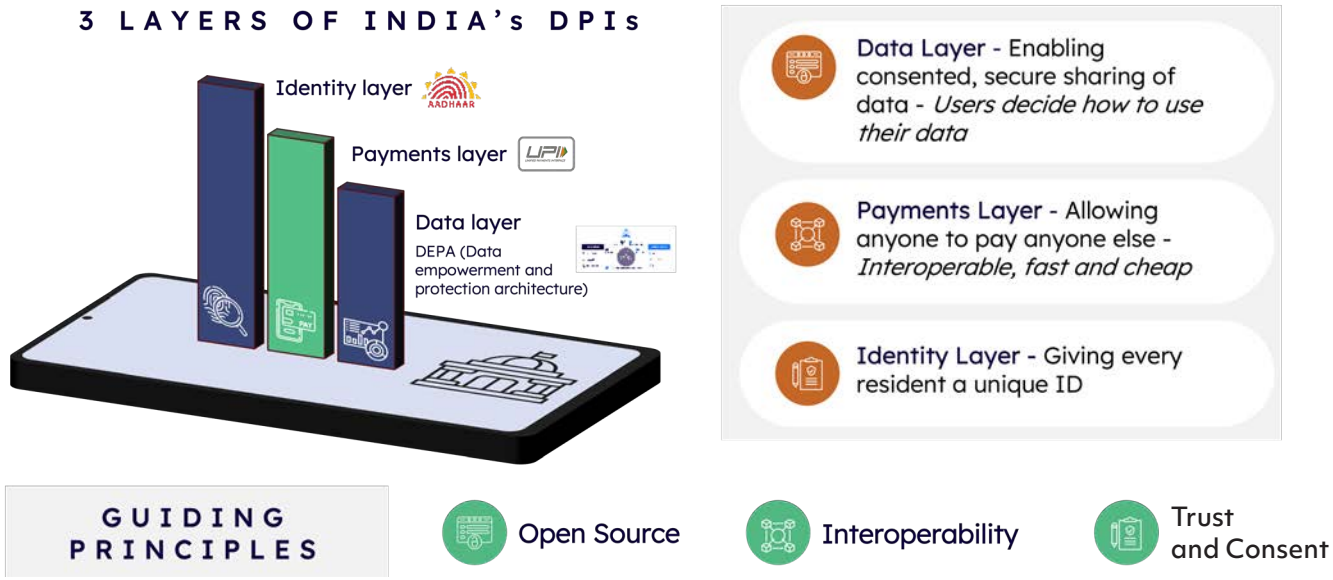
3. **Physical Infrastructure Layer -** Physical layer (network, computing & storage) ensuring immersion, interaction and persistence.

1.1 c. Foundation / Tech-stack

At the core of India's digital revolution, the key DPIs with a strong foundation of interoperability, open-source principles, and consent-driven frameworks come together. Aadhaar, UPI, and DEPA exemplify these principles, enabling seamless digital identity, secure payments, and controlled data access. These DPIs not only enhance user experiences, but also foster collaboration between public and private entities.



DPIs built layer by layer focusing on 3 core guiding principles



Global economies work on trust and transparency. Indian DPIs' foundational layers are based on transparency and trust, promoting paperless transactions, reducing bureaucracy, and advancing the concept of digital identity and document management. This forms the backbone of massive adoption of DPIs across the country.

Indian DPIs represent critical layers on which various government services are built –

- **Identity layer** enables secure and unique identification of individuals, and businesses and facilitates seamless authentication, verification, and integration of identity information, enabling efficient delivery of public and private services.
- **Payment layer** facilitates secure and convenient transactions between individuals, businesses, and the government and aims to promote a cashless economy, enhance financial inclusion, and simplify the process of giving and receiving payments by leveraging technology and interoperable payment solutions.
- **Data Exchange** layer provides a standardized, consent-driven, and interoperable platform where individuals, businesses, and government agencies can securely share and access data for various purposes, such as financial services, e-governance, education, healthcare, and more.

1.1 d. DPIs as a Utility

The introduction of DPIs has had a profound impact on various sectors, stakeholders, and government services in India. Key benefits across stakeholders include:

For individuals -

1. Increased access to services, improved standard of living, cost savings, and enhanced productivity.
2. Enable citizens to avail government welfare programs, financial services, and healthcare facilities seamlessly.

For businesses - DPIs enable simplifying operations, foster ease of doing business, provide authentication solutions, and offer insights into consumer data.

For Government entities – Higher tax revenues, reduced operational costs, improved service delivery, and enhanced global image. DPIs have enabled efficient tax collection and facilitated the implementation of transparent and accountable governance practices.

Source: Dr. Pramod Varma, Arthur D. Little, nasscom

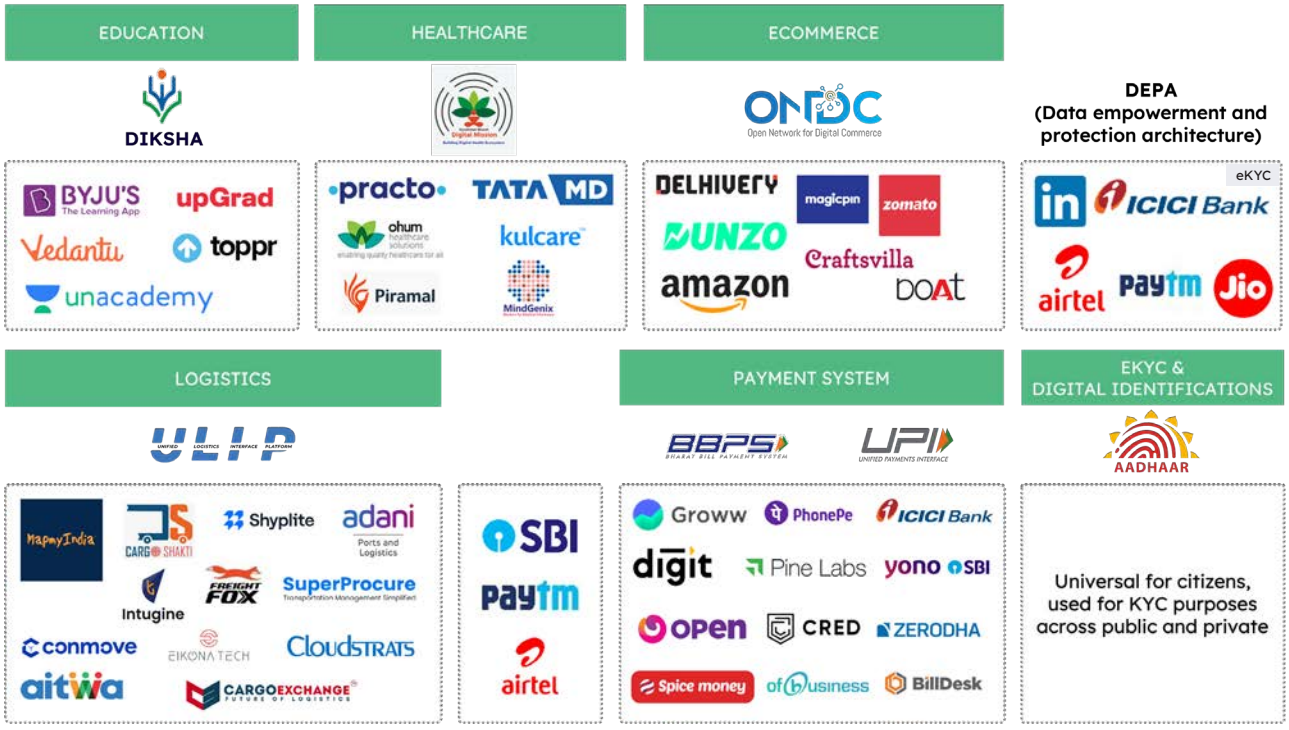
DPIs are spread across all sectors

Non-Exhaustive

Service Provider Landscape Using DPIs

Riding on the benefits offered by the DPIs, many private players have adopted them for building business-centric solutions.

Private players and start-ups creating solutions for unique problems using DPIs



Source: ICRIER, Arthur D. Little, nasscom analysis

DPI Impact – Past & Present

Chapter #2

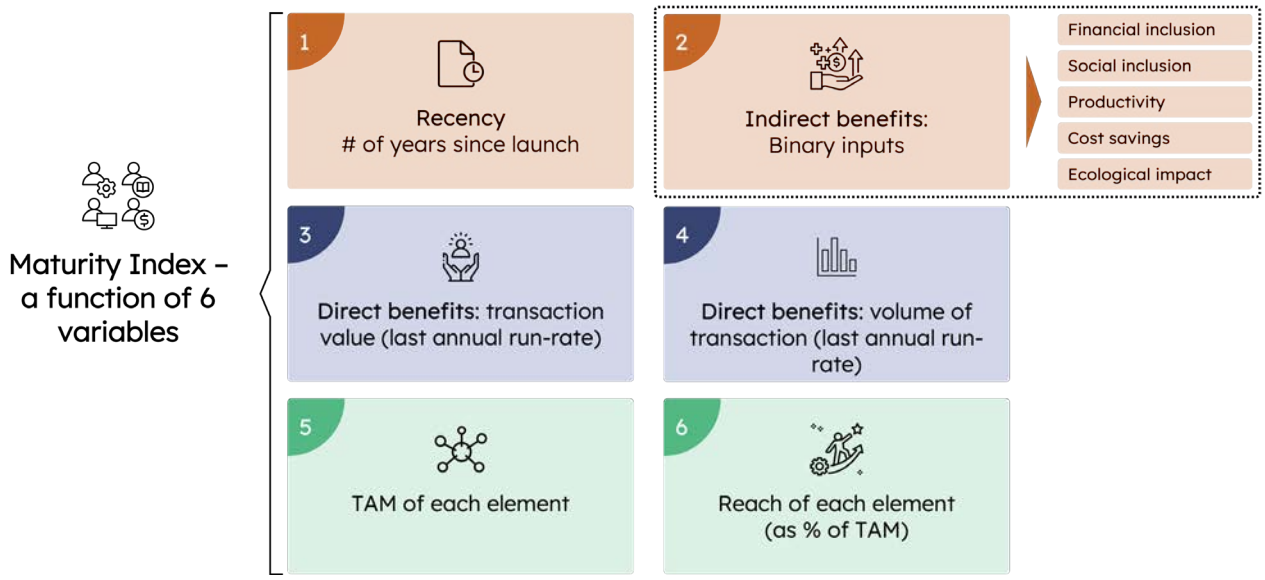
DPI Impact – Past & Present

Since the inception of DPIs in more than a decade, the progress and impact created is humungous. This chapter assesses the progress of DPIs, which includes user adoption and growth, direct impact on citizens and economy, indirect non-tangible benefits like convenience, time savings etc.

2.1 Maturity Framework

To further analyse and categorize the DPIs into specific categories, Arthur D. Little designed a 'Maturity Framework' built on 6 major components.

DPI Maturity Framework parameters



The framework is based on the 6 variables, basis which a maturity score is assigned to each DPI. These variables include –

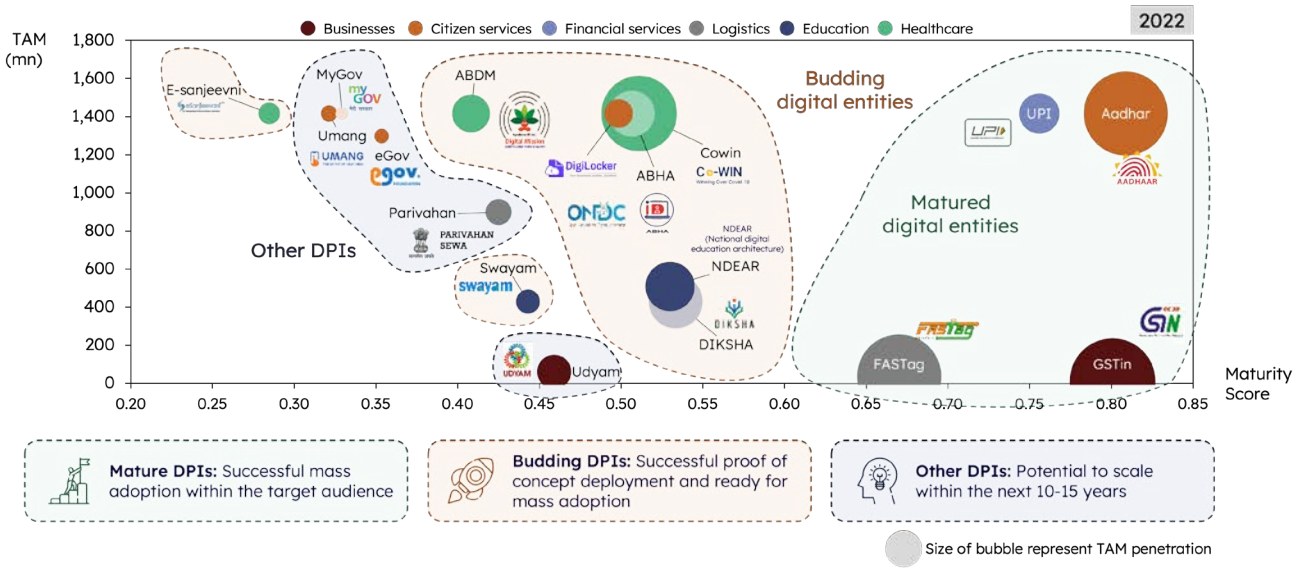
1. **Recency:** Measured as the number of years since the DPIs have been launched and measures the period from when the citizens have availed benefits from the DPIs.
2. **Indirect benefits:** These are the intangible, indirect benefits availed by the citizens from the DPIs. These include financial inclusion, social inclusion, increase in productivity, cost savings, and ecological impact.
3. **Direct benefits:** These measure the dollar value or volume generated through the adoption of the DPI by the citizens.
4. **TAM (Total Addressable Market):** The total population which can potentially benefit from the DPIs.
5. **TAM Penetration and Reach:** Total users and the reach of the DPIs as percentage of the TAM.

Source: Arthur D. Little analysis

The Maturity Framework assesses the impact of Indian DPIs based on total reach and adoption.

DPI Maturity Framework

Non-Exhaustive



It measures the maturity score on X axis, with TAM on the y axis. The size of the bubble represents the penetration of TAM by the DPI. Matured DPIs, in the top right corner, have scaled substantially, indicating a high maturity score. While the budding DPIs still have scope for growth and maturity.

There is a natural clustering with most mature DPIs (comprising of Aadhaar, UPI, FasTag and GSTN) on the right side, followed by the budding DPIs, and other DPIs which are nascent. To elucidate, GSTN is at the bottom of the chart, while Aadhaar is on the top, despite having similar maturity score. This highlights the key difference that GST is for limited TAM, whereas Aadhaar's TAM comprises of the overall population of the country.

The budding DPIs comprise of a cluster with high TAM and low maturity score, which includes the DPIs for education, healthcare and commerce.

2.1 a. DPI progress in the last 10 years

This section covers the progress of the DPIs in 4 parts –

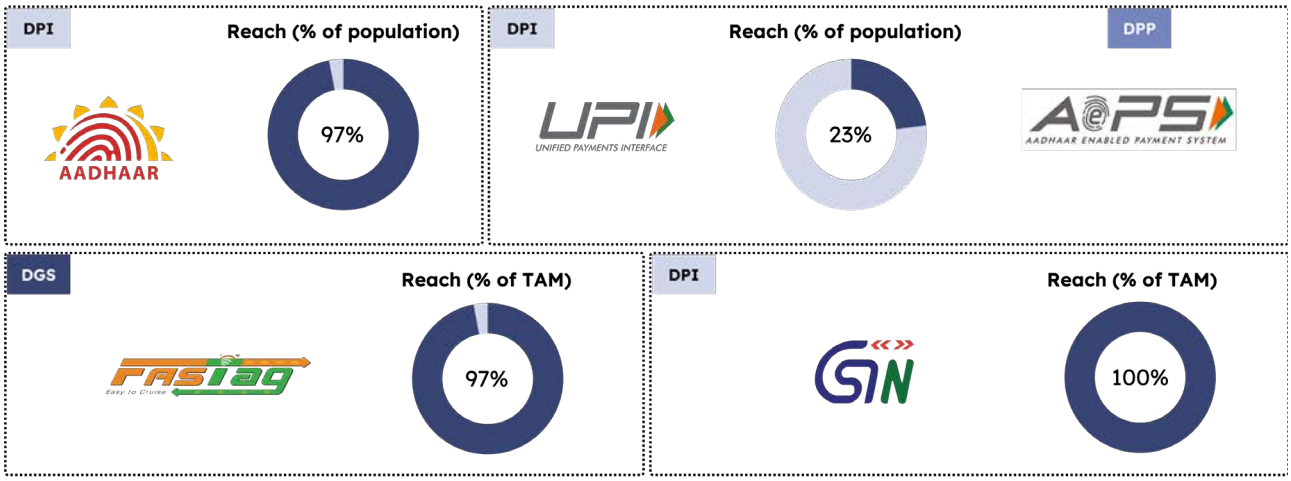
1. Matured DPIs
2. Budding DPIs
3. Other notable DPIs
4. Select state-level DPIs

Source: Arthur D. Little, nasscom analysis

Matured DPIs

Matured DPIs are impacting ~1.3 Bn citizens, covering 97% of the population

Mature

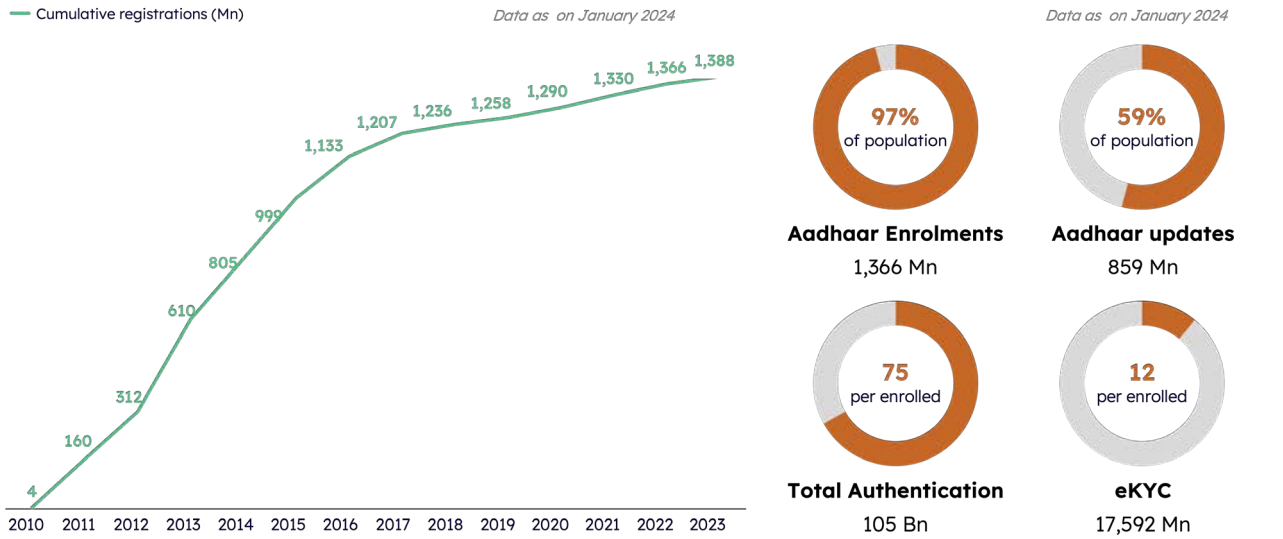


Details on each matured DPI -

Aadhaar is a unique biometric identification system, providing authentication through biometric, enrolment software, Central Identities Data Repository (CIDR), authentication servers and Aadhaar network. It has facilitated the development of services like Aadhaar-enabled Payment System (AePS) and Aadhaar Payments Bridge (APB), electronic Know Your Customer (eKYC) and eSign. Aadhaar today provides a digital ID to over 1.3 billion Indian citizens (~97% of the population). The growth for this DPI since its inception has been over 300 times.

Aadhaar is the pioneer in creating unique digital identities for citizens

Mature



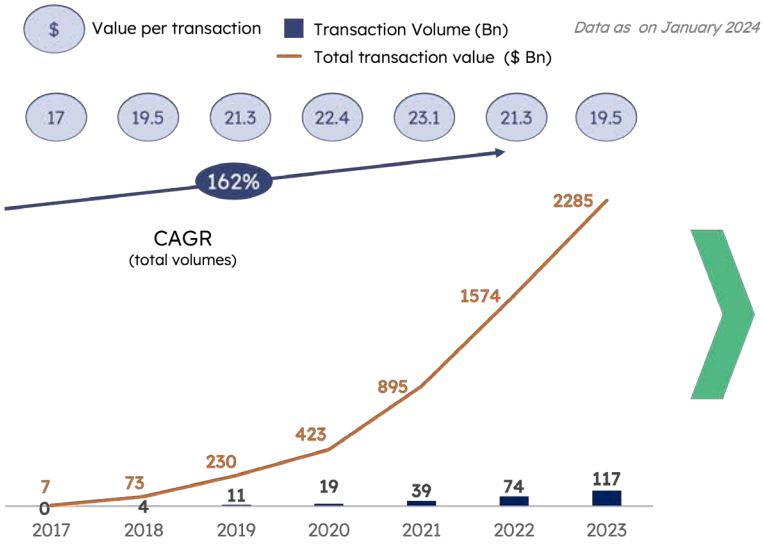
Note: As sourced from government dashboards

Source: uidai.gov.in, Arthur D. Little, nasscom analysis

Unified Payment Interface (UPI) is used to link bank accounts to any UPI-enabled app, leading instant transactions across various platforms. It has driven financial inclusion and revolutionized the payment landscape for millions of Indians. Private fin-tech players have also supported the growth of the ecosystem by building business models around it. Stabilizing transaction size indicates that UPI payments are replacing cash transactions for regular low-ticket expenses.

UPI has driven financial inclusion and revolutionised the payment landscape for millions of Indian citizens & merchants

Mature



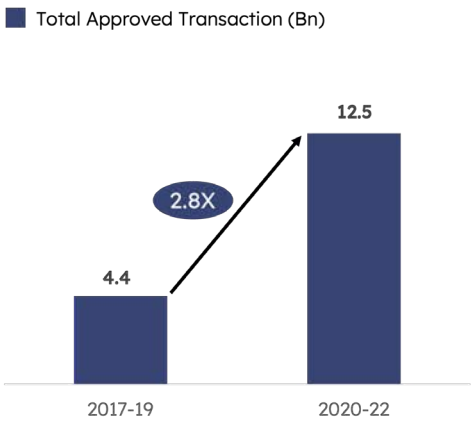
Key Insights

- **326X growth** in total transaction value; **1.1X growth** in value per transaction in last 5 years
- Provides convenience in online transactions and has improved financial inclusion
- Participation from **private players** (PayTM, PhonePe, & BharatPe) has enabled widespread adoption as they onboarded merchants (small street vendors in the Tier2+ markets)
    - These players are now providing credit to these merchants who earlier didn't had access to credit – helping in financial inclusivity

AePS (Aadhaar enabled Payment System) is a payment service that allows a bank customer to use Aadhaar as their identity to access their Aadhaar enabled bank account and perform basic banking transactions securely like balance enquiry, cash withdrawal, remittances through a Business Correspondent. AePS ensures the security and authenticity of the transactions by utilizing biometric authentication linked to the individual's Aadhaar number, eliminating the need for physical documents, and minimizing the risk of identity theft or fraud.

AEPS allows online payments using Aadhaar – the adoption has increased 2.8X over the last 5 years

Mature

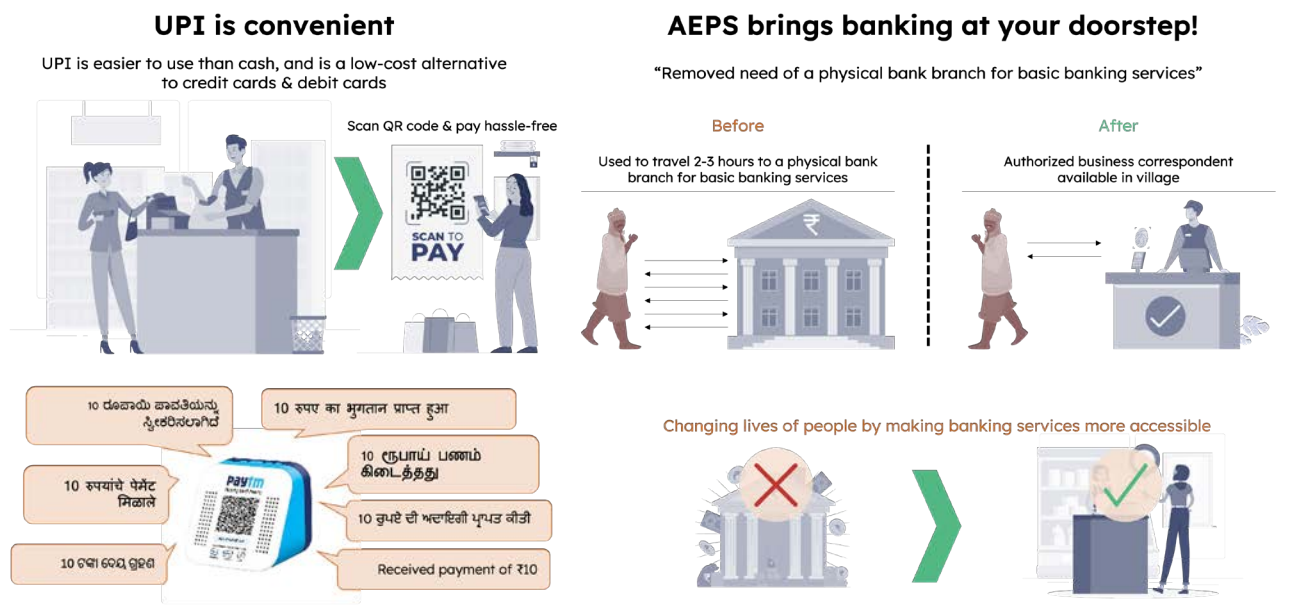


Key Insights

- Improved financial inclusion as people in rural areas can now access banking services via Aadhaar card
- Reduced costs and improved convenience for financial transactions

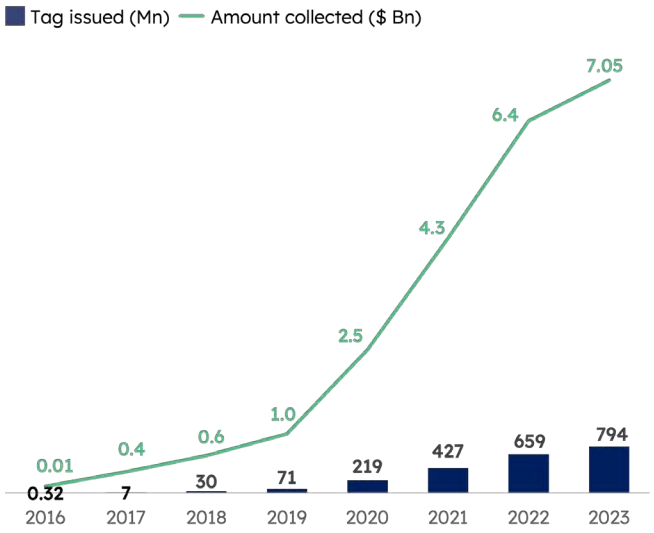
Source: npci.org.in, Arthur D. Little, nasscom analysis

Case example - UPI AND AEPS IN ACTION



Fastag: FASTag, built by National Payments Corporation of India (NPCI) on top of UPI protocols, is an RFID device mapped with the payment ID of any vehicle and allows quick and seamless payment of tolls and taxes on highways. Presently, tax collections on all the national highways is mandatorily paid by FASTag. It lowers congestion at toll-plazas and improves travel time.

FASTag widely adopted by tolls and made mandatory on national highways, leading to 97% adoption



Key Insights

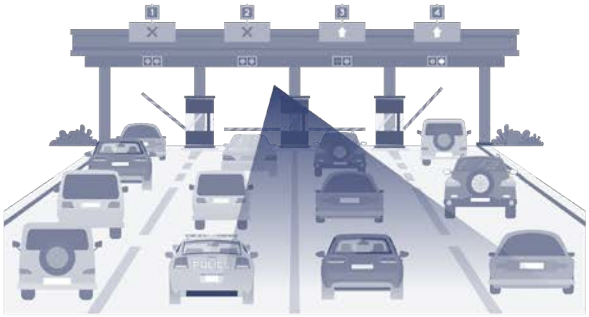
- FASTag implementation across all national highways has reduced the waiting time at tolls
- Overall, FasTag has a potential to reach 38 Mn registered vehicles in 2022
- With government penalizing users who don't have FasTag with 2x toll – led to 97% adoption
- Future plans include installation of cameras across the highways to automate tax collection without FASTag and toll gates

Note: 2023 data till Nov 2023

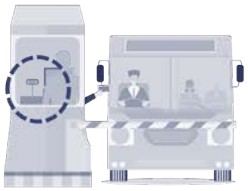
Source: npci.org.in, Arthur D. Little, nasscom analysis

Case example - FASTag IN ACTION

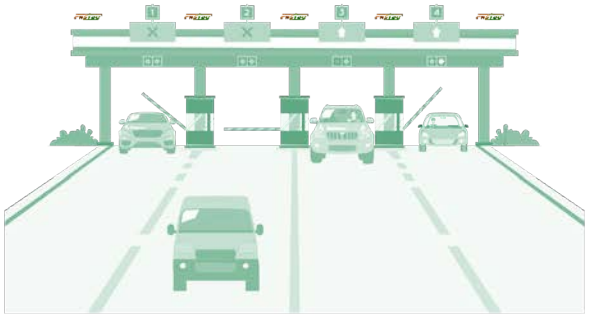
Without FASTag, long waiting time at Toll Plaza with congestions during peak hours



Cash/Upi Payment Takes upto 1 Minute for Each Vehicle



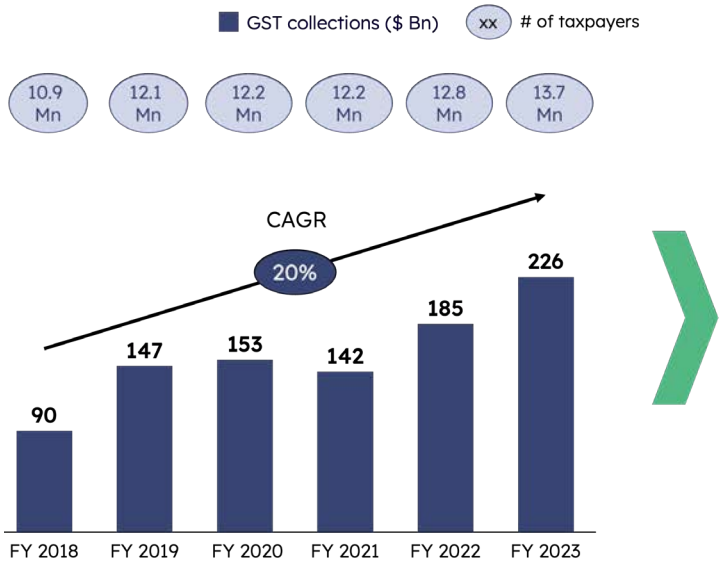
FASTag reduced congestion at Toll Plaza



RFID Scanner Takes Less than 10 Seconds for Each Vehicle

Goods and Services Tax Network (GSTN) has built an indirect taxation platform for GST to help taxpayers in India to prepare, file returns, make payments of indirect tax liabilities and do other compliances. It provides IT infrastructure and services to the Central and State Governments, taxpayers, and other stakeholders for implementation of Goods and Services Tax (GST) in India. Since its inception, GST has shown consistent annual revenue growth of around 20% and a significant increase in registered taxpayers.

GSTN streamlined taxation system and resulted in ~2X increase in number of taxpayers and 1.5X increase in overall tax collected



Key Insights

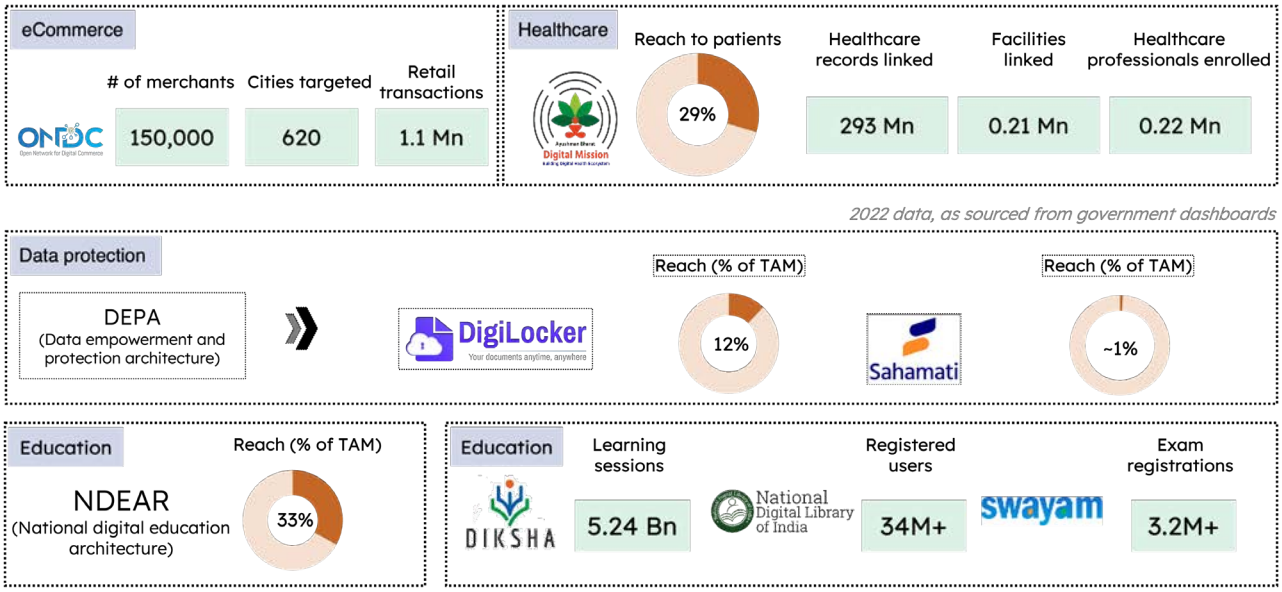
- GST has let to efficiency in tax system and reduced compliance costs
- It has increased efficiency of logistics due to abolishment of check-posts at state borders
- Number of tax payers increased from 47 lacs to 137 lakhs in this period
- The tax revenue for the government have increased substantially (20% yoy growth between 2018 to 2023)
- Maharashtra had highest GST collection of $27.2 Bn (₹2.8 Lakh Cr.) in FY22, followed by Gujarat & Karnataka

Note: The data pertains to respective Financial years.

Source: gst.gov.in, incometaxindia.gov.in, Arthur D. Little, nasscom analysis

Budding DPIs

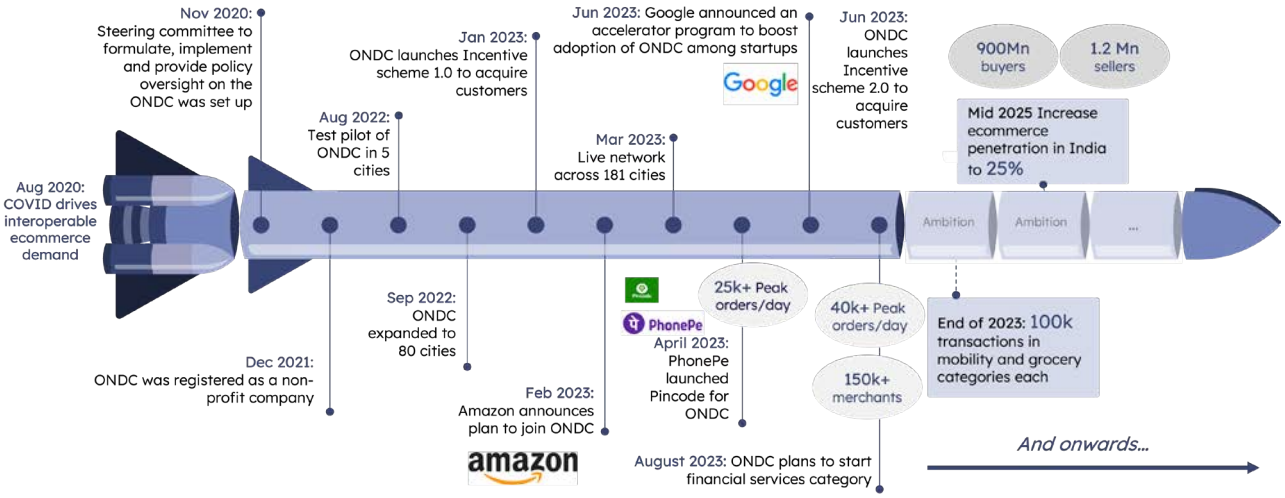
Budding DPIs such as ABDM and ONDC have shown great potential for scaling in the future



Open Network for Decentralized Commerce (ONDC) is an open protocol which envisions an equal access to the digital retail markets for small businesses and retailers of the country, thus providing a level playing field for all players. The platform onboards sellers, logistics partners, delivery force of gig-workers and does not charge exorbitant margins from the community. Users or buyers of the platform can choose which seller they want to buy from, and how much to pay for shipping etc.

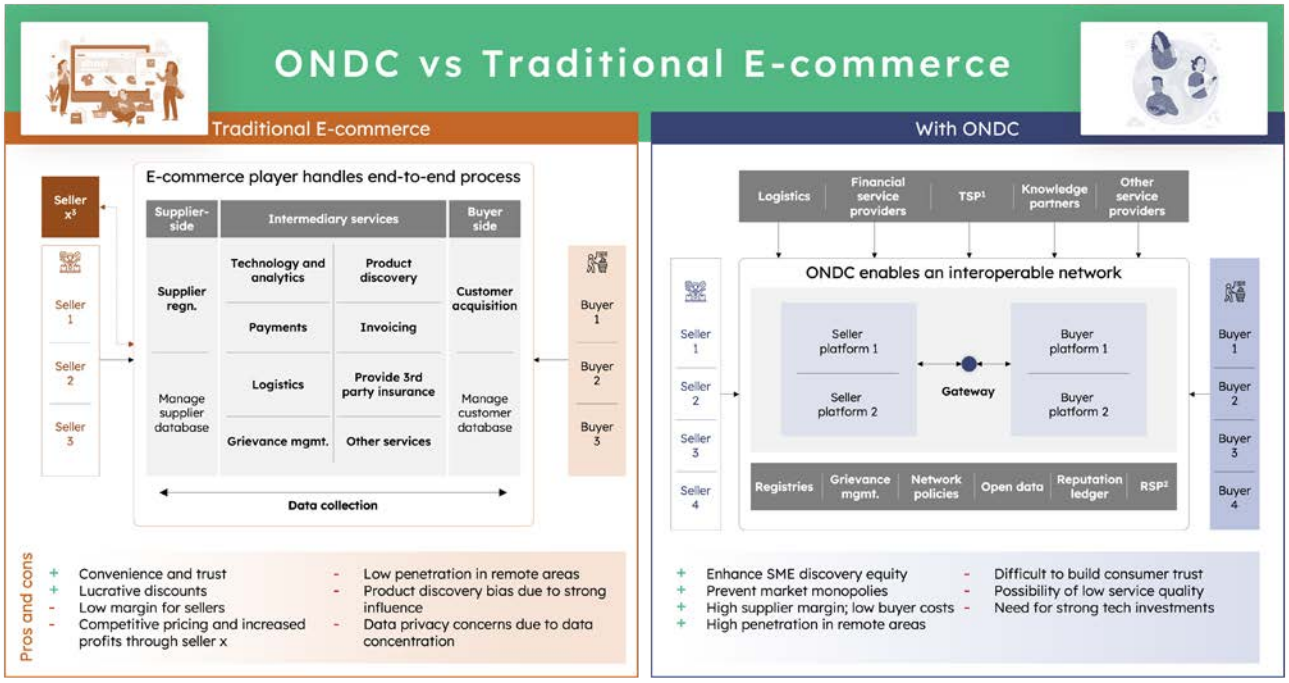
ONDC has gained significant traction since its inception, onboarding 150k+ merchants, touching 40k+ orders/ day and integrating big tech companies till now

Budding



Note: Data as of August 2023, sourced from government dashboards and news articles

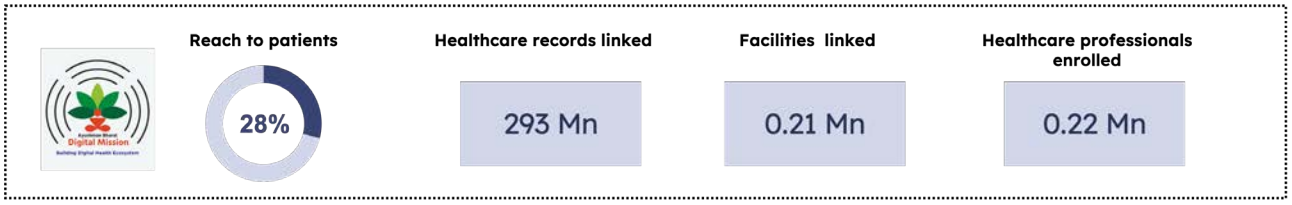
Source: Arthur D. Little, nasscom analysis



DPIs for healthcare

DPIs in healthcare aim to improve healthcare accessibility, enable better disease surveillance, and streamline administrative processes.

ABDM lays the groundwork for the digitization of Indian healthcare, reaching over 28% of population



[1] Technology Service Providers

[2] Reconciliation Service Providers

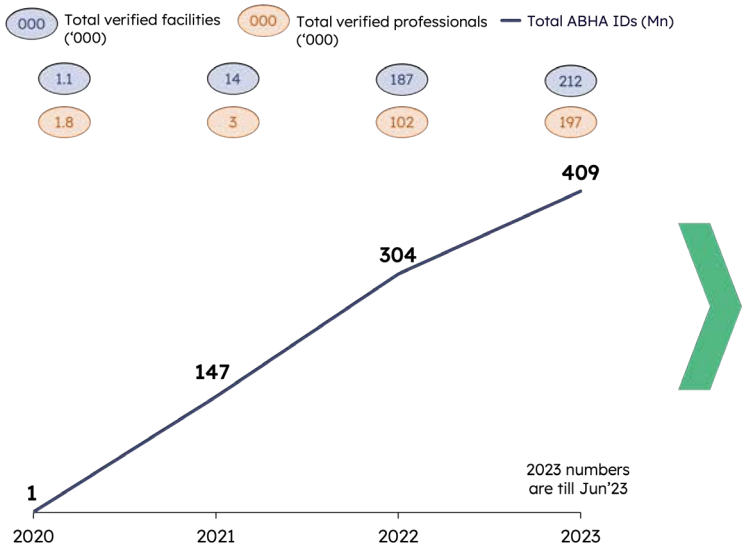
[3] Seller created by the e-commerce player based on purchase data to self-manufacture key products

Note: Data as of 13th August 2023, as sourced from government dashboards

Source: ADL, ONDC report, Arthur D. Little, nasscom analysis

Ayushman Bharat Digital Mission (ABDM) aims to develop the backbone necessary to support the integrated digital health infrastructure. The idea is to bridge the gap amongst different stakeholders in the healthcare ecosystem. With the existing infrastructure, one can digitally identify people, doctors, and healthcare facilities, facilitate electronic signatures, ensure non-repudiable contracts, make paperless payments, securely store digital records, and streamline healthcare information through digital management.

ABDM is the integrated digital health infrastructure, with growth of over 800X in ABHA IDs registered since 2020



Key Insights

- ABHA[1] ID is a unique 14 digit number that identifies the citizen's participation in India's digital healthcare ecosystem
- 800X growth in ABHA IDs, 109X growth in verified professionals registered in ABDM, and over 190X growth in facilities verified in ABDM since 2020
- ABDM aims to improve access to healthcare, reduce costs, and improve the overall quality of care
- This is aimed to make the healthcare ecosystem more efficient

ABDM has been adopted in the public sector, however its adoption amongst the private players is yet to scale

Budding

ADOPTION	UTILIZATION	PUBLIC SECTOR
28% penetration of ABHA IDs with more than 444 Mn ABHA IDs created	293 Mn health records linked to ABHA ~10 Mn records linked per month	~74% of the HFR registrations are from the public sector
22% penetration of HFR with more than 2 lakh registrations	~37000 tokens generated daily for 'Scan and Share' >100% growth in 3 months	~85% of the HPR registrations are from the public sector
7% penetration of HPR with more than 2 lakh registrations	80000+ HWCs digitalized for eSanjeevani	~100% of the 'Scan and Share' tokens are gen. in the public sector

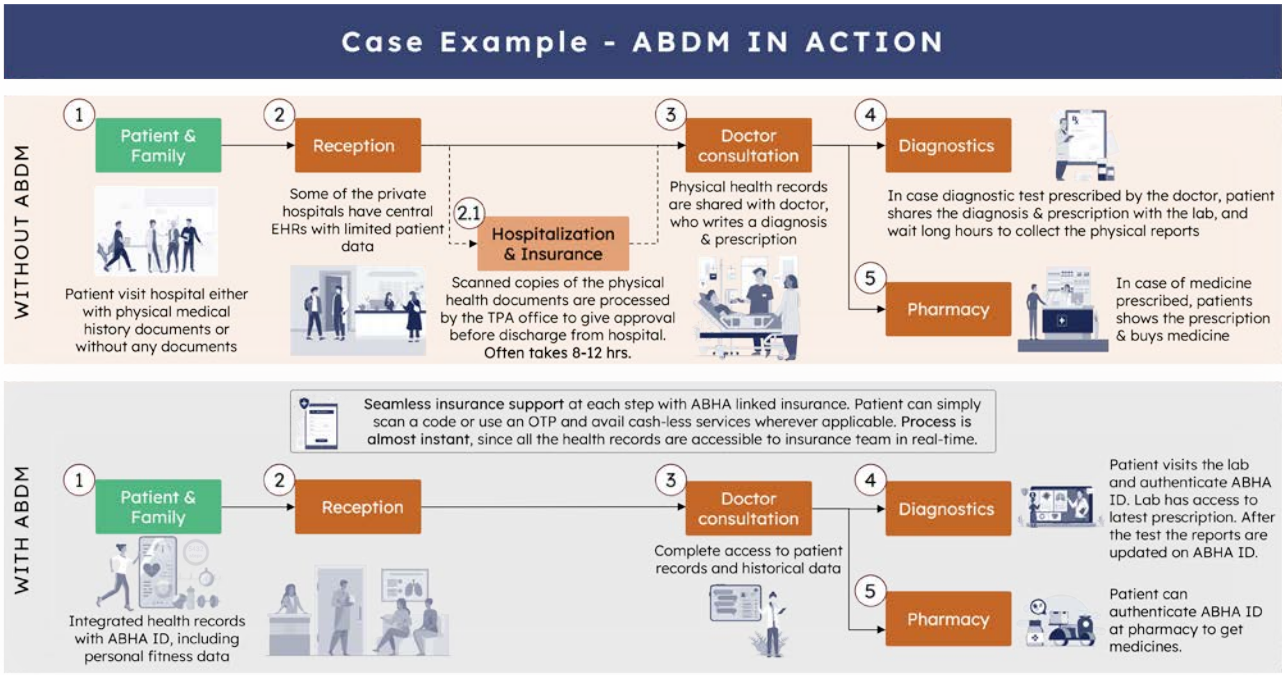
GOVERNMENT INITIATIVES TO PROMOTE ABDM INTEGRATION

Multi-platform ABHA creation: Including on COWIN, PMJAY, BIS	DHIS: Offers monetary incentives for record-linking	HCX platform: Single window for all insurance claims processing

[1] Ayushman Bharat Health Account

Note: Data as of 14th August 2023, as sourced from government dashboards

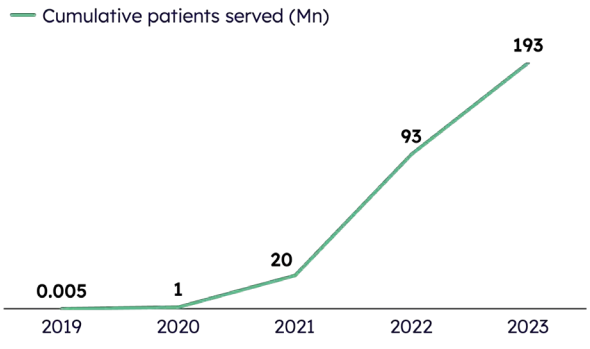
Source: dashboard.abdm.gov.in/abdm, ADL, ONDC report, Arthur D. Little, nasscom analysis



eSanjeevani provides access to medical professionals for the citizens located even in the remotest part of the country, providing direct & assisted tele-consultation. This is a step towards digital health equity to achieve Universal Health Coverage (UHC). This service is cloud based, ABDM compliant and abides by the EHR guidelines of Ministry of Health and Family Welfare.

eSanjeevani: a platform of the healthcare stack leveraged by 73 Mn patients for doctor consultations

Budding



- E-Sanjeevani facilitates quick and easy access to doctors and medical specialists from a smartphone
- Quality health services can be availed remotely via eSanjeevani by visiting the nearest Ayushman Bharat Health & Wellness Centre.

Key Insights

- It accounts to 5% penetration in population
- Improved healthcare access for rural areas
- Reduced cost due to online consultation and no need for travel for patients
- Improved efficiency of healthcare system and utilization of doctors

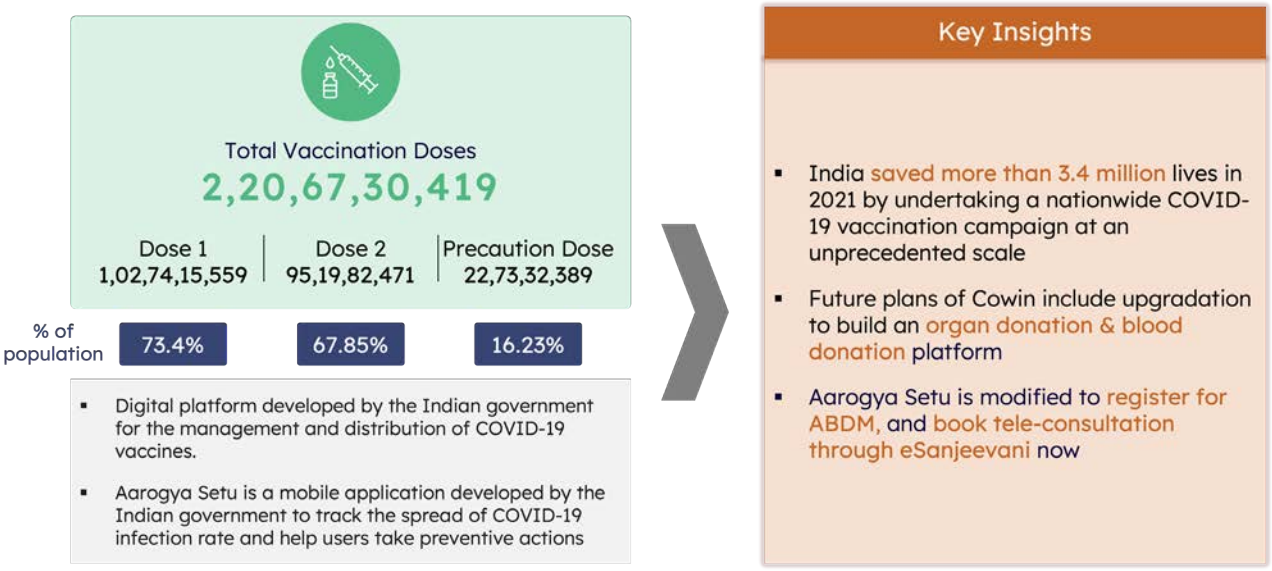
CoWIN has revolutionized vaccine registration, scheduling, and monitoring, ensuring efficient distribution and data-driven decision-making. It is estimated that it saved more than 3.4 million lives in 2021, by undertaking a nationwide COVID-19 vaccination campaign at an unprecedented scale covering 1.4 bn citizens.

Note: Data as of 13th August 2023, as sourced from government dashboards

Source: esanjeevani.mohfw.gov.in/#/about, Arthur D. Little, nasscom analysis

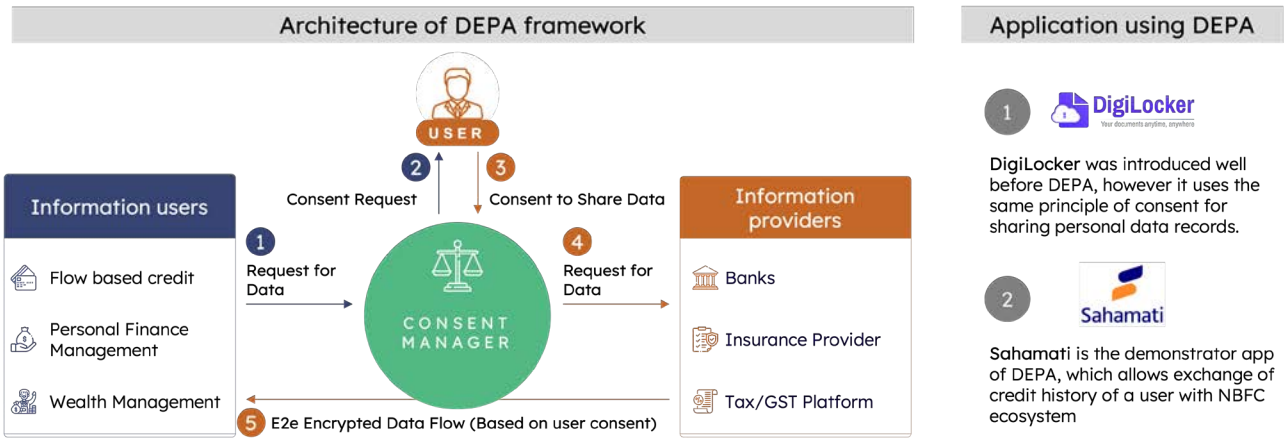
CoWIN & Aarogya Setu facilitated the rapid vaccination drive for ~1.4 Bn citizens of the country

Budding



Data Empowerment and Protection Architecture (DEPA) empowers citizens to seamlessly and securely access their data and share it with third party institutions. It creates a digital framework that allows users to share their data on their own terms through a third-party entity, who are known as Consent Managers.

DEPA framework (Data Empowerment and Protection Architecture) governs the consent- based data sharing between multiple stakeholders



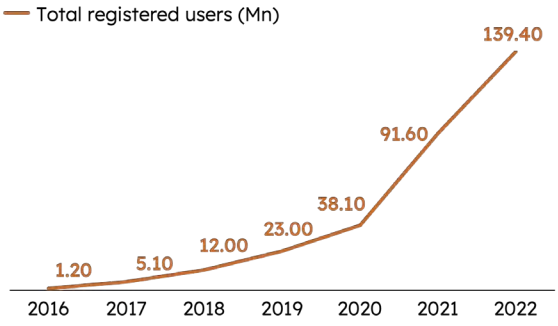
DigiLocker aims at 'Digital Empowerment' of citizens by providing access to authentic digital documents to their digital document wallet. This DPI serves, built on DEPA, federates data records issued by government entities and allows users to securely store and share their documents as needed.

Note: Data as of 13th August 2023, as sourced from government dashboards

Source: dashboard.cowin.gov.in/, The Lancet, Arthur D. Little, nasscom analysis

With 157 Mn total registered users, DigiLocker penetration is ~11% of the TAM

Budding



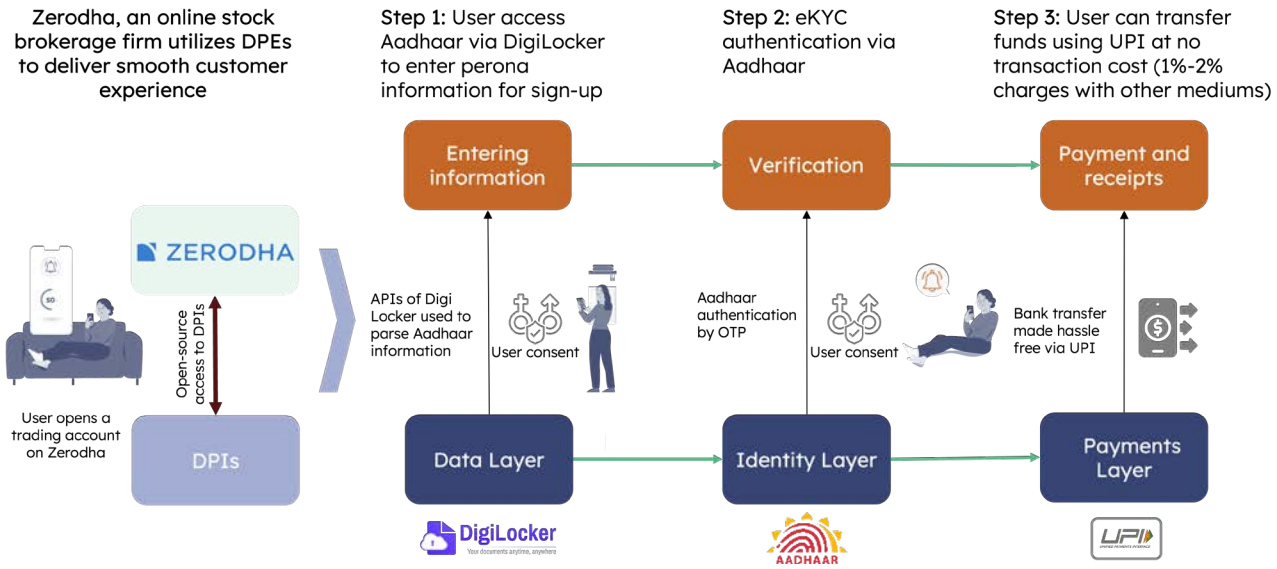
- The vision of DigiLocker is to create a digital twin of the traditional paper-based document ecosystem
- DigiLocker serves as a user-centric platform where entities such as loan providers, educational institutions, and others can access and utilize the data stored in the system

Key Insights

- 7.7X growth in registered users from 2018-2022
- It has reached ~11% penetration in the Total addressable market
- It has the potential to integrate data from multiple state-level and central-level authorities and aggregates them into a central repository

6.16	1684	182
Documents issued (Bn)	*Issuers*	*Requestors*

Case example - ZERODHA LEVERAGING, AADHAAR EKYC, UPI AND DigiLocker



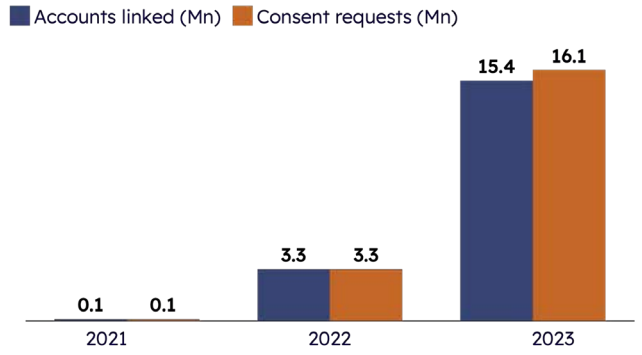
Sahamati, built on DEPA, is powering harmonious adoption of the Account Aggregator framework to create better value and innovative services for every Indian through secure exchange of financial data, between financial institutions like banks, insurance agencies, or mutual fund companies with the consent manager.

Note: Data as of 13th August 2023, as sourced from government dashboards

Source: DigiLocker.gov.in, Arthur D. Little, nasscom analysis

Sahamati is powering simple and secure exchange of user data between financial institutions – doubling the number of linked accounts within the last year

Budding

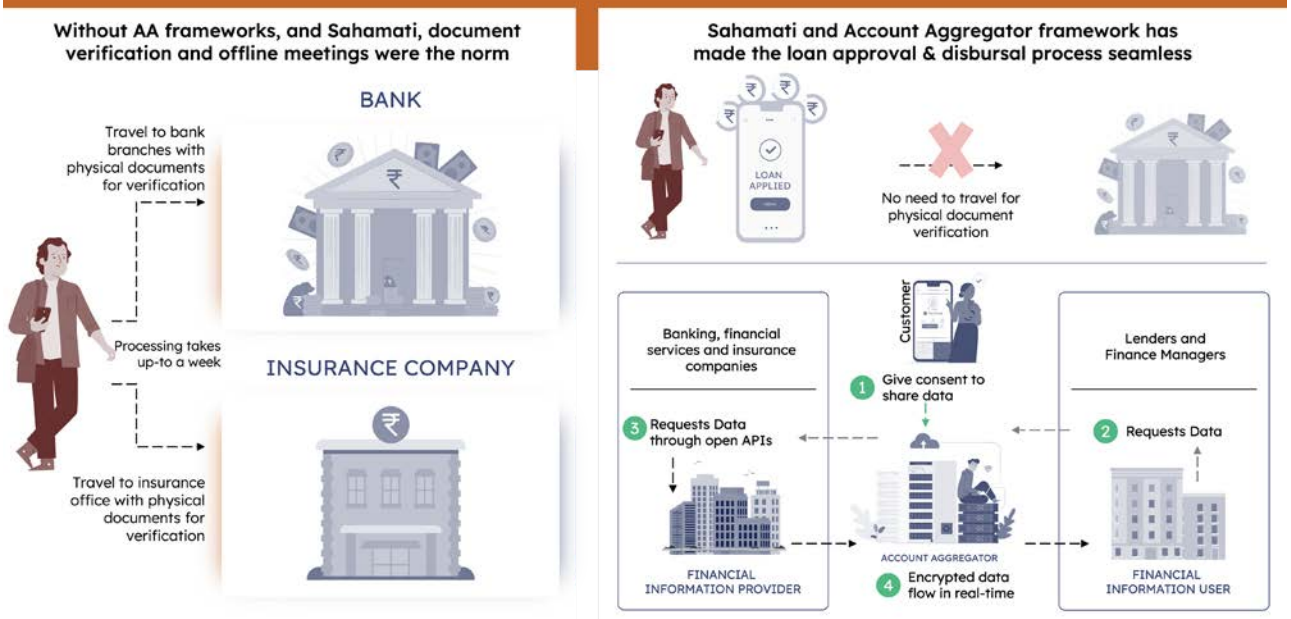


- Sahamati, an account aggregator, is powering harmonious adoption of simple and secure exchange of user data between financial institutions

Key Insights

- The number of linked accounts doubled in the last year, whereas the number of consent requests has tripled
- Allowed financial inclusion, as more banking related services can be pitched to customers
- Sharing of data between financial institutions has become seamless

Case example -SAHAMATI IN ACTION



DPIs for education sector

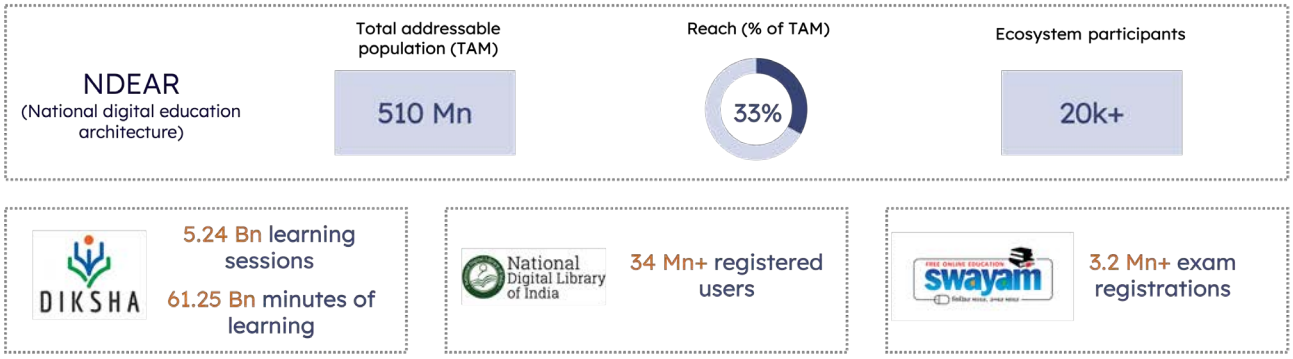
National Digital Education Architecture (NDEAR) lays down a set of guiding principles and building blocks to enable the creation of digital technology-based applications pertaining to education and aims to achieve the goals laid out by National Education Policy (NEP) 2020. It seeks to digitize every aspect of learning and provide a comprehensive learning methodology for the next generation of students.

Note: Data as of August 2023, as sourced from government dashboards

Source: Sahamati.org.in/aa-dashboard/, Arthur D. Little, nasscom analysis

NDEAR has the potential to disrupt the education of 510 Mn students

Budding



NDEAR ecosystem is the backbone infrastructure on which multiple platforms and services in the education sector are built

Budding

Adoption of NDEAR is in its early phase, with a potential to cater to ~500 million students across the nation

Budding

Note: 2022 data, as sourced from government dashboards, Arthur D. Little, nasscom analysis

Source: ndear.gov.in/, Arthur D. Little, nasscom analysis

Digital Infrastructure for Knowledge Sharing (DIKSHA) serves as a National Digital Infrastructure for Teachers. Diksha portal enables, accelerates, and amplifies solutions in the realm of teacher education. It aids teachers to learn and train themselves using available assessment resources.

Diksha offers a stack of services covering each leg of education value, from digitizing textbooks, to preparing mock quizzes, collaboration tools etc.

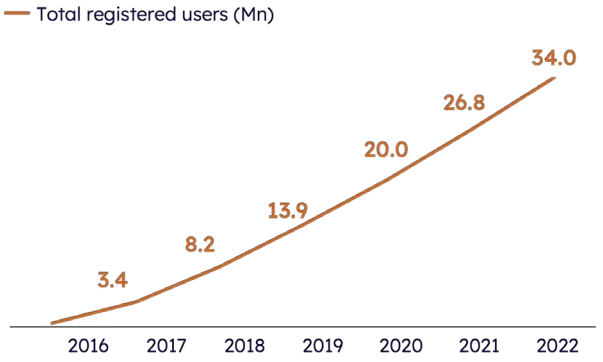
Budding

- Enhanced teacher training and improved accessibility and quality of educational resources more for students and learners across the country

National Digital Library (NDL) is a virtual repository of learning resources and provides a host of services for the learner community. It offers open access of learning resources for graduates, postgraduates, competitive exams, home study etc. The content includes books, research articles, texts, presentations, videos, images, simulations, animations, supplementing the traditional text-book based methodology.

National Digital Library is aimed to revolutionize the traditional text-book based teaching methodologies, reaching over 34 Mn users

Budding



- Provides open access of learning resources for graduates, postgraduates, competitive exams, home study etc.
- Content include books, research articles, texts, presentations, videos, images, simulations, animations supplementing the traditional text-book based methodology

Key Insights

- 68X growth in total registered users from 2016-22
- The target population for National Digital Library is huge with ~500 Mn potential students who can utilize this service
- With 34 Mn subscribers, it is reaching to only 7% of the target audience
- The penetration can be increased by running awareness event at public and private educational institutes

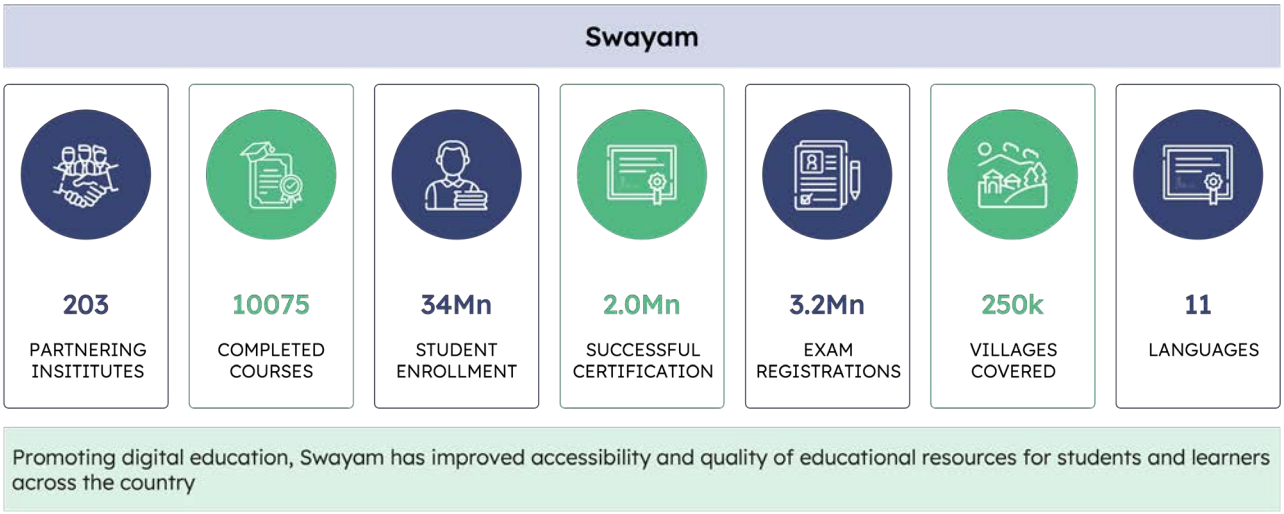
Note: Data as of August 2023, as sourced from government dashboards

Source: diksha.gov.in, National Digital Library, Arthur D. Little, nasscom analysis

Study Webs of Active Learning for Young Aspiring Minds (Swayam) is an education platform that aims to empower students, teachers, and institutes in developing curriculum and providing learning material, taught in classrooms from Class 9 till post-graduation. Promoting digital education, Swayam has improved accessibility and quality of educational resources for students and learners across the country.

Swayam is an education platform that empowers students, teachers & institutes in developing curriculum and providing learning material, reaching over 34 Mn students

Budding

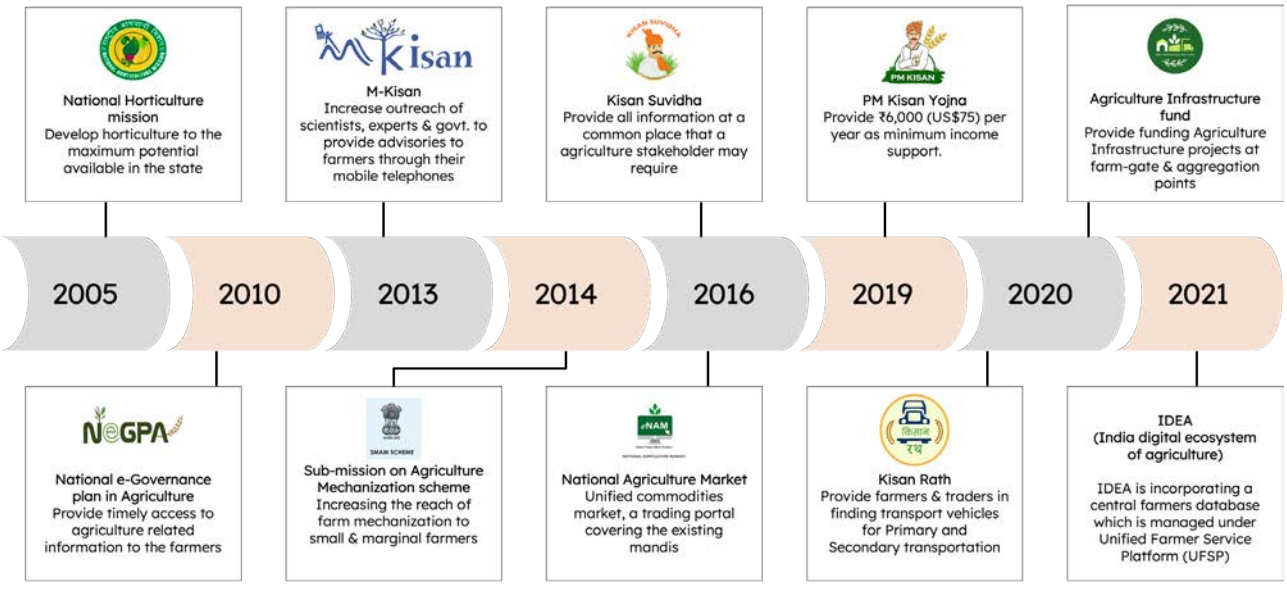


DPIs for Agriculture sector

India has been proactive in using digital technologies to deliver the relevant agriculture related services and subsidies to the farmers. In 2005, National Horticulture Mission (NHM) was launched to maximize the horticulture potential of the country. Several schemes, and mandates have been implemented by the government, before culminating into a formal DPI for this sector in 2021, named **IDEA – India Digital Ecosystem for Agriculture.**

India's agriculture ecosystem is witnessing a gradual increase in the number of DPIs, with IDEA being the latest addition

Others

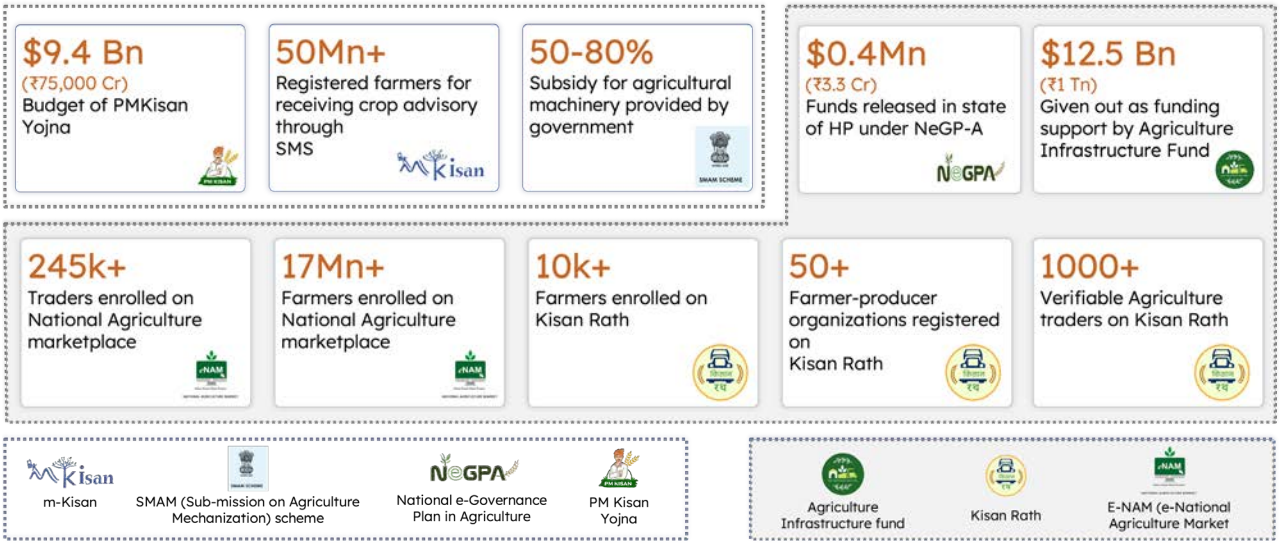


Note: Data as of August 2023, as sourced from government dashboards

Source: swayam.gov.in, AICTE, Arthur D. Little, nasscom analysis

For agriculture ecosystem, digital initiatives & government schemes are creating a huge impact

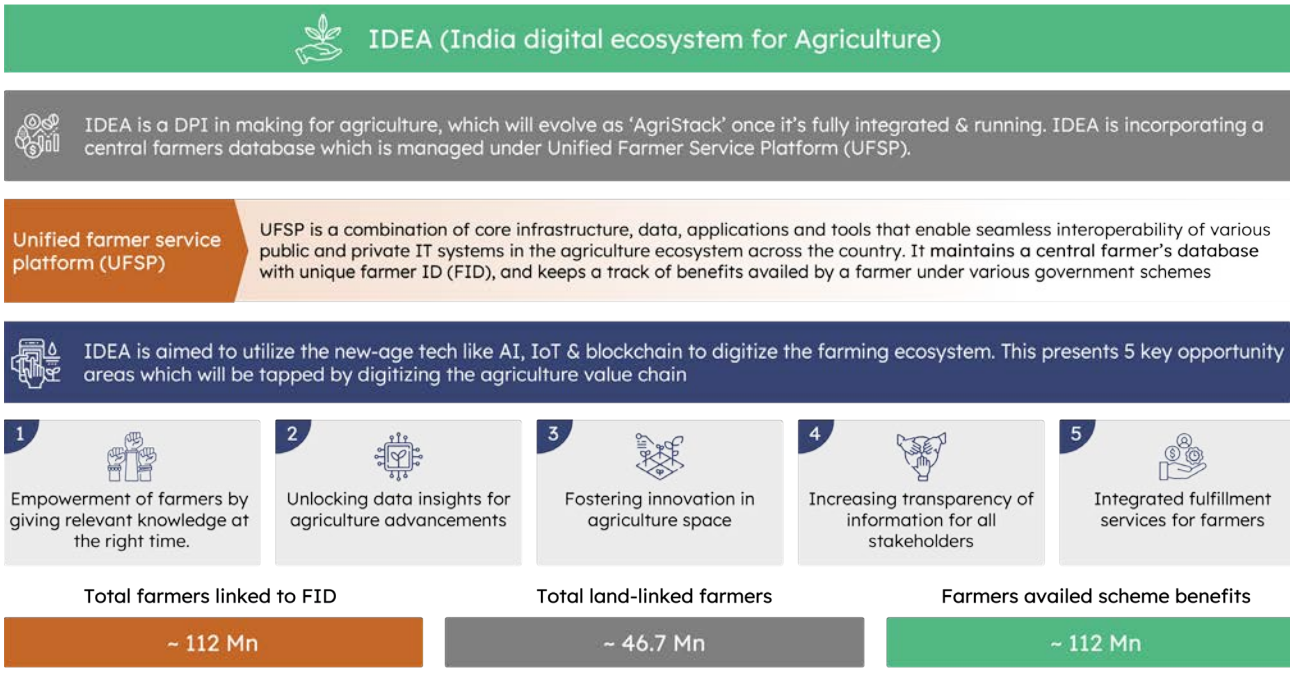
Others



India Digital Ecosystem for Agriculture (IDEA) - The adoption of IDEA has already begun with the Unified Farmer Service Platform (UFSP), which aims to create a central database of farmers, lands, and the farm output on each piece of land. Once the farmers are onboarded and are connected to the system, it will solve for each problem faced by the farmers methodically using new platforms, and policy changes.

AgriStack DPI, 'IDEA' is in initial phases of implementation – unique farmers' ID is at the forefront

Others



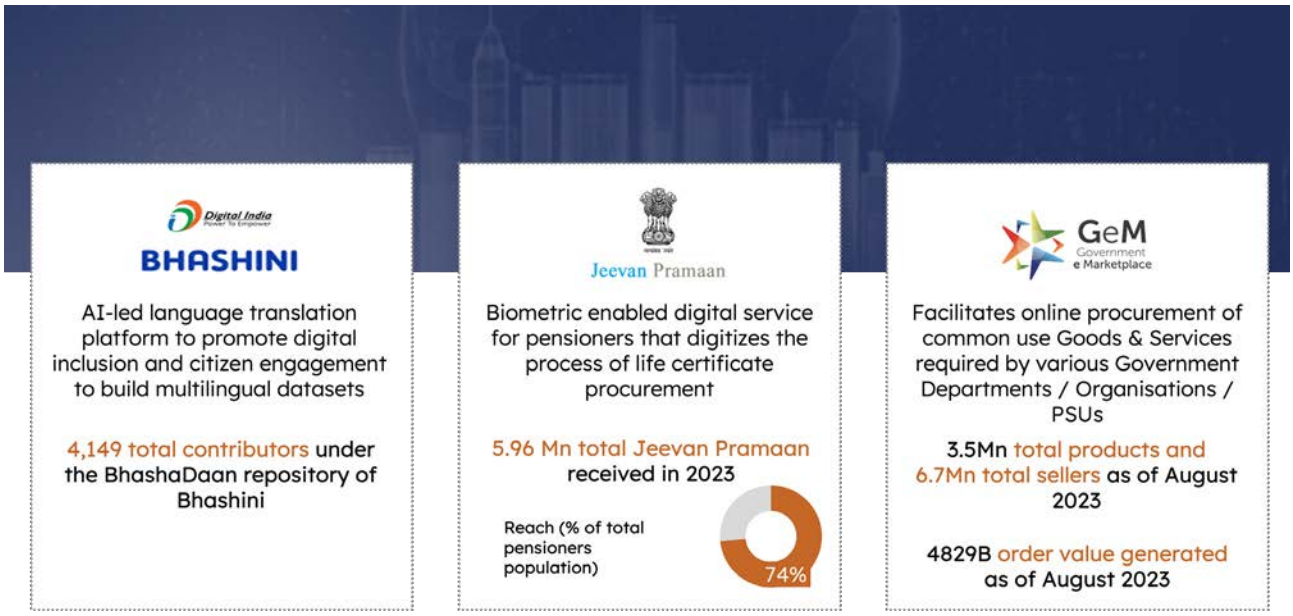
Note: Data sourced from government dashboards as of 13th August, 2023

Source: kisan.gov.in, Arthur D. Little, nasscom analysis

Other nascent DPIs

Other DPIs in India such as Bhashini and GeM also showcase lot of potential to grow into scalable solutions

Others



Some of the services that are yet to scale but expected to create larger impact in the future

Others

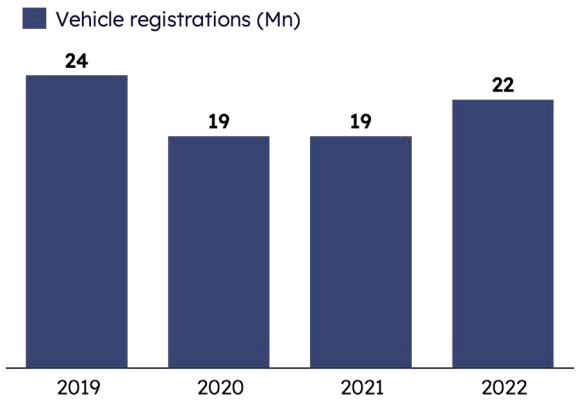
mParivahan aims to automate all vehicle registration and driving license related activities in transport authorities of the country, with introduction of smart card technology to handle issues like inter-state transport vehicle movement and to create state and national level registers of vehicles/DL information. It is a digital medium to interact with all stakeholders and provides services related, but not limited to, licenses, vehicle services, manufacturer services etc.

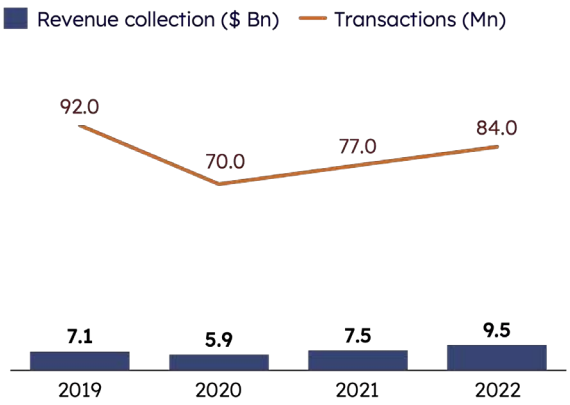
Note: Data sourced from government dashboards as of 13th August, 2023

Source: swayam.gov.in, AICTE, Arthur D. Little, nasscom analysis

mParivahan witnessed 1.3X growth in revenues collected since 2019

Others





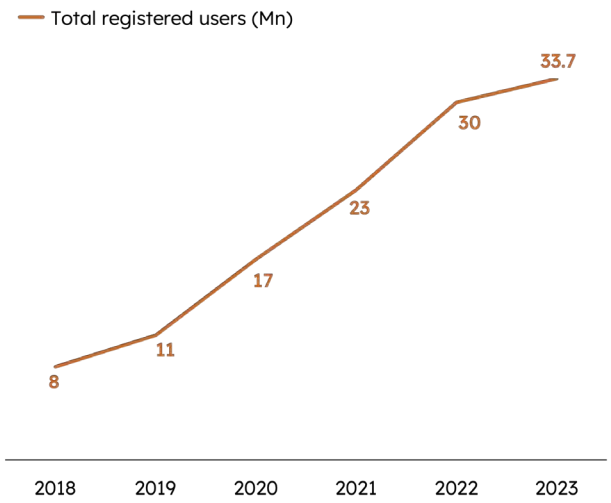
Key Insights

- mParivahan portal provides services for citizens, OEMs and third parties related to vehicles such as Driving License services, eChallan, vehicle scrapping etc.
- The dip in 2020 is due to Covid and slowed Auto market. As Auto market recovered in 2021 and 2022, there was a steady increase in the number of vehicle registrations and revenue collected.

myGOV is a citizen engagement platform which collaborates with government bodies and citizens for policy formulation and seeks the opinions of people on issues and welfare. Government uses this platform to disseminate information to citizens for various schemes and programs. myGov uses multiple methodologies like discussions, polls, surveys, blogs, on-ground activities, internet & mobile app, IVRS, for crowd sourcing ideas and discussing issues of citizens.

myGov witnessed ~4X growth in total registered users since 2018, reaching approx. 2% of the population

Others



Key Insights

- myGov offers a platform for collaboration with citizens for policy making and offers multiple government services
- With 33 Mn total subscribers, myGov is only reaching to ~2% of the population

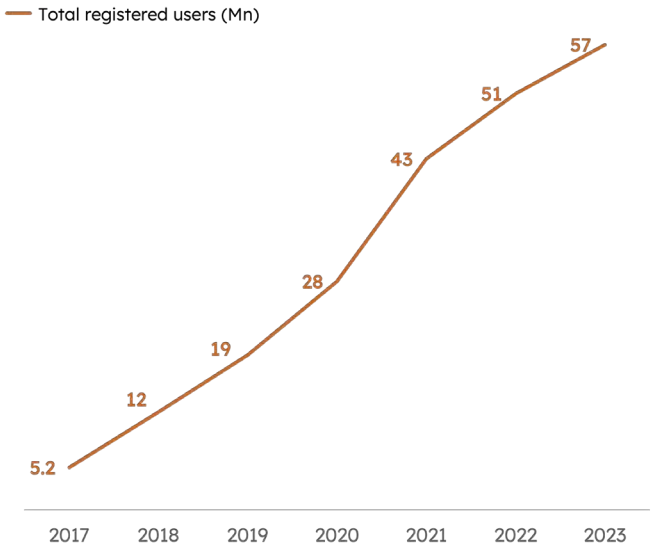
Unified Mobile Application for New-age Governance (UMANG) is a platform that aims to revolutionize citizen services by consolidating a wide range of government services into a single app. With its user-centric approach and focus on accessibility, UMANG empowers users to effortlessly access various services, ranging from healthcare to scholarships, in real-time.

Note: Data as of 13th August 2023, as sourced from government dashboards

Source: parivahan.gov.in/parivahan, mygov.in, Arthur D. Little, nasscom analysis

Transactions per user in UMANG platform has grown 7x since 2017

Others



Key Insights

- Umang app is a single platform for access to all government service, revolutionizing citizen services into a single app
- With 57 Mn registered users in 2022, Umang is accessed by 3.7% of the population.
- Transactions per user has gone 7x since 2017 when the service was launched. Direct result of expansion in service integration over the years.
- Umang can grow its adoption by integrating more government services

eGov foundation was founded in 2003, with the aim to digitize the government services across the country. .

eGov foundation, with its platforms DIGIT and DIVOC, aims to build public digital platforms, enable effective policy to formulation & build open ecosystems for government bodies

Others

1 Genesis of eGov: The eGov Foundation was founded in 2003 with the aim of digitizing citizen service delivery in India. It started with the development of a module for property tax collection and gradually expanded to build other modules for municipalities.

2 Scale and Impact: The goal of eGov was to digitize 2000+ cities by 2020 but achieving scale has been a challenge. However, they have successfully implemented solutions in cities like Delhi, Chennai and pan state implementations in AP, Punjab, Odisha, providing providing a unified experience for urban governance.

3 Introduction of DigiGov: To address scalability and customization challenges, eGov developed DIGIT, an open-source Digital Public Goods (DPG). DIGIT is built on cutting-edge technology, follows a microservices-based architecture, and allows for horizontal and vertical scalability.

4 Policy Engagement: The foundation actively engages in public policy discussions and advocated for the creation of shared digital infrastructure. Their efforts have led to the establishment of a Center for Digital Governance by the GoI, which aims to support the digitization of online governance across all Indian cities.

5

- 2 Bn+[1] citizens impacted
- 100 partners onboarded
- 40 solutions built

[1] eGov has operations in other countries as well

Note: Data sourced from government dashboards as of 13th August, 2023

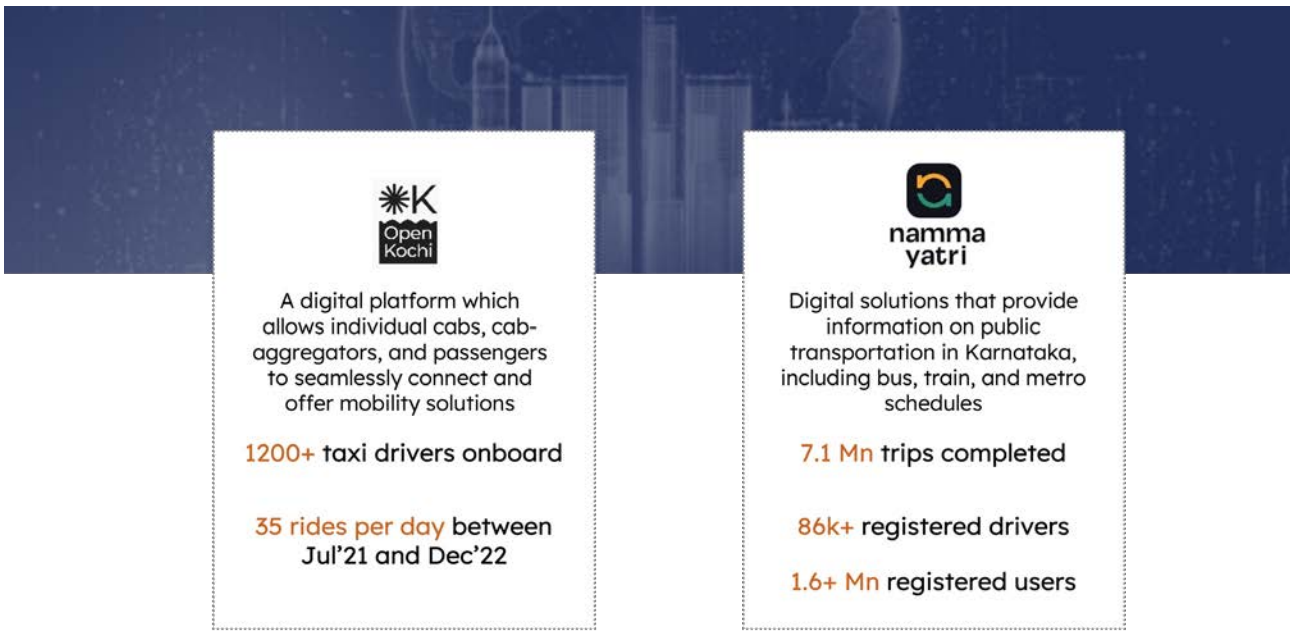
Source: web.umang.gov.in, Arthur D. Little, nasscom analysis

Select state level DPIs

In addition to the national level DPIs, various state governments and independent bodies have launched local digital entities aimed to solve regional problems.

Few DPIs focused on solving state level challenges have been tremendously successful making them ready to be scaled nationally

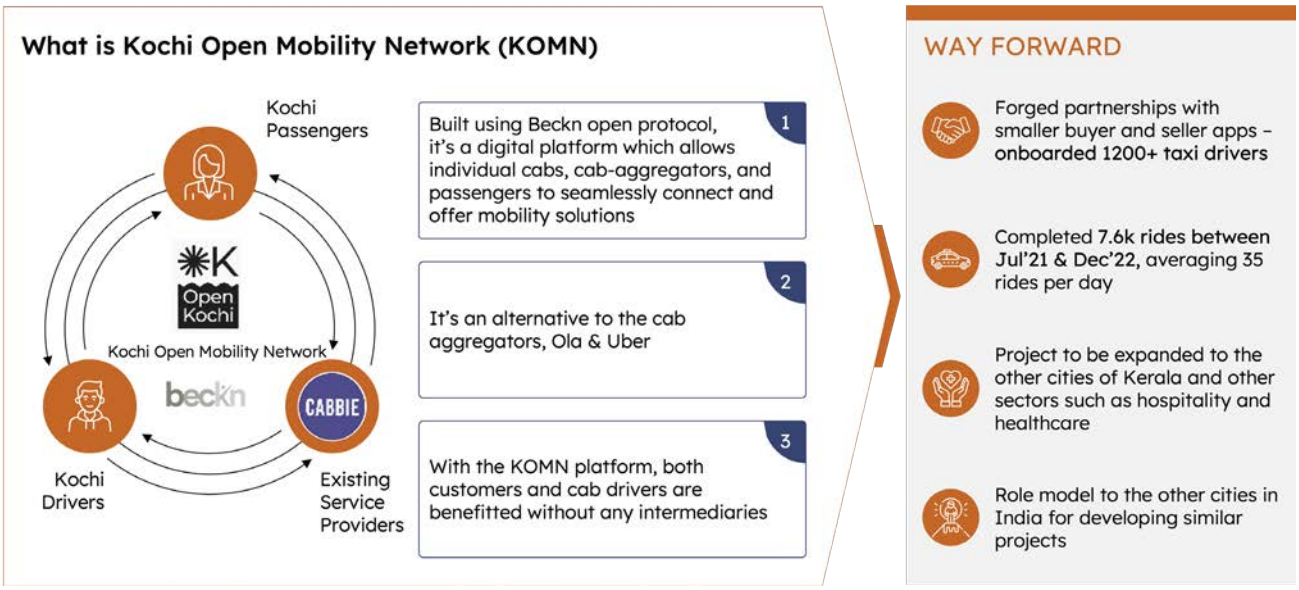
Others



Source: egov.org.in, nammayatri.in/open, Arthur D. Little, nasscom analysis

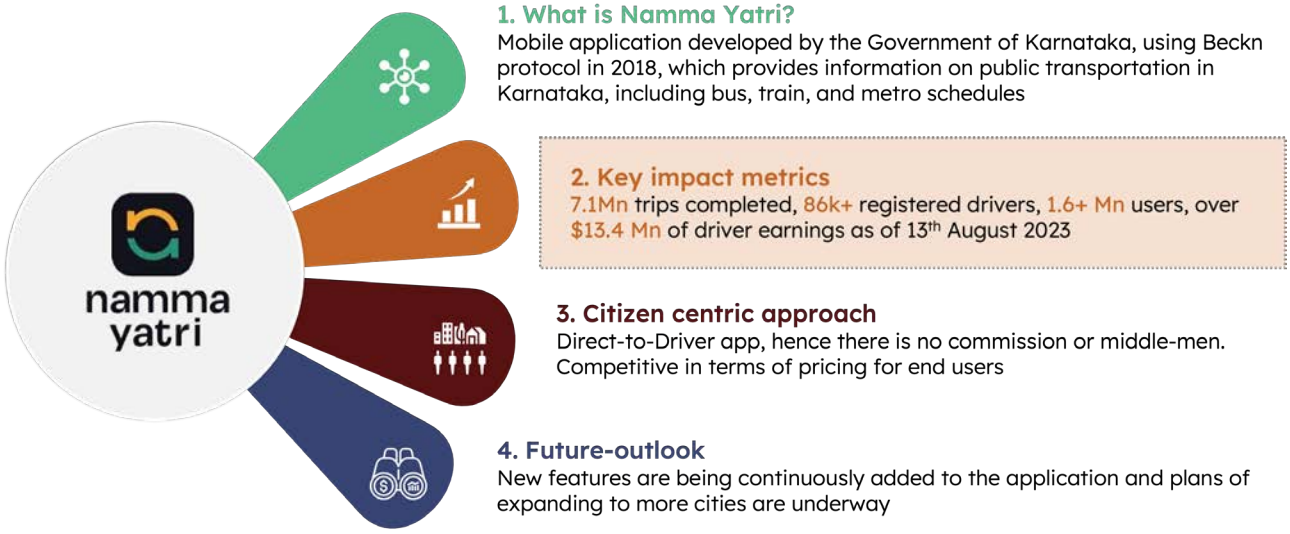
Kochi Open Mobility Network (KOMN) was launched by Kochi's Metropolitan Transport Authority in 2021 and drives the integration of urban transport across modes using technology. KOMN facilitates all mobility apps in the network to communicate with each other in the same language, offering open interoperable led integration approach. It brings taxi owners and riders on a single platform and entrusts the power back to the taxi owners and riders, delivering enhanced convenience to users.

Kochi Open Mobility Network (KOMN), a pioneering initiative launched by Kochi Metropolitan Transport Authority in July 2021, aims to decentralize cab aggregators



Tackling the same problem, Karnataka government launched Namma Yatri app, which is aimed to empower the auto drivers of Bangalore.

Namma Yatri simplified public transportation in Bengaluru, with easy access to information & decentralization of authority from private auto-aggregators



Source: openkochi.net, nammayatri.in/open, Arthur D. Little, nasscom analysis

Indian DPIs - Impact on India in 2022

Chapter #3

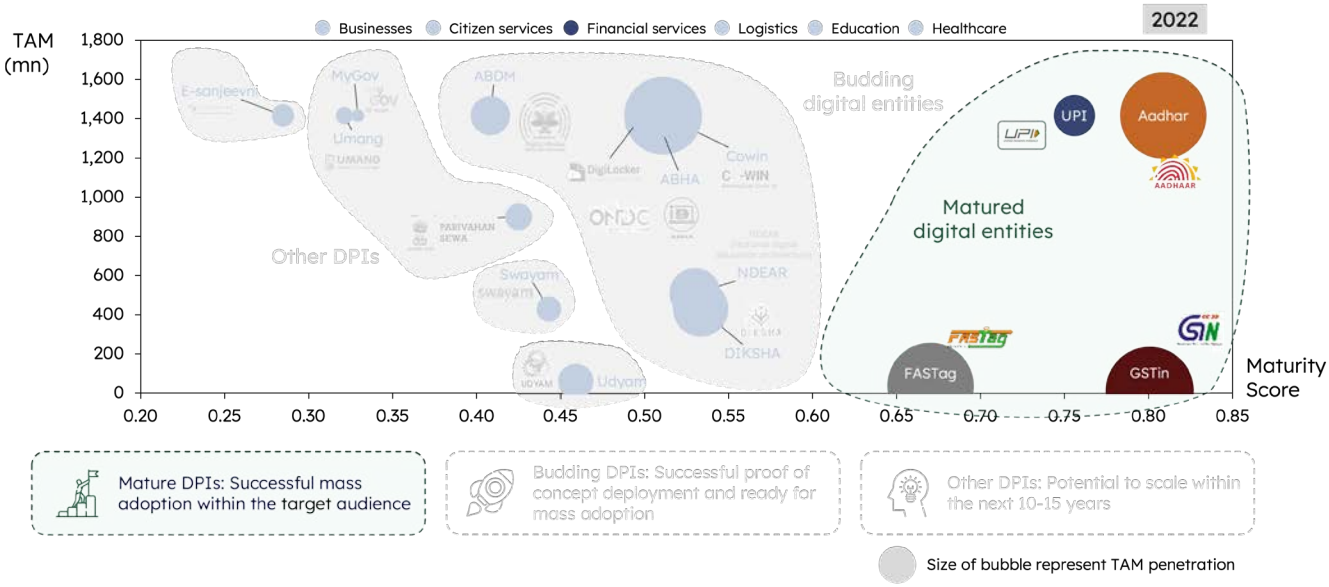
Indian DPIs - Impact on India in 2022

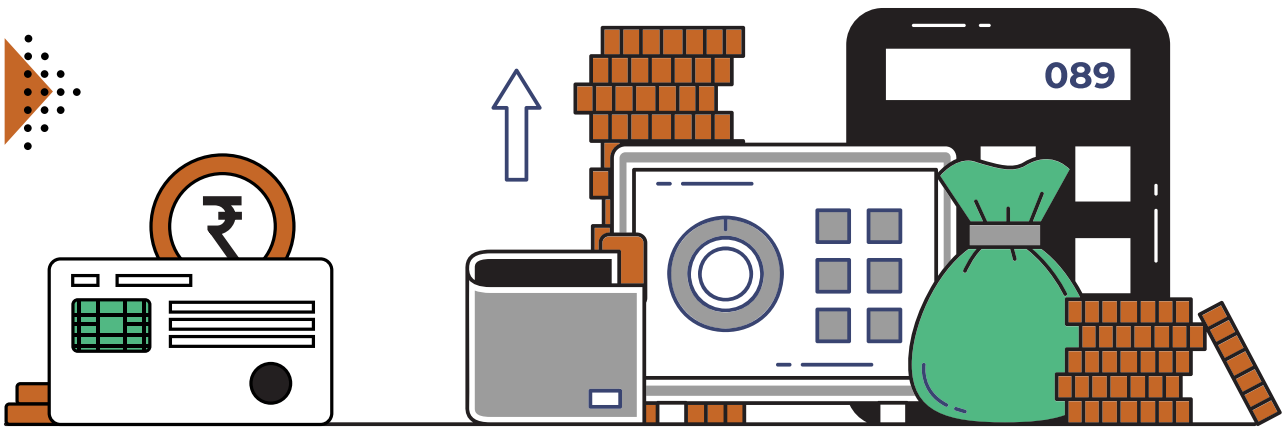
This chapter covers an analysis of the DPIs, evaluating the economic, social, ecological, time and cost savings through implementation of the DPIs.

The Arthur D. Little Maturity Framework segregates the digital entities into mature and budding DPIs based on their adoption. This serves as the premise for evaluating the economic impact by the DPIs.

DPI Maturity Framework*

Non-Exhaustive



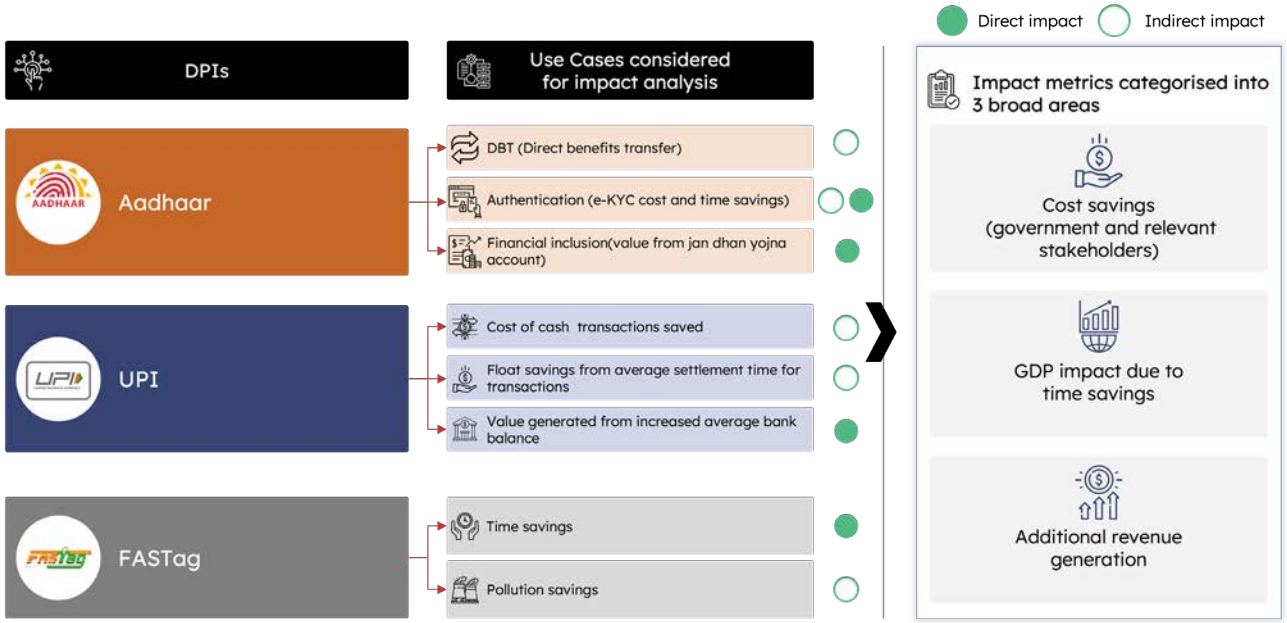


* Disclaimer - The maturity index is based on various assumptions

Source: Arthur D. Little, nasscom analysis

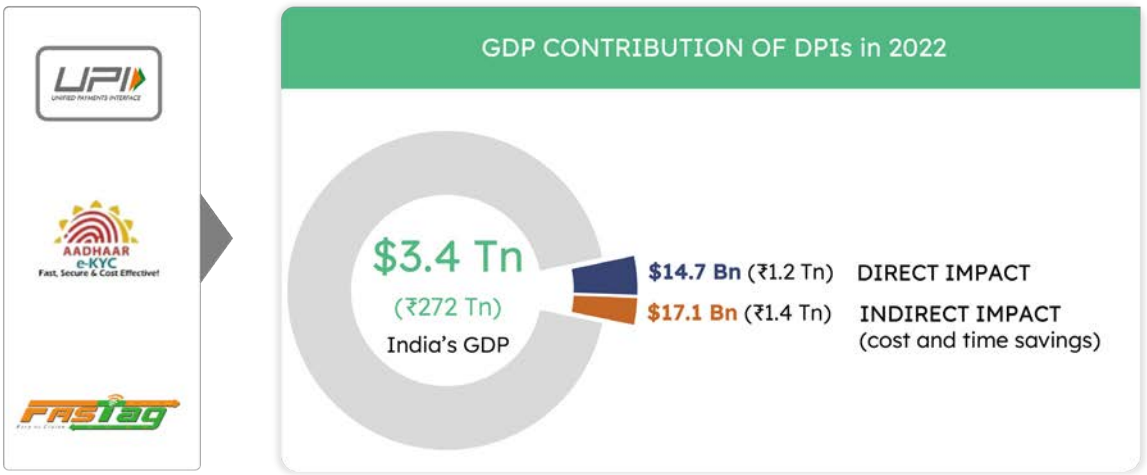
For an analysis of the economic impact, select mature DPIs - Aadhaar, UPI, and FASTag were considered. Also, the value add in the economic impact of a DPI includes all the platforms and services which are solely built on Aadhar and UPI. For e.g., between UPI and Aadhaar, the economic value add due to AePS is also accounted for.

Key use cases of digital entities adding value to the overall economy



Economic value add by DPIs

Our analysis indicates that matured DPIs have enabled value creation of $31.8 Bn, equivalent to 0.9% of India's GDP. The assessment includes direct as well as indirect impact created by these DPIs.

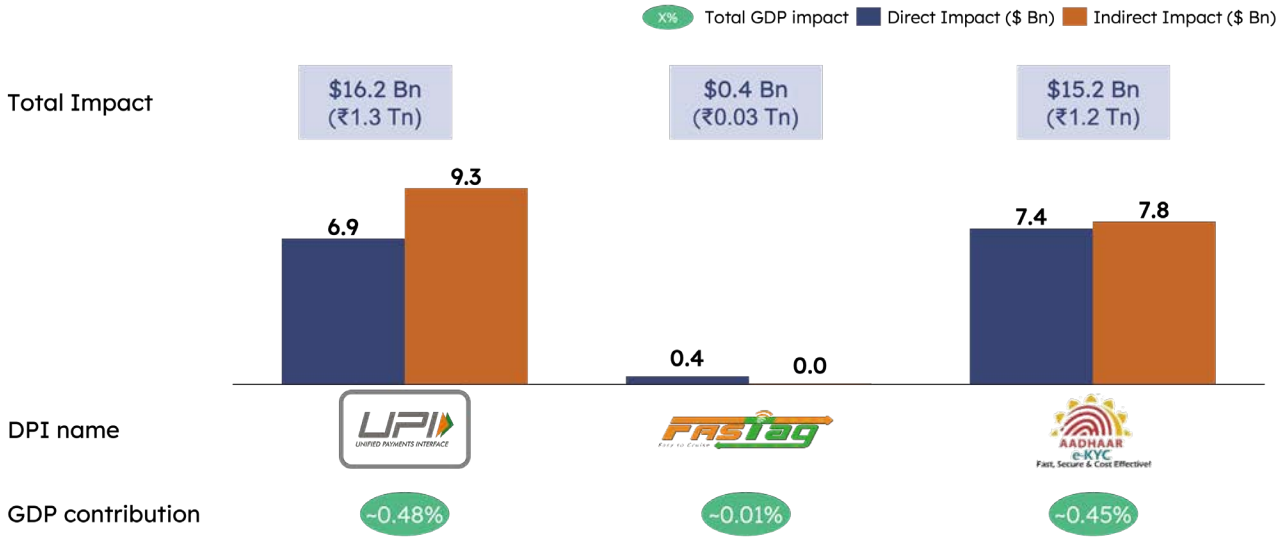


- **Direct impact** is a direct addition to GDP e.g., taxes collected
- **Indirect impact** results from parameters that affect GDP indirectly e.g., cost savings by government and households

Note: Economic value-add measured in $ Bn for 2022 based on the specific use cases. GDP of India for 2022 as per IMF, $3.4 Trillion

Source: Arthur D. Little, nasscom analysis

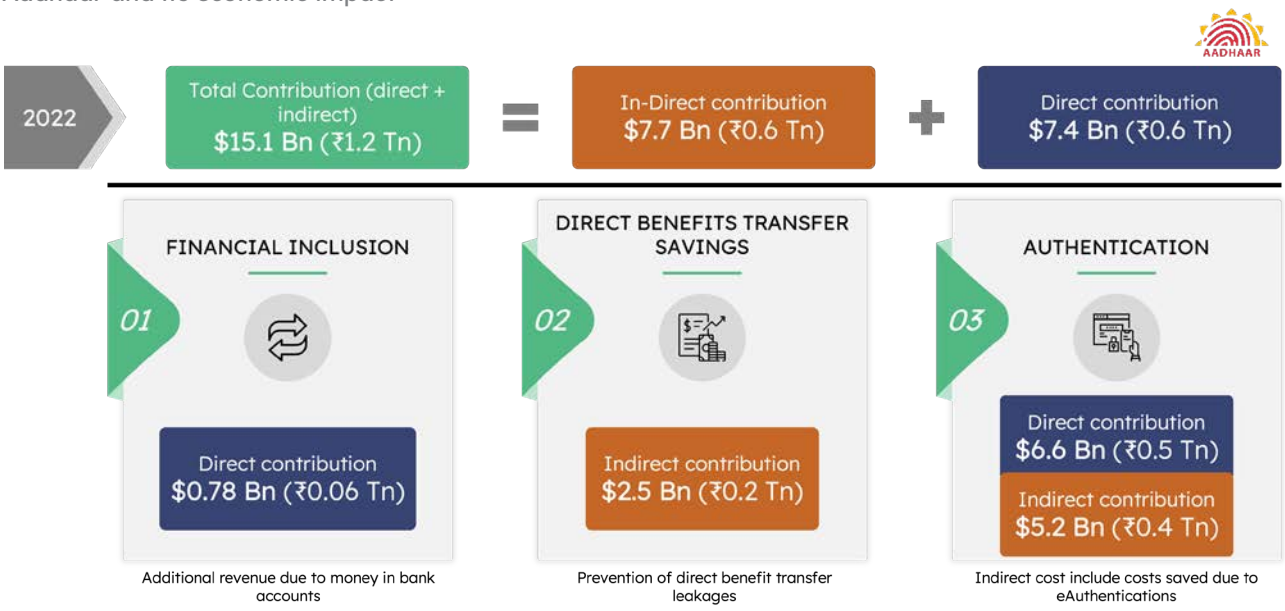
Direct impact includes direct value add to GDP like extra tax or toll collected. While the indirect impact translates to either cost savings, or time savings (opportunity cost).



Value addition to India's GDP by Aadhaar

Aadhaar plays a pivotal role as the foundational identity layer for multiple DPIs. The use cases for calculating Aadhaar's contribution to GDP includes additional revenue due to money in bank accounts (e.g., Jan Dhan Yojna accounts), direct benefit transfer savings due to prevention of leakages, and costs saved due to e-Authentications.

Aadhaar and its economic impact



Overall, Aadhaar has enabled economic value of $15.1 Bn, with the major contributor being direct benefits transfer leakages being eliminated.

Note: Economic value-add measured in $ Bn for 2022 based on the limited use cases.

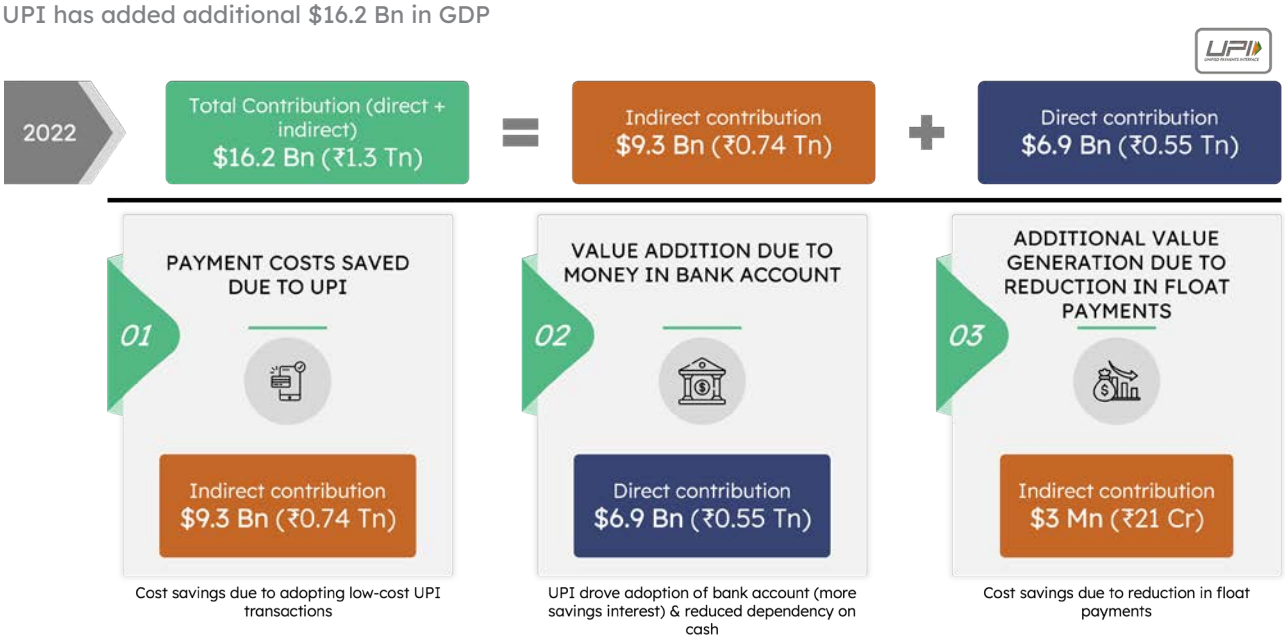
Financial data is shown as per respective financial year; Govt. collection includes additional tax revenue and household savings include cost saved due to no cascaded taxes

Source: Arthur D. Little, nasscom analysis

Value addition to India's GDP by UPI

UPI has replaced cash transactions as well as electronic transfers across sectors. Three use cases are identified for the analysis for value addition to GDP.

UPI has added additional $16.2 Bn in GDP



The use cases for calculating UPI's contribution to GDP include:

1. **Payment cost saved due to UPI:** While UPI is replacing cash based and electronic transactions, it saves on cash-handling expenses as well as the markups paid on electronic transfers. Presently, UPI does not charge anything from merchants or users for sending or accepting payments..

2. **Value addition due to extra interest earned from bank accounts:** As more retail transactions are conducted online with UPI, users' dependency on cash reduced. This resulted in extra interest earned on their bank accounts due to the just-in-time nature of these transactions.

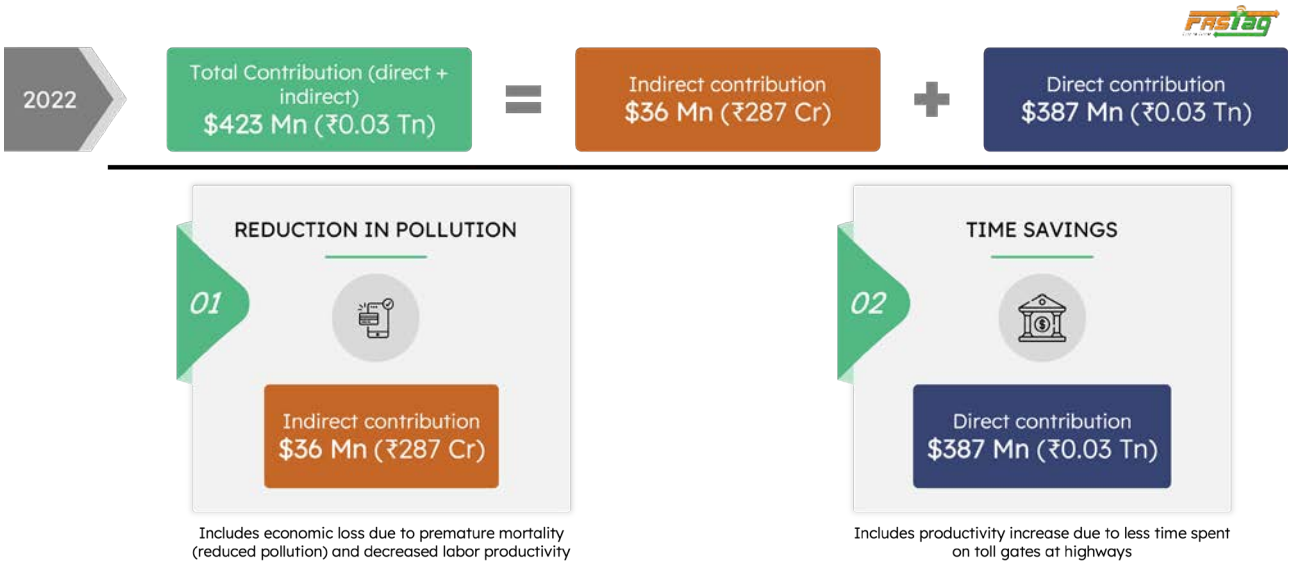
3. **Value addition due to reduction in float payments:** Electronic payments earlier used to take more than 1 day to reflect, which resulted in money staying in float accounts with the bank. With UPI, this transfer is immediate, hence users can earn extra interest.

Value addition to India's GDP by FASTag

FASTag, built on NPCI, enabled value creation of $423 Mn (₹0.03 Tn) to the GDP including direct and indirect impact. With FASTag, vehicles at the toll gate are spending less time paying for the toll, significantly reducing slow-moving congestion and pollution. The value add due to this is evaluated as indirect benefit. A direct contribution to GDP is the marginal increase in productivity of the users by saving waiting time at the toll.

Source: Arthur D. Little, nasscom analysis

FASTag, built on NPCI, has reduced waiting time at toll gates on National and state highways, added $423 Mn (₹0.03 Tn) to GDP



Non-economic value add of DPIs

Apart from economic value add, DPIs also contribute to financial benefits, ecological benefits and process efficiencies and convenience for the citizens. This section analyses the non-economic benefits qualitatively, highlighting the magnitude of impact created by matured and budding DPIs.

Financial inclusion

Aadhaar based authentications made it easy to open a bank account, leading to higher adoption of PMJDY (PM Jan Dhan Yojna), from 44% in 2014 to 77% of the population gaining access to bank accounts in 2023. As of 2nd August 2023 there were 497 Mn beneficiaries of PMJDY which helped government in the disbursal of $6.3 Bn.

Under Pradhan Mantri Jan Dhan Yojna, 497 Mn bank accounts were opened to integrate Aadhaar with the financial sector

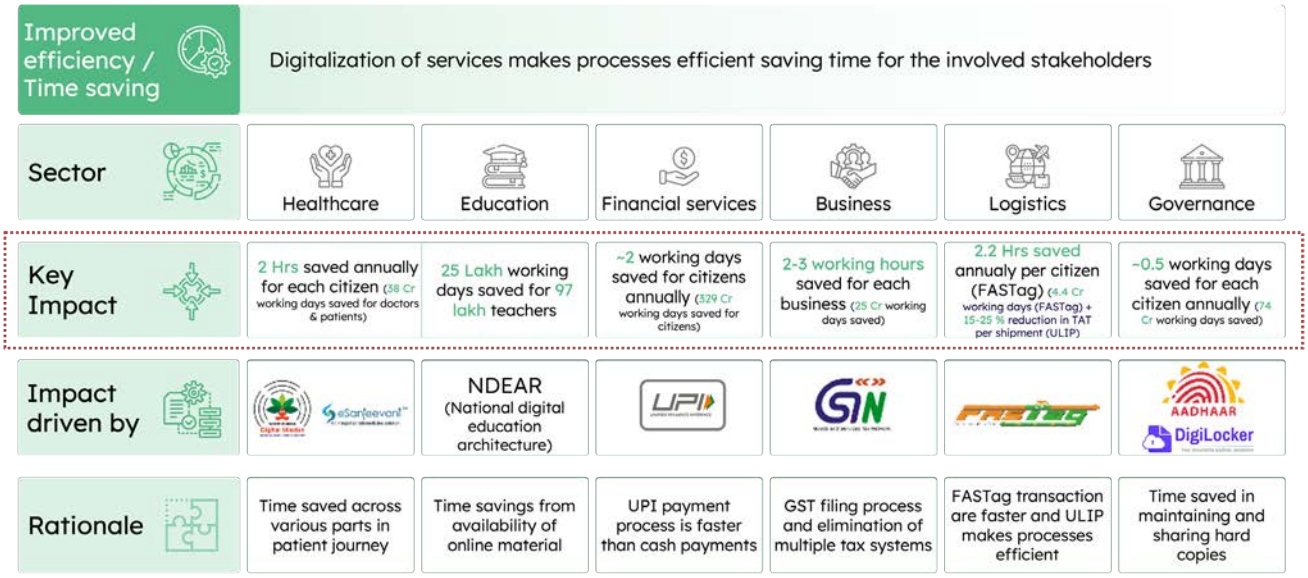
Financial inclusion	Includes accessibility of banking services which allows efficient transfer of government benefits	
Sector	Financial services	Governance
Key Impact	497 Mn beneficiaries of PMJDY *Data as on 2nd August 2023*	Govt. savings (FY22) in direct benefit transfer of $6.3 Bn (₹50,125 Cr)
Impact driven by	AADHAAR	AADHAAR, DigiLocker
Rationale	Value generated from PMJDY accounts	Savings from DBT (direct benefit transfer)

Source: Arthur D. Little, nasscom analysis

Time Savings

Time savings is the most versatile parameter, and every digital entity is aimed to save time for the citizens by changing the mode of delivery of these services. On an average, in 2022 every Indian citizen saved ~2 working days by using digital services.

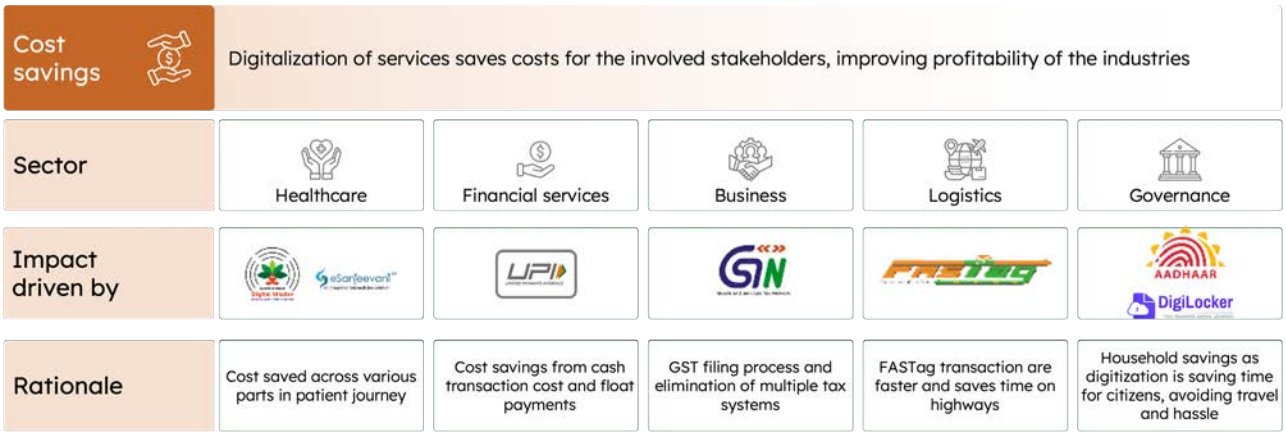
With the convenience of online service delivery, the country saved ~2 working days per citizen annually in 2022 across different industries



Cost Savings

Cost savings are a direct result of 'time saved', across different industries by reducing inefficiencies and making the processes faster.

Digital initiatives helped in reducing inefficiencies & eliminating leakages and increasing profitability – across different industries



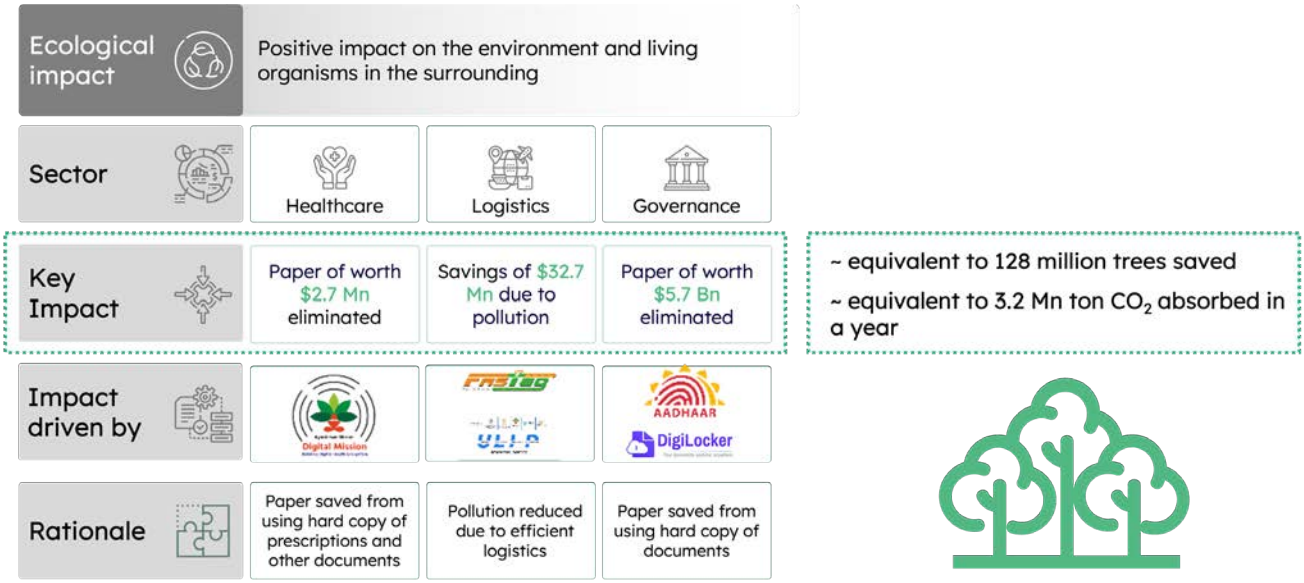
Note: TAT: Turn around time

Source: Arthur D. Little, nasscom analysis

Ecological Impact

One of the core impacts of DPI adoption includes ecological impact by way of paper savings and reduction in pollution. Every digitization has impact on an ecological impact, only a select digital entities (e.g., ABDM, FASTag, Digilocker and Aadhar) with highest impact are considered for evaluation.

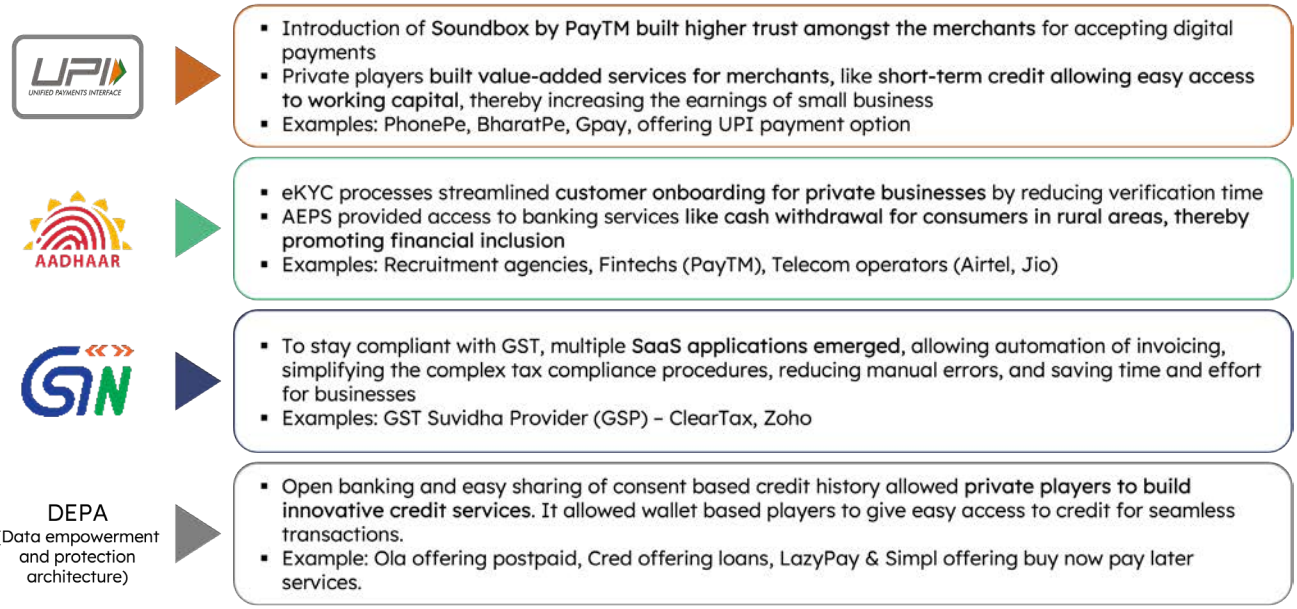
Time saved in logistics & transportation sector reduced carbon emissions by 3.2 Mn tonnes in 2022



Innovative business solutions

Adoption of DPIs have led to innovative and customized business models built by private and public entities, which enabled better services and solutions for the citizens.

Innovation in business models catalysed by DPIs



Source: Arthur D. Little, nasscom analysis

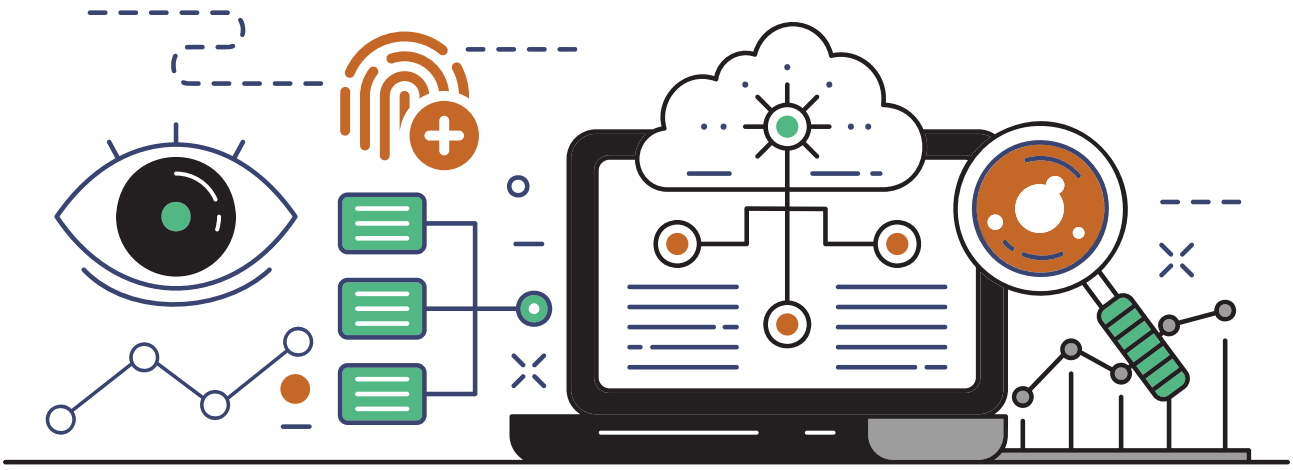
Solving for UN Sustainable Development Goals (SDGs)

India's digital framework has made it possible to address each of the SDGs and improve the lives of the citizens, both economically and socially.

DPIs also aim to fulfill core UN SDG goals through citizen centric solutions

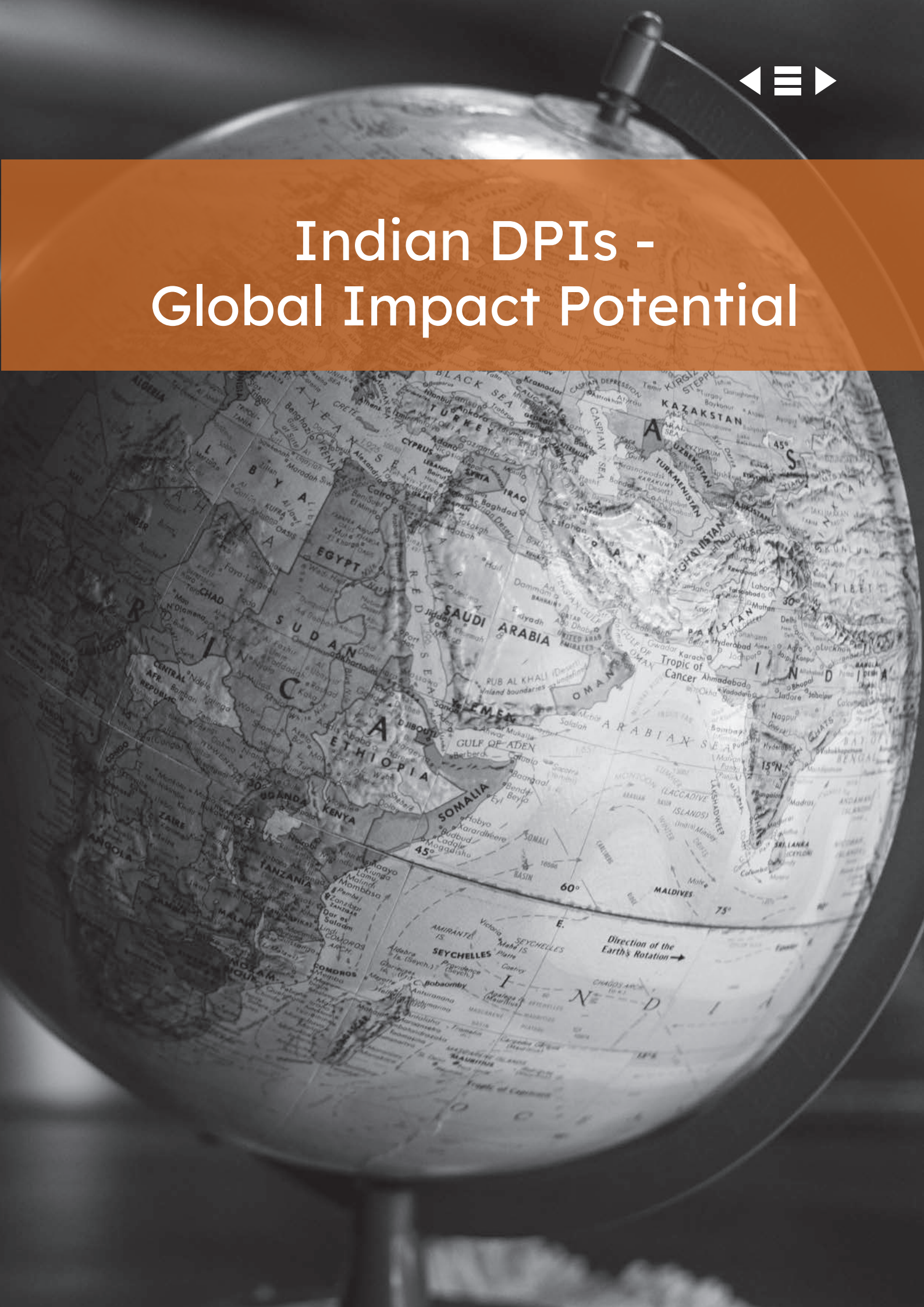
Key challenges	Sector	India's digital solution	SDG goals of UN
Financial and social inclusion for the citizens	Financial services	UPI, AEPS, NPCI, PMJDY	• No poverty • Zero hunger • Partnership for goals
Access to healthcare	Healthcare	ABDM, ABHA, e-Sanjeevni	• Good health and well being
Effective governance & delivery of government services	Governance	Aadhaar, DigiLocker, DIGIT	• Industry innovation and infrastructure • Reduced inequalities • Climate action • Gender equality • Peace justice and strong institutions
Access to education	Education	NDEAR, Diksha	• Quality education • Decent work and economic growth
Decentralization and inclusivity in commerce	Retail and E-commerce	ONDC	• Industry innovation and infrastructure • Decent work and economic growth

The digital solutions developed by India are by design open source, highly interoperable and customized. These solutions if implemented globally can help countries solve similar challenges and help improve lives of their citizens. This will also help countries align themselves with UN SDG goals.



Source: Arthur D. Little, nasscom analysis

Indian DPIs - Global Impact Potential



Chapter #4

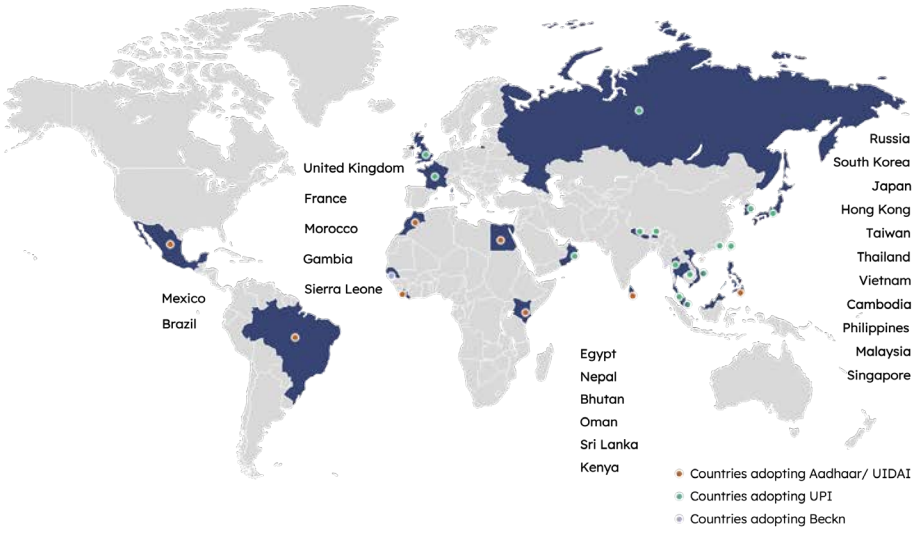
Indian DPIs - Global Impact Potential

Projected impact of adoption of Indian DPIs by select countries

Witnessing the success of DPIs such as Aadhar and UPI in India, countries across the globe are also adopting digital methods to solve for their local challenges. While some countries are adopting UPI and Aadhar, others are building digital solutions similar to them.

Presently, over 30 countries are either adopting or in early discussions to implement UPI, Aadhar, and Beckn in their respective countries for boosting social & financial inclusion.

~30 countries are adopting India's DPIs such as UPI, Aadhaar and Beckn for boosting social & financial inclusion



Philippines and Morocco implemented an Aadhaar-like system

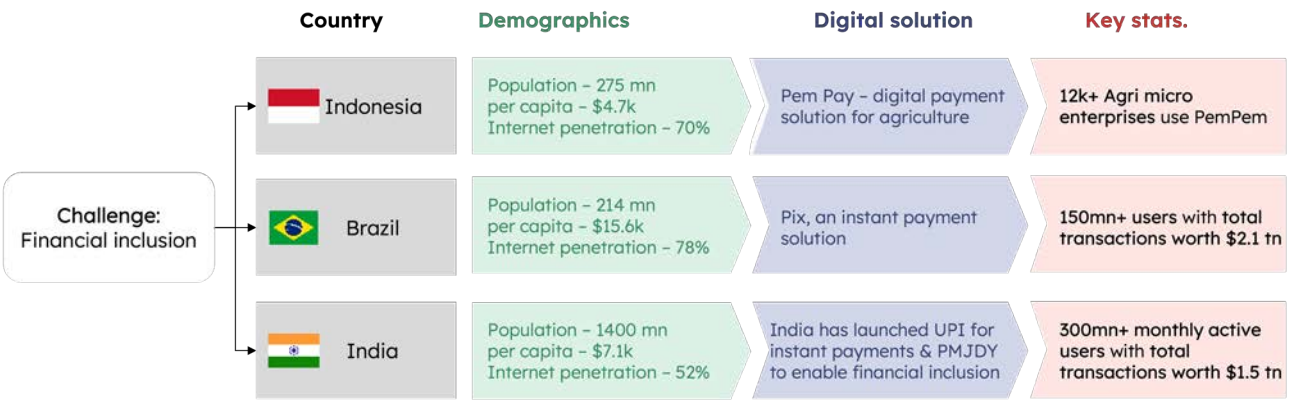
8 to 10 more countries (Kenya, Vietnam, Sri Lanka, Brazil, Mexico, Singapore, Sierra Leone, Gambia, and Egypt) in discussion phase

Over 30 countries have adopted / are in the process of adopting UPI

Source: Arthur D. Little, nasscom analysis

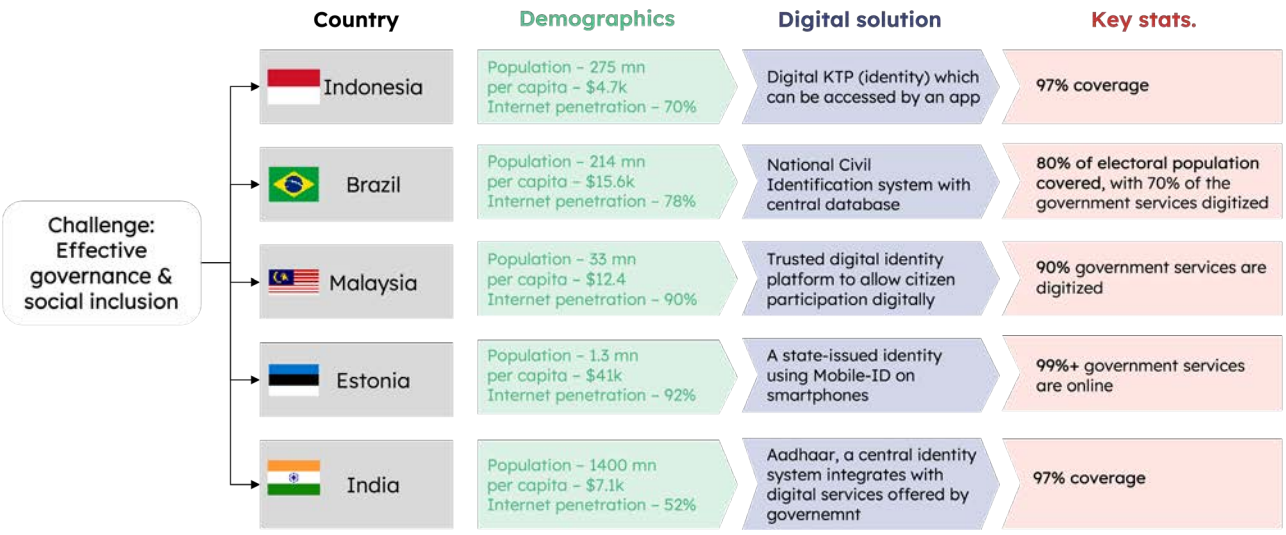
Similar to India, if successfully implemented, countries globally will also benefit from these digital infrastructures. The impact & economic value addition will depend on the challenges addressed by these. A digital solution in isolation may not solve the challenges faced by any country, a series of policy changes are often needed for maximum impact.

Comparison of countries solving for financial inclusion with similar solutions as UPI



For social inclusion, the population and demographics of the country plays an important role, for example for countries like Estonia (with small populations ~1.3 Mn & 90%+ internet penetration) a digital solution based on smartphones will work effectively. Whereas for countries like Brazil or Indonesia a totally different approach is needed.

Comparison of countries adopting digital governance & driving social inclusion



Source: Arthur D. Little, nasscom analysis

DPIs of India is designed to be interoperable and is open source, and it can be effortlessly replicated by other countries.

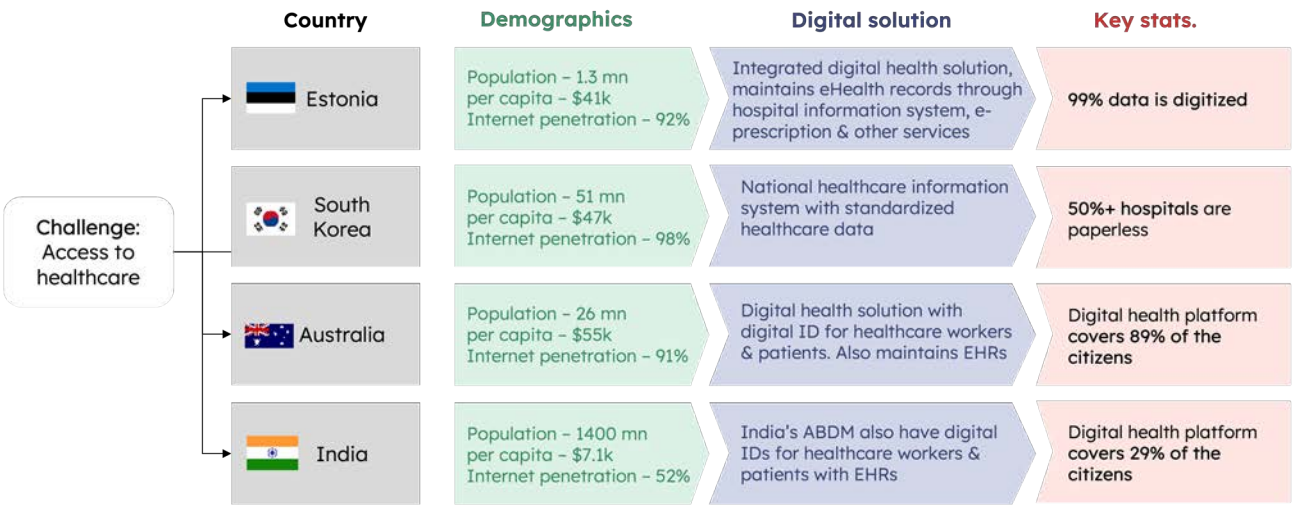
Over 30 countries are planning to adopt UPI. Singapore and Russia have set-up bi-lateral partnerships with India to take UPI at global level. Singapore has integrated PayNow with UPI to instantly transfer funds between the two countries. Similarly, Russia is also in discussion to launch Rupay and Mir cards with UPI-FPS interaction.

True potential of UPI 2.0 lies in reducing remittance cost for global transactions of UPI. Remittance cost can come down from currently ~4% to ~1%. For instance, India would have saved over ~$3 bn in remittance cost in 2022, when India received ~$100 bn foreign funds.

Philippines and Morocco have already implemented Aadhaar like systems in their countries, while other countries are already in talks.

India's digital health register ABDM is not the first of its kind. Several countries have executed digital solutions related to healthcare very well. Countries like South Korea have made more than 50% of their hospitals paperless, while countries like Australia are maintaining digital health records for ~90% of their population. India has a long way to go before the tangible benefits of ABDM are unlocked, despite the 30% citizen enrolments most of the documentation is still paper based in India.

Overview of countries improving access to healthcare using digital solutions



Source: Arthur D. Little, nasscom analysis

Indian DPIs - Future Impact Potential by 2030

Chapter #5

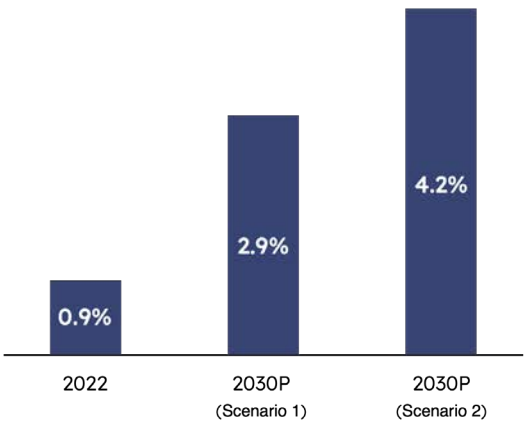
Indian DPIs - Future Impact Potential by 2030

With mature DPIs like Aadhaar already reaching 97%+ adoption, budding DPIs are also projected to create a larger impact for the Indian economy and citizens. These DPIs are also focused on solving sector specific challenges and drive innovation and inclusion within the country.

Projected economic value add of DPIs in India's GDP

By 2030, adoption across the matured and budding DPIs has potential to scale and add higher economic and social impact. The economic value add of these DPIs by 2030 has the potential increase to ~2.9%-4.2% of GDP from 0.9% in 2022.

Potential economic value add of DPIs in India's GDP; 2022, 2030P



Key Insights

- DPIs will lay the future for India to become a $8 Tn economy by 2030 and help India achieve the target of $1Tn digital economy
- GDP contribution potential to grow from 0.9% in 2022 to ~2.9% - 4.2% in 2030[1]

The incremental value add will be largely driven by ABDM (better healthcare for citizens of the country, resulting in increased labour productivity) and ONDC (incremental growth in retail spending of the country). Aadhar will continue to be a major contributor as use cases expand to broader range of services.

[1] Under base scenario; Conservative scenario assumes lower increase in efficiency from the implementation of ABDM and NDEAR ecosystem

Source: Arthur D. Little, nasscom analysis

Non-economic value add by 2030

While the mature DPIs have achieved exponential adoption by 2022, the next 7-8 years present an opportunity to scale up further and impacting to the citizens even in the remotest parts of the country.

By 2030, DPIs will have made life of the citizens more efficient with social and financial inclusion

Financial inclusion	90%+ of the population above 15yrs have access to a bank account. In 2022 only 78% had a bank account	760 Mn beneficiaries of PMJDY	Government savings in direct benefit transfer of $15.3 Bn
Social inclusion	Equal access to opportunities, resources, and services. Empowers citizens to engage in all aspects of life: social, economic, and cultural	137 Cr Aadhaar users with DBT of $15.3 Bn	~70%+ of the population (106 Cr) will be benefitting from digital services
Time saving	Digitalization of services makes processes efficient saving time for the involved stakeholders	Annually a citizen saved 4.2 working days by using digital services	15-25 % reduction in TAT per shipment (ULIP)
Cost savings	$ 104 Bn cost savings through digitization		
Ecological impact	$7.6 Bn worth paper saved & reduced carbon emission by 4 Mn carbon ton		

Source: Arthur D. Little, nasscom analysis

Transformation of Matured and Budding DPIs through innovative technology integration

Being digital in nature, the solutions using DPIs are most affected by technological enhancements and disruptions. To avoid the risk of becoming obsolete, the digital services will need to be upgraded to stay relevant and useful.

Few such forces of technological advances that can create a larger impact are AI and the new internet built on the principles of Web3 and immersion of Metaverse.

Matured DPIs expected to evolve, driven by advancements & integration with key emerging technologies

Aadhaar

- AI-Powered grievance management system has been launched for better governance and administration
- Natural language processing technology, could enhance service delivery and provide personalized recommendations for government schemes
- Adapting characteristics of a blockchain based system into the centrally regulated Aadhaar ecosystem to enable banking services which cannot be availed using only Aadhaar is under consideration

UPI

- AI can be used to improve fraud detection and prevention, while blockchain can help increase transparency and security in transactions
- The primary objectives of Central Bank Digital Currency (CBDC) are to decrease the operational expenses associated with managing physical cash, promote financial inclusion, and enhance the resilience, efficiency, and innovation of the payment system

GSTN

- Analyse transaction data, identify patterns, and detect anomalies to assist in identifying potential tax evasion or compliance issues
- Smart contracts, executed on a blockchain, can automate tax calculations, invoicing, and payment processes, reducing administrative burden and minimizing errors
- Storing data across multiple nodes in a secure and encrypted manner, blockchain ensures that taxpayer information is less susceptible to breaches and unauthorized access

Current budding DPIs expected to leverage emerging technologies to mature and contribute to the economy

ABDM

- AI can analyse patient data and medical history to offer personalized treatment plans and health recommendations, optimizing healthcare outcomes for individual patients under ABDM
- AI algorithms can forecast disease patterns and healthcare trends, enabling better resource allocation and planning within the ABDM framework
- Manage operations including medicine delivery and on-ground procedures in an efficient manner by sharing data

ONDC

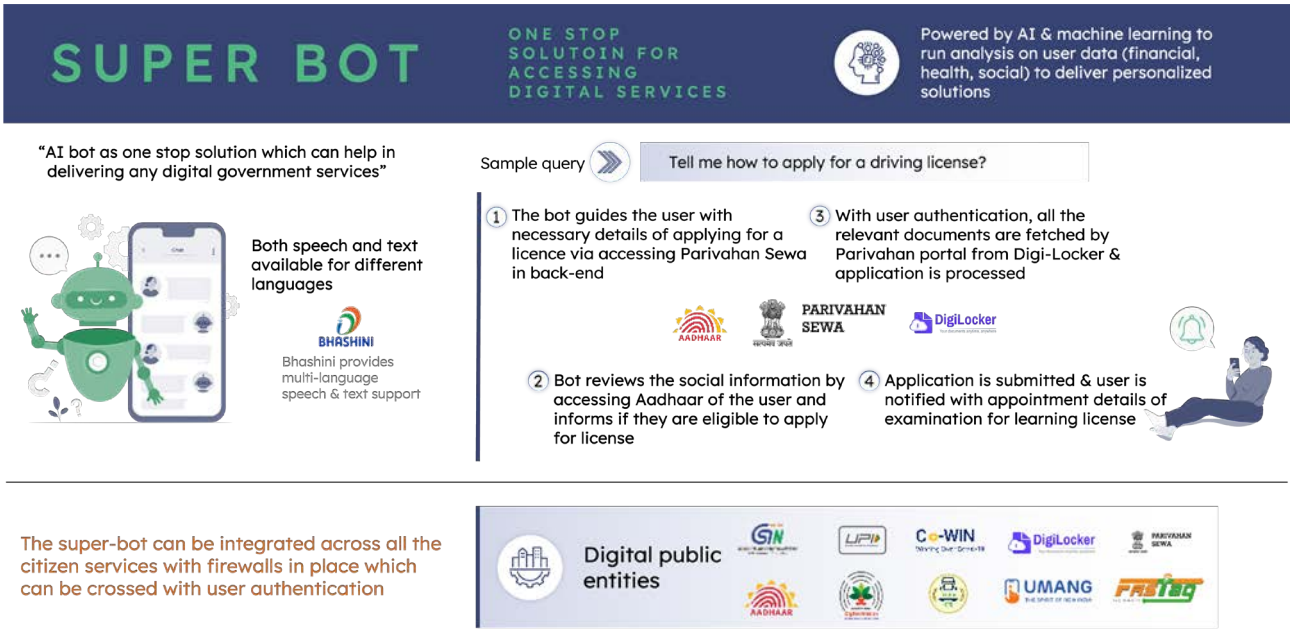
- Machine learning (ML) algorithms have been used by private players to build eCommerce platforms, ONDC lays foundation to build applications using similar ML models
- Digital experiences will evolve as metaverse adoption increases – resulting in more immersive shopping experience in a decentralized fashion

NDEAR

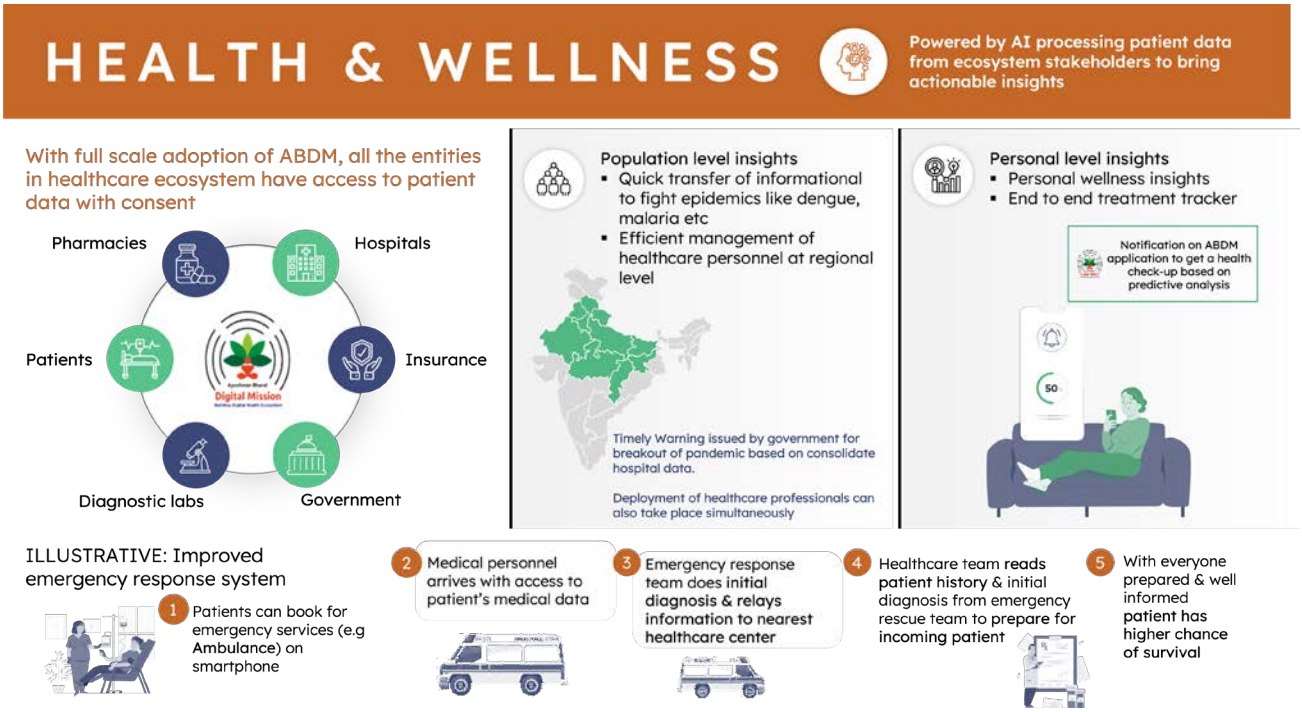
- AI algorithms can analyse student data, learning patterns, and preferences to provide personalized recommendations, adaptive content, and tailored learning pathways
- Blockchain can provide a tamper-proof and decentralized system for issuing and verifying educational credentials, such as certificates and degrees, ensuring their authenticity and reducing fraudulent practices
- Immersive learning experience with AR, VR and metaverse improving quality of learning

Source: Arthur D. Little, nasscom analysis

A next-gen digital services Super Bot with multilingual capabilities and speech-controlled portal has been envisaged to provide one-stop solution for all citizens problems.



Similarly, a highly advanced version of ABDM integrated with cloud computing and AI can be used to present a holistic health and wellness solutions. Such a system can deliver the true experience of connected healthcare to its citizens with better epidemic management, wellness solutions, etc. to improve health at individual level and faster emergency response systems.



Source: Arthur D. Little, nasscom analysis

Key challenges

Certain challenges hinder the adoption and scaling up of DPIs to their full potential, which need to be managed by all stakeholders.

Key challenges to the adoption of DPIs

Lack of interconnectedness among government ministries, each with its own rules, regulations, and databases that do not communicate with each other – hampers the development of DPIs

Real-Time Data Availability: Users can access up-to-date information through DPIs, enabling them to make informed decisions. Ensuring real time data availability will help drive the adoption of various DPIs.

Language Expansion: DPIs are recognizing the diversity of languages in India and addresses this by integrating with Bhashini. This expansion enables users to access services in their preferred language, promoting inclusivity and accessibility.

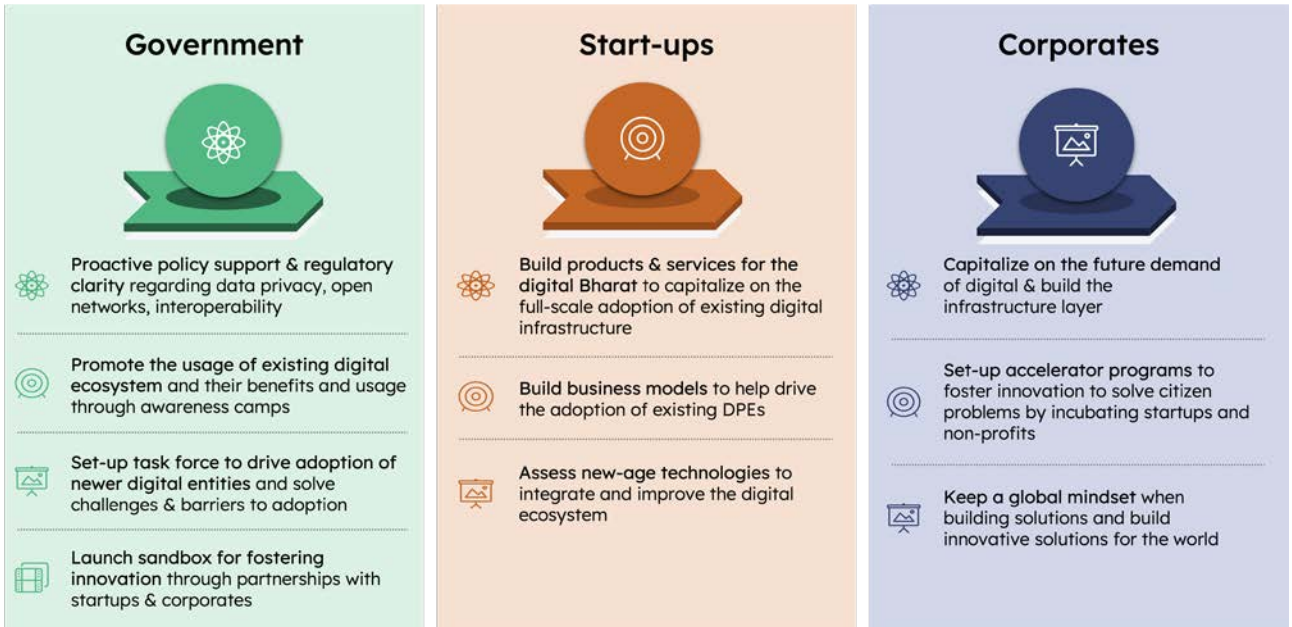
Cybersecurity and data protection: The digital public ecosystem requires robust data protection and cybersecurity infrastructure to safeguard against any untoward data leakages.

Future Partnerships: DPI's vision extends beyond government services. For enhancing the overall user experience banks, telecom companies, insurance providers, and retail sector is collaborating to provide personalized services digitally.

Key Imperatives for the ecosystem

While the country has successfully adopted the early DPIs, with the proliferation of transformative technologies in the future, there are certain imperatives that the stakeholders need to be cognizant of.

Challenges to be addressed by all stakeholders



Source: Arthur D. Little, nasscom analysis

Appendix

Scope of Study

Focus of the study is to assess the economic and non-economic impact achieved due to India's DPIs. It covers metrics related to DPIs including -

1. Current progress of national and state level DPIs in the Indian digital ecosystem
2. Maturity analysis of the DPIs
3. Economic and social impact on governments, businesses, and consumers
4. Future potential of the mature and budding DPIs
5. Roadmap to increase adoption of existing DPIs and develop budding DPIs
6. Learnings from global counterparts and roadmap to take the Indian DPIs global

Approach and Methodology

Qualitative Assessment

The report's qualitative evaluation encompasses insights derived from interviews conducted with both business and technology leaders responsible for constructing and overseeing the digital ecosystem, as well as stakeholders affected by it. The research involved conducting over 20 interviews with leaders from diverse digital sectors, including thinktanks, developers, infrastructure providers, businesses, consumers, and NGOs, spanning various industries such as banking, healthcare, agriculture, eCommerce, and technology.

The insights from interviews were supplemented by extensive secondary research involving analysis of research publications, press releases, and reports issued by government, public and private entities on these topics.

Quantitative Assessment

Quantitative assessment is driven through econometric models to estimate economic impact of various mature and budding DPIs in India. The inputs to the econometric model were sourced from publicly available databases, research publications, and expert interviews. The economic impact (direct and indirect) was estimated by calculating additional revenue generation, cost savings, and time savings. The impact has been calculated bottom-up based on the most impactful use cases of the selected DPIs. The use cases were derived and chosen in consultation with industry experts. The following methodology has been used to calculate the impact for these DPIs:

Aadhaar –

- Leakages avoided by the government in providing social support through Direct Benefit Transfer scheme
- The average time saved with implementation of Aadhaar authentications and eKYC, resulting in incremental value-add for the citizens. Applications covered include those in Telecom, Banking, Public Distribution System, etc.
- Incremental income from new bank accounts opened under the Pradhan Mantri Jan Dhan Yojna scheme.

UPI -

- With shifting to UPI, the total direct and indirect payment system costs saved such as reduction in transportation of physical currency, less visits to the ATMs, etc.
- The additional value generated by consumers, banks, and businesses due to increase in average bank balance over a month driven by reduced cash withdrawal from bank accounts.
- The extra value generated due to payments being blocked for a lower time in the system, freeing more working capital.

FASTag -

- Total time saved by passengers at toll gates after implementation of FASTag
- Total work hours saved due to increased labour productivity.

ONDC –

- Incremental increase in the overall eCommerce spend after ONDC implementation calculated by forecasting the change in penetration and average spend per user

Diksha –

- Increased labour productivity due to a more educated population

ABDM –

- Extra productivity achieved by health professionals due to a digital healthcare system.
- Total time saved by the working population in availing medical facilities.

The aggregate GDP impact due to the time saved is calculated based on the labour population impacted and the average labour productivity. The total impact by global adoption of UPI and Aadhaar is similarly calculated at a country level (depending on data availability) based on the characteristics of each country and extrapolated to calculate the overall impact on the world. The 2 use cases – savings due to better public distribution system and value generated due to reduced float payments have been omitted for global impact calculation due to constraints on data availability.

Acronyms

Acronym	Full form	Acronym	Full form
AA	Account Aggregator	**HWC**	Health & Wellness Centre
ABHA	Ayushman Bharat Health Account	**IoT**	Internet of Things
AI	Artificial Intelligence	**IVR**	Interactive Voice Response
APB	Aadhaar Payments Bridge	**KOMN**	Kochi's Open Mobility Network
API	Application Programming Interface	**ML**	Machine Learning
AR	Augmented Reality	**MoHFW**	Ministry of Health & Family Welfare
ATM	Automated Teller Machine	**NBFC**	Non-Banking Financial Company
BIS	Beneficiary Identification System	**NLP**	Natural Language Processing
CAGR	Compound Annual Growth Rate	**NPCI**	National Payments Corporation of India
CBDC	Central Bank Digital Currency	**OEM**	Original Equipment Manufacturer
CIDR	Central Identities Data Repository	**OS**	Operating System
DBT	Direct Benefits Transfer	**OTP**	One-time Password
DGS	Digitized Government Service	**PAN**	Permanent Account Number
DHIS	Digital Health Incentive Scheme	**PMJAY**	Pradhan Mantri Jan Arogya Yojana
DPG	Digital Public Good	**PMJDY**	Pradhan Mantri Jan Dhan Yojna
DPI	Digital Public Infrastructure	**PoS**	Point of Sale
DPP	Digital Public Platform	**PSU**	Public Sector Undertaking
e2e	End-to-end	**QR**	Quick Response
e-Gov	electronic Governance	**RFID**	Radio Frequency Identification
EHR	Electronic Health Record	**RFP**	Request for Proposal
eKYC	electronic Know Your Customer	**RSP**	Reconciliation Service Provider
ERP	Enterprise Resource Planning	**SaaS**	Software as a Service
eSign	electronic Signature	**SDGs**	Sustainable Development Goals
FID	Farmer ID	**SME**	Small and Medium-sized Enterprise
FPS	Faster Payment System	**TAM**	Total Addressable Market
GDP	Gross Domestic Product	**TAT**	Turn around Time
Gen-AI	Generative AI	**TPA**	Third Party Administrator
GoI	Government of India	**TRAI**	Telecom Regulatory Authority of India
GSP	GST Suvidha Provider	**TSP**	Technology Service Provider
GST	Goods & Services Tax	**UFSP**	United Farmer Service Platform
HCX	Health Claims Exchange	**UHC**	Universal Health Coverage
HFR	Health Facility Registry	**UN**	United Nations
HP	Himachal Pradesh	**VR**	Virtual Reality
HPR	Healthcare Professionals Registry		

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About nasscom

nasscom is the industry association for the technology sector in India. A not-for-profit organization funded by the industry, its objective is to build a growth-led and sustainable technology and business services sector in the country with over 3,200 members. nasscom Insights is the in-house research and analytics arm of nasscom, generating insights and driving thought leadership for today's business leaders and entrepreneurs to strengthen India's position as a hub for digital technologies and innovation.

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About Arthur D. Little

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations.

Our consultants have strong practical industry experience combined with excellent knowledge of key trends and dynamics. ADL is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations.

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