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DIGITAL PUBLIC INFRASTRUCTURES:
LESSONS FROM INDIA FOR A THRIVING DATA ECONOMY

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CONTENTS

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INTRODUCTION

The past decade has borne witness to an unparalleled proliferation of the digital economy across the globe, wherein data has evolved from being a mere by-product to an increasingly valuable asset. As the global economic landscape undergoes a rapid shift towards an era driven by Artificial Intelligence (AI) enabled insights and information, Digital Public Infrastructures (DPIs) have emerged as a class of technology system around which innovations in both private and public services can spread. These DPIs include digital identity systems, open data platforms, e-governance portals, digital payments, and other tools whose foundations have been laid on socio-economic drivers such as rapid digitalization, increased citizen expectations, greater financial inclusion, concerns regarding data privacy, and, above all, an evolving legislative and regulatory environment.

There are numerous instances of countries reaping benefits by harnessing DPIs to deliver essential services to their citizens. During the recent crucible of the global pandemic, for example, countries like Norway, India, Sri Lanka, South Korea, Estonia, and Singapore effectively used advanced healthcare systems and digital tools to track the spread of Covid-19, monitor compliance, and oversee vaccine delivery.[1] Most of these countries, as well as the US, UK, Canada, and New Zealand, have also adopted Open Data initiatives of varying scales to promote government transparency, accountability, and civic engagement. But while well-implemented DPIs provide significant benefits that can propel a country's digital economy, there are also underlying risks that need to be carefully managed, including fears around data privacy and security; the potential monopolization of the DPI in the hands of select providers; and the weaponization of the DPI by the state as a tool for surveillance and citizen monitoring.[2]

> Notwithstanding the inherent risks, however, a well-designed DPI ecosystem that builds interoperability and adequate safeguards for data governance and security can not only unlock the latent potential of the data economy but also enable fair and competitive marketplaces while ensuring the safety of all participating stakeholders.

Several countries have shining examples of well-implemented DPIs, with India's model often cited as one of the most successful. What makes India's DPI ecosystem stand out is its integrated building-blocks approach, its widespread adoption across society, and the way it has empowered its citizens and businesses via unprecedented financial inclusion, rapid innovation, and consistent GDP growth.

In this paper, we lay out a conceptual framework for DPIs and explore the foundational components of India Stack, the country's unified software platform that is bringing India's population into the digital age.[3] We discuss the myriad of benefits that have hitherto been achieved, even while we recognize the challenges and risks inherent in developing such an ecosystem. Finally, we highlight some emerging principles and recommendations that could serve as best practices for other countries to adopt DPIs.

A CONCEPTUAL FRAMEWORK FOR DIGITAL PUBLIC INFRASTRUCTURE

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In modern societies, three essential flow components shape economic dynamics:

01. Flow of people

To a large extent, economic growth relies on citizens' mobility, as they seek trade, employment, and development opportunities, irrespective of their location.

02. Flow of money (goods and services)

The circular flow of money, from producers to consumers in the form of wages and back to producers as payments for goods and services, also drives economic activity and associated government policies.

03. Flow of information

Lastly, with the rise of digital interactions in the economy, the ethical flow of personal and aggregate data has become vital, so ensuring privacy, security, and control to minimize the risks of fraud and undue concentration when delivering essential services is key.

Needless to say, these flow components are highly interconnected, making it crucial to manage their interplay when developing modern public infrastructure. For example, in an increasingly digital world, the flow of people can be managed with a legal form of national identity that enables citizens to prove who they are, which can provide an authentication mechanism to access public and private services ranging from bank accounts, credit lines, and government benefits. The flow of money, in turn, requires a secure and interoperable payment ecosystem that individuals and businesses can use to make payments in an easy, cashless, safe, and seamless manner. And the flow of information can be regulated through a robust data governance policy underpinned by a solid legal framework and technology-based safeguards.[4]

The question, however, is how to administer and govern these public infrastructures to ensure that they can be sufficiently **scalable** to meet the country's growth, **sustainable** in terms of maintenance and cost-effectiveness, and **flexible** to rapidly adapt to changing technology and societal needs. In this regard, three possible models emerge:

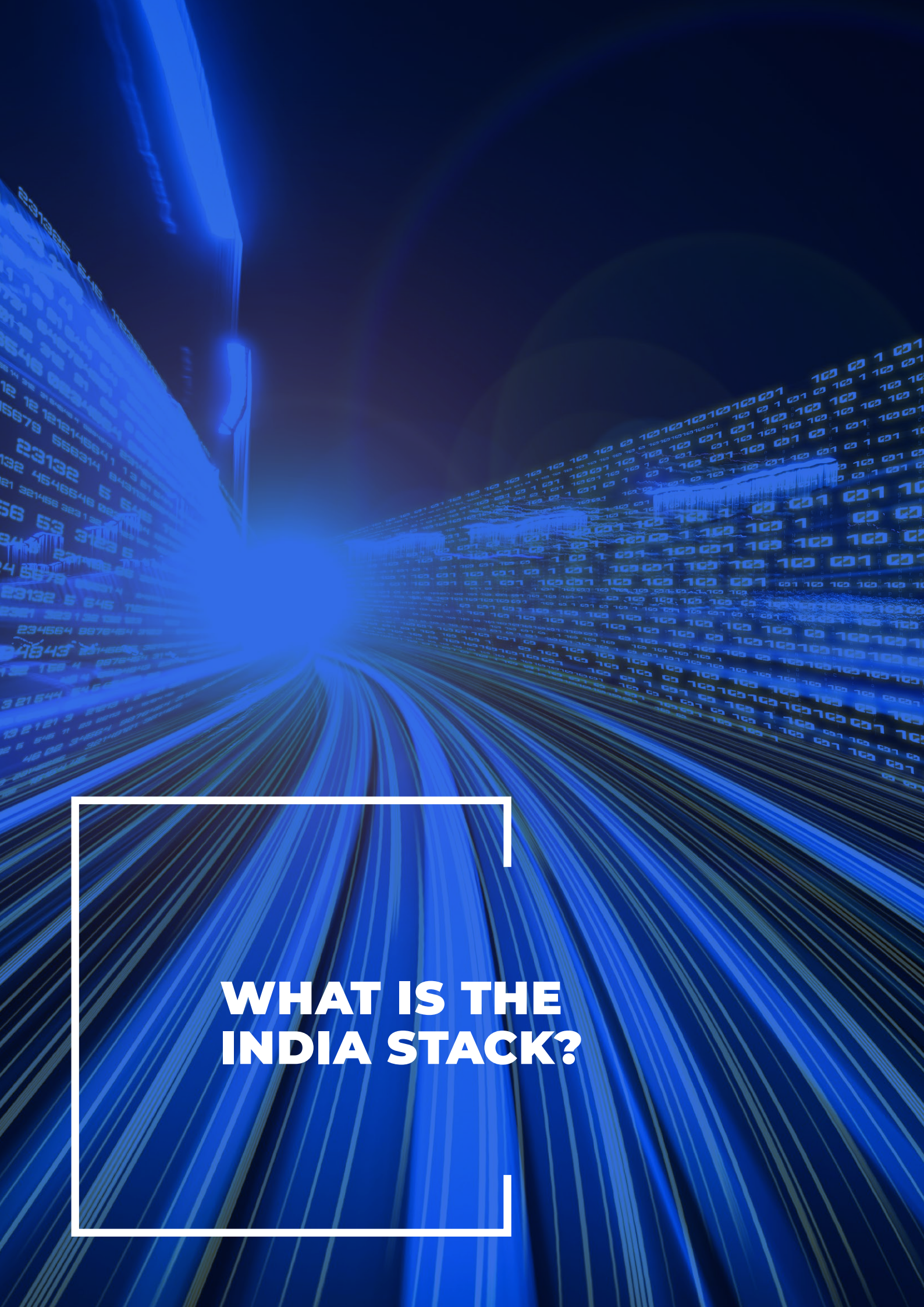
- **All-government approach:** In this model, the government owns all platforms and policies, providing end-to-end services through monolithic tech systems. However, it comes with significant drawbacks, including a single point of control (and potential failure) as well as slower innovation.
- **Big Tech approach:** The Big Tech model places ownership of all platforms and applications in the hands of private technology corporations. However, concerns about interoperability and potential monopolization under this model are well documented.
- **DPI approach:** Lastly, the DPI model combines government and regulator-driven enabling policies with minimal, shared technology platforms and open Application Programming Interfaces (APIs) and protocols. This approach encourages innovation, fosters competition, and ensures both openness and sovereignty, striking a balance between public and private interests.

Figure 1. Three approaches to developing modern public infrastructure

Simply put, DPIs are fundamental pillars of governance that catalyze economic development by enabling public authorities to leverage digital technologies to improve the overall quality of life of their citizens, enhance operational efficiencies, and foster innovation.[5] Some of their elements might include a **digital-first, user-centric approach,** to ensure that public services are easily accessible to every citizen, irrespective of their location; **interoperable components based on open standards,** to enable the seamless exchange of information across different government services; a high level of transparency, to ensure safe data-driven decision-making, with a strong emphasis on privacy and security; and **effective collaboration between the public, private, and third sectors**, to stimulate innovation.[6]

> India is one of many countries that has clearly championed this third paradigm by leveraging digital technology and data-driven solutions with a robust overarching governance framework.

While the government has borne primary responsibility for implementing the DPIs, the involvement of a wide range of non-state actors, including policymakers, investors, tech companies, industry organizations, civil society volunteer groups, and entrepreneurs, has also been critical to its success. India's approach towards DPI combines technological innovation with scalability, frugality, and interoperability to ensure last-mile inclusion. And it has all been made possible by a revolutionary project called India Stack.



WHAT IS THE INDIA STACK?

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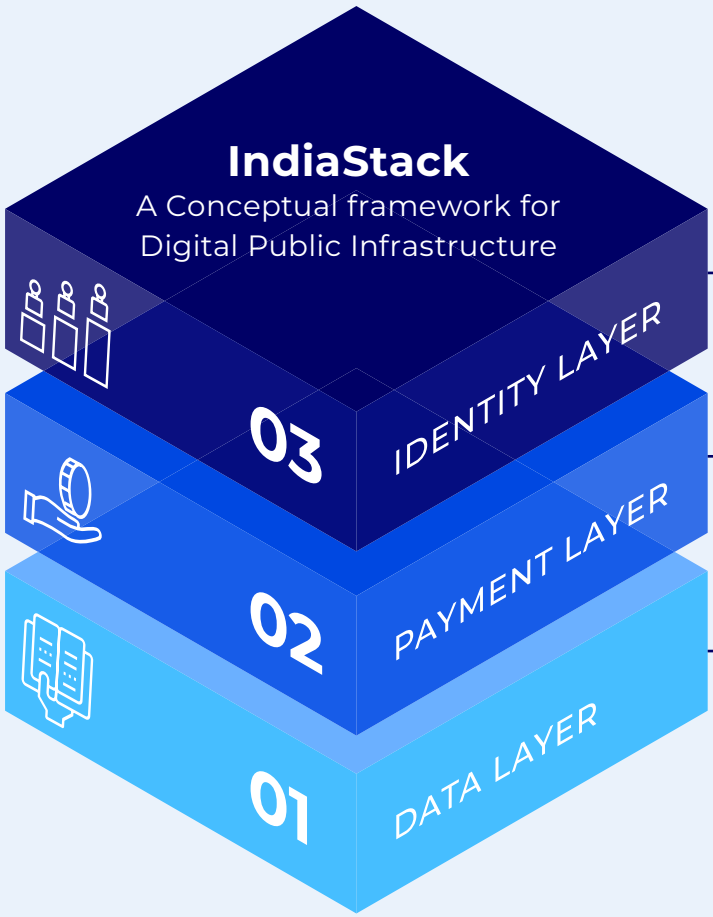
India Stack epitomizes a paradigm shift in the way nations leverage digital infrastructure to empower their citizens and drive economic growth.

The three foundational layers of the India Stack help mediate the flow of people, money, and information in the digital economy.

Figure 2. India Stack's three layers



Flow of People
eKYC, eSIGN

Flow of Money
UPI—Separation of consent from custodian

Flow of Information
DEPA and Account Aggregator—Consented and secure flow of both personal data and training data

DIGITAL IDENTITY
Aadhaar

At the heart of the India Stack is Aadhaar, India's digital identity program of unparalleled scale and significance. The story begins in 2009, when the country was grappling with low financial inclusion (only 17% of the adult population had bank accounts) and inefficient provision of public services; two problems with a common denominator: the lack of reliable identity information on millions of Indian citizens. Despite initial hurdles and concerns regarding data privacy, the government initiated Aadhaar, a Herculean public outreach campaign aiming to gather individuals' basic attributes (name, age, gender, and address) and provide every person with a unique 12-digit identity number, equipped with biometric information and two-factor authentication mechanisms (e.g., using people's mobile number and/or email).

> With over 1.31 billion numbers issued, the ubiquity of the Aadhaar has allowed millions of unbanked Indians to open bank accounts.

Under the *Jan Dhan Yojna*, the country's commitment to financial inclusion, more than 508 million beneficiaries have been able to access previously unimaginable financial services. This has increased India's banked population from 35% of adults in 2011 to 80% as of 2018, an improvement that, according to estimates, would have taken the country 47 years to accomplish following traditional growth processes.[7]

Enriched with a set of API-enabled digital identity products, such as e-Know Your Customer (eKYC), an Aadhaar authenticated onboarding platform, and Digilocker, a document storage and retrieval asset, firms across telecom, financial services, and healthcare industries have also been able to offer much faster and cheaper customer onboarding experiences. In fact, a World Bank report estimates that the *queriability* and interoperability enabled by the Aadhaar system have significantly helped reduce onboarding costs for firms from $23 to an estimated $0.15.[8]

The country also benefited from more efficient Direct Benefits Transfers (DBTs) to these bank accounts thanks to reduced leakages and the elimination of ghost beneficiaries. As of March 2023, India's DPI-based DBT system has aided about 650 million people, who received $322 billion directly into their accounts, even while saving more than $27 billion across key central government schemes.[9] These benefits are also extended across a range of other government services, including income-tax filing, pension distribution, and voter registration, which also use Aadhaar authentication.

PAYMENTS
United Payment Interface

India was largely a cash economy until the first decade of the millennium. In 2012, the Reserve Bank of India (RBI) published a paper that estimated the number of non-cash transactions per person was only 6 per year, and that only 6% of the more than 10 million retailers in India had the appropriate card payment infrastructure to accept non-cash payments.[10] The paper laid out a vision to create a safe, efficient, interoperable, authorized, accessible, and inclusive payment and settlement system to increase the use of electronic payments and reduce the country's reliance on cash, which was not only costly but also detrimental to India's attempts to bring citizens into the formal sector. Thus, was born the Unified Payment Interface (UPI), India's homegrown real-time mobile payments system that allows users to transfer money instantly using their mobile devices and a unique, bank-account-linked Virtual Payment Address.

> *Designed to provide interoperability between money custodians, payment networks, and digital payment applications, UPI has quickly become the premier mode of payment in the country.*

In September 2023 alone, India did over 10.5 billion transactions, valued at over $189 billion, using UPI.[11] Compared to 405 million transactions in September 2018 this is an explosive compound annual growth rate of 88.87%. Moreover, its innovative features, such as QR Code-enabled scan and pay, UPI Autopay, UPI or Credit Card, UPI on ATMs, and UPI Lite have democratized access to an easy-to-use, secure and cashless payments ecosystem transcending demographic and socio-economic boundaries. Today, most Indians use UPI to make payments as low as 10 rupees (about $0.12) for everyday needs, from groceries to scheduling payments for bills and utilities, to financial investments.

DATA GOVERNANCE
DEPA

As Aadhaar and UPI became ubiquitous, Indians became increasingly data-rich. However, the legacy custodian-centric data-sharing model resulted in too much information remaining in silos, precisely at a time of heightened concerns regarding data security.[12]

> *Having achieved the initial mandates of greater financial inclusion and more efficient public services, the next opportunity was to empower citizens by unlocking the potential of their personal data to improve access to previously unavailable services, including credit lines, healthcare, and employment.*

Therefore, the third layer of the India Stack puzzle established a model for data governance based on the Data Empowerment and Protection Architecture (DEPA), a framework for a secure, consent-based data sharing ecosystem.[13] The system empowers people to seamlessly and securely access their data and share it with third parties using the services of a private **Consent Manager** institution that allows individuals to provide consent via an innovative digital standard to securely share data for pre-defined purposes.

For example, a user can log into the financial institution's loan application that has built an integration with a type of Consent Manager called Account Aggregator (AAs). The user can then provide explicit consent to share their bank account statements with this lending provider for analysis to assess their creditworthiness and obtain a loan. Individuals can use this AA technology framework to avail themselves of personalized financial services such as lending, insurance, and wealth management. Since its launch in 2021, the network has grown to incorporate 14 AAs and 94 registered regulated financial services entities that serve as financial information providers. As of October 2023, 28.4 million accounts have been linked for consent-based data sharing.[14]

DESIGN PHILOSOPHY OF THE INDIA STACK

DESIGN PHILOSOPHY OF THE INDIA STACK

Countries like India, Brazil, and Estonia are often cited when it comes to recognizing the success and impact of DPIs in their digital economies. A key to this success is how these countries have adopted certain core principles in their DPI approach, namely in terms of design, governance, and public-private innovation.

> In particular, the India Stack has leveraged a minimalist design philosophy, which has allowed the government to promote widespread adoption of the platform and encourage the emergence of innovative use cases.

To identify the key lessons that can serve as a benchmark for other countries looking to build their DPI, it is essential to understand five fundamental concepts that have underpinned India's digital journey:

- **Interoperability:** Aadhaar, UPI, and DEPA have been designed to be interoperable so that different systems and components can seamlessly interact. This has been achieved by adopting a set of common standards and protocols using APIs to enable the integration of diverse services and technologies.
- **Extensibility:** Due to the modular design of the India Stack components, the base framework can be extended to build newer features that cater to new use cases without having to re-engineer the core architecture. For example, the eKYC service is built upon Aadhaar and can be combined with Digilocker to provide a paperless onboarding experience
- **Protocols approach:** India Stack relies on a standards- and protocol-driven approach. Therefore, while UPI has a core underlying platform that leverages the nation's payments rail, it provides an API-based approach to allow multiple players to connect and interact via Apps. Similarly, DEPA offers a set of standards and protocols that AAs use to allow individuals to use Apps that leverage consent-driven data sharing.
- **Private sector participation:** Other than Aadhaar, which is a publicly provisioned, public infrastructure, both UPI, which is owned by the National Payments Corporation of India[15] (NPCI) and DEPA's AA ecosystem, which is governed by Sahamati[16], an industry-led body, are privately provisioned, public infrastructure. This dual approach has allowed private players to leverage their resources, expertise, and innovation capabilities to power the growth of the ecosystem and achieve market penetration.
- **Competitive market:** The India Stack approach ensures that all incentives for participating stakeholders are appropriately aligned—not just in terms of commercial advantages but also regarding the standards and protocols that underpin the architecture. This provides a level playing field to all participants irrespective of size, allowing newer entrants to innovate and challenge more established players.
- **Open networks:** At its core, the driving vision of India Stack is to create open networks. The idea behind these is to establish a level playing field for all members of a digital ecosystem so that they can focus on building the best consumer experiences and products instead of having to worry about infrastructure, permissioning, and access. We explore this fundamental concept in the following section.

BENEFITS OF THE INDIA STACK

BENEFITS OF THE INDIA STACK

SOCIAL BENEFITS

Notably, the India Stack has significantly influenced the reform of social services in India, thus broadly delivering on the original mandate with which it was conceptualized. In particular, the digitization of social services through India Stack has increased transparency and accountability in service delivery, resulting in a myriad of social benefits.

First, India Stack has gone beyond basic **financial inclusion** of erstwhile unbanked populations. It allows low-cost, digital financial services to reach people in remote and underserved areas, helping them securely access banking and payment services.

In addition, the India Stack has enabled the efficient and transparent **delivery of public services and subsidies** while reducing corruption and ensuring that benefits reach their intended recipients. Savings from the DBT and related reforms are estimated to be 1.14% of GDP as of March 2021.[17]

Finally, despite the significant growth in digital penetration, India remains a country with low financial and digital literacy and low technological access. However, the government continues to invest in **ancillary infrastructure** such as high-quality telecommunications to ensure that e-government services, including the delivery of online education, digital platforms for skill development, or digitized health services, are made accessible to the remotest parts of the country. For example, the CoWIN portal for Covid-19 has over 1.1 billion Aadhar-based registrations and has helped administer over 2.2 billion vaccinations during and after the pandemic.[18]

ECONOMIC BENEFITS

The benefits of India Stack have extended far beyond its social mandate and helped the country unlock economic value as well, boosting government revenue collection, fostering innovation and competition, and expanding markets.

Since the Indian Income Tax Department mandated linking Aadhaar with individuals' unique tax document, the Permanent Account Number (PAN), the program has brought more individuals into the tax-paying bracket and boosted **tax revenue generation**.[19] As per the Central Board of Direct Taxes, at current exchange rates, the country's net direct tax revenue collection has increased 160%, from $76.7 billion in 2013-14 to an estimated $199.5 billion (provisional) in 2022-23.[20]

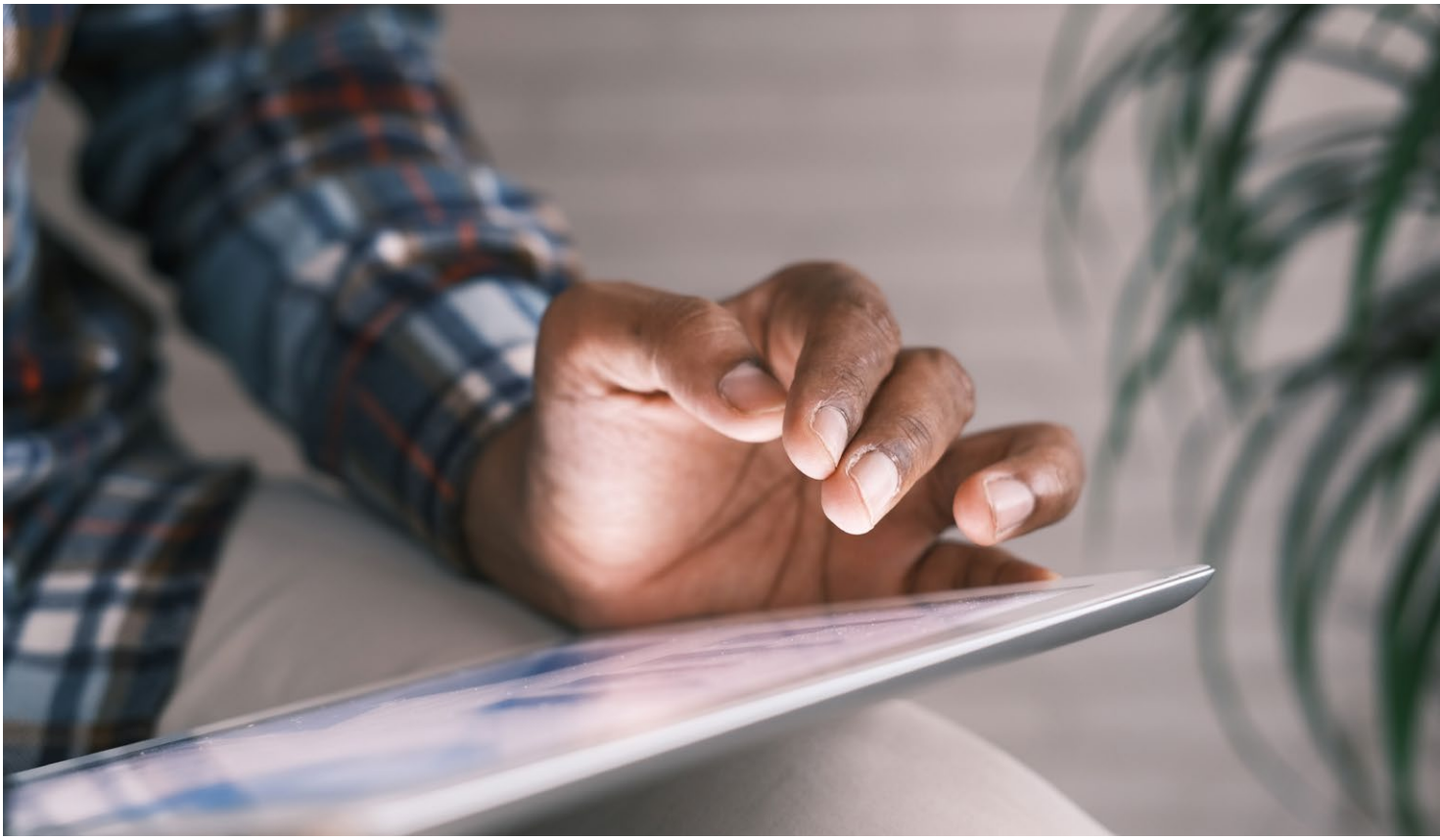
India's approach to scaling the India Stack ecosystem using a public-private partnership approach has also provided a fertile ground for **innovation and entrepreneurship** for start-ups and businesses looking to develop innovative digital services and solutions, thereby driving economic growth and job creation. India now boasts over 33 tech unicorns and continues to solidify its position as a major global player in software and technology exports. This growth has extended beyond the financial sector into areas such as healthcare, agriculture, and education.

Most importantly, the India Stack has contributed to the **financial empowerment of Micro, Small, and Medium Enterprises (MSMEs)**.[21] For a country like India to achieve sustained economic growth, the flow of capital in the form of readily available credit to small shopkeepers, agricultural entrepreneurs, and other MSMEs is essential. However, obtaining a loan from the formal financial system can be prohibitively expensive

for these businesses. This discrepancy is partly due to the operational hurdles and high costs associated with the credit application process. However, the main limitation is the traditional loan underwriting practices that demand borrowers to provide substantial collateral as a prerequisite.

Nonetheless, these borrowers often possess a valuable asset in the form of a consistent track record of cash flows that can offer a degree of reassurance and security to potential lenders. The concept of data-driven collateral, or information collateral, offers a solution to this challenge. Enter OCEN, the **Open Credit Enablement Network**, an initiative to unbundle credit through the creation of specialized entities and an open protocol-based API infrastructure. It allows marketplaces or aggregators such as Etsy, an artisan marketplace, or Doordash, a food-delivery app, to facilitate their sellers or riders to share their financial and performance data (customer ratings) with a network of lenders through a consent flow. The lenders, in turn, can develop their models to take into account this information to extend short-term credit to the artisan or riders. This approach, in conjunction with features of the India Stack, such as e-signatures, electronic liens, and the UPI ecosystem, empowers the participants in the OCEN network to fully digitize and expedite the entire process of originating a loan for customers, underwriting, completing the necessary documentation, disbursing funds, and even handling repayments.

Similarly, other emerging open marketplaces have been built upon the foundational components of India Stack. For example, the **Open Network for Digital Commerce (ONDC)**, enables buyer and seller network participants to interact with each other to create hyper-focused e-commerce marketplaces.[22] Other than the fact that it is government-backed and hence reliable, the key benefits of ONDC are available to both consumers and sellers: **increased choice and competition**, as end users can now access both well-known e-commerce players like Amazon and smaller businesses on the same platform; **better price discovery**, resulting in lower prices to the end user; and **greater customer support** that is integrated into the apps.



CHALLENGES, RISKS AND MITIGANTS

CHALLENGES, RISKS AND MITIGANTS

> One of the critical concerns for DPIs is the likelihood that they might succumb to monopolization, authoritarianism, and digital colonization, i.e., the possibility that excessive control of key digital infrastructure and associated data will be concentrated in a single entity, often the government or a government-controlled agency.

This, in turn, could lead to the weaponization of DPI, resulting in the malicious use of these digital assets for unethical purposes such as espionage and surveillance, misinformation and manipulation, censorship or exploitation.

While the India Stack has brought significant benefits to the country, there have been criticisms against it, many of them reasonable. We look at some of the common objections and highlight the measures that the government has put in place to address these issues, in light of proposing potential mitigants that other countries might consider in their own digital journeys.

IDENTITY LAYER—AADHAAR

The main concerns about Aadhaar range from the more benign, such as the exclusion of some segments of the population, to the more nefarious, such as it becoming a tool for surveillance.

A commonly cited concern is that authentication failures or discrepancies in their biometric data could result in people from marginalized communities being denied basic services such as DBTs. To address this, the Unique Identification Authority of India (UIDAI), which administers the program, provides a number of workarounds. Depending on their location, beneficiaries can use either biometric or one-time password (OTP) based authentication, with provisions such as alternative ID forms for exceptional cases and grievance redressal mechanisms.

It is important to note here that over 1700 DBT schemes have been identified for Aadhaar authenticated delivery, with over $322 billion being directly transferred as of March 2023. For a country the size of India, there are bound to be operational challenges. Still, in general, Aadhaar has ensured that more people from marginalized communities have access to benefits and public services than ever before.

On the other hand, concerns about Aadhaar becoming a surveillance tool are more unfounded, as there is a robust governance scheme in place. The Aadhaar Act of 2016 provides a legal framework for the use of Aadhaar, which includes provisions for data protection and privacy. In fact, Section 32(3) of the Aadhaar Act specifically prohibits the UIDAI from controlling, collecting, storing or maintaining any information for the purpose of authentication either by itself or through

any entity.[23] The Supreme Court of India has issued several rulings to uphold the constitutional rights and privacy of citizens while allowing Aadhaar to be used for specific purposes. Aadhaar's architecture inherently emphasizes certain key features that significantly reduce the risk of it becoming a surveillance tool, including:

- **Data minimization**—Only the minimum required data is collected for authentication purposes. Unnecessary data collection is discouraged, and most entities avoid storing Aadhar numbers in their databases.
- **Data encryption**—The biometric and demographic data collected during Aadhaar registration is stored securely and encrypted.
- **Limited scope of use**—Aadhaar is not mandatory for all services and is primarily used in specific areas like welfare distribution, DBTs, and subsidies. Although a lot of key services, such as banking, do use Aadhaar as a preferred KYC document, it is not mandatory.

PAYMENTS LAYER—(UPI)

Similar to Aadhaar, the common fears about UPI revolve around security, fraud, and its potential use as a financial surveillance tool.

As is the case with any payment instrument used to initiate digital transactions, UPI is indeed vulnerable to frauds such as phishing, malware, and SIM cloning. However, security breaches have been largely minimized through features such as the use of a Virtual Private Address that does not reveal the user's bank account details, multi-factor authentication, dynamic PINs, etc. Naturally, a lot also depends on the efforts of individuals to ensure that they adopt the security measures provided by the UPI applications that they use.

Likewise, some of the key principles listed above, such as data minimization, encryption, and limited government access, are applicable here as well. Only authorized government agencies, such as law enforcement agencies, tax authorities, or agencies involved in national security, are granted access to financial transaction data and that too only after the agency demonstrates the need for access and specifies the purpose.

DATA LAYER (DEPA)

The proliferation of data in India over the last decade has been accompanied by a number of data breach incidents, such as the exposure of sensitive health card data at a leading diagnostic entity, the unauthorized sharing of personal data by certain fintechs, and the use of personal data for political purposes. These incidents highlighted the concerns related to data sharing and control, such as the digital divide between rural and urban India, the concentration of data in the hands of a few large corporations, and the misuse of personal data for commercial purposes or targeted profiling.

This, in turn, underscored the need for robust data protection measures, regulations, and ethical practices. In particular, the importance of promoting digital freedom, open governance, and respect for individual rights cannot be overstated. Addressing these issues through stringent security measures, clear data protection laws, transparent privacy policies, and user empowerment in data control is paramount.

DEPA Inference—
Data Governance for Personal Data

A good example of how India has sought to mitigate these risks is the way the Data Empowerment and Protection Architecture has been conceived and implemented.[24] DEPA adopted a "techno-legal" approach, that aims to achieve public policy objectives of data privacy, transparency, and secure data sharing through technology design, and promises to ensure fair competition, privacy protection, and user autonomy while enabling market innovation and consumer protection.

DEPA creates a digital framework that allows users to share their data available with Financial Information Providers (FIPs, such as banks) to Financial Information Users (FIUs, i.e. lenders, fintechs) on their own terms through Consent Managers and AAs.

Put another way, this techno-legal governance regime embeds key data protection principles into a public technology stack. These include:

- Consent-based data sharing, where AAs facilitate data sharing only with the explicit and informed consent of the data owner. Users have control over what data is shared, with whom, and for how long. Consent can be revoked by the data principal at any time.
- The data shared is purpose-limited, meaning that FIUs need to clearly specify the purpose for which they are accessing the customer's data, such as for lending or personal finance purposes.
- Data Minimization ensures that only the specific data required for a particular financial transaction is shared, reducing the risk of data exposure.

For any techno-legal framework to succeed, it has to be backed by a clearly defined and enforceable legal framework. The Indian government recently passed the Digital Personal Data Protection Act of 2023, to establish a comprehensive data protection regulation.[25] This legislation outlines the rights of individuals, data protection and fiduciary responsibilities of data handlers, and provisions for penalties and adjudication in case of a breach.

DEPA Training—
Addressing data governance in the AI regime

Commerce in modern data-driven economies is increasingly driven by AI. However, one generally sees that information tends to get concentrated in the hands of certain dominant players. Consequently, smaller organizations that wish to build better AI models remain constrained by the lack of high-quality training datasets, as they do not have a sizeable user base of their own. For such organizations, creating training datasets can be expensive, laborious, and time-consuming.

Although DEPA Inference has largely addressed the challenges of sharing personal data, using the same approach to share AI training is neither feasible nor practical due to various constraints, such as inadequate incentives to individuals, longer time horizons and diverse data sources, and finally, the risk of re-identification of datasets to original users by using reverse engineering.

Enter the DEPA Training framework, a techno-legal solution that aims to address these challenges in non-personally identifiable information (PII) training data by streamlining the process of sharing diverse datasets across organizations in a secure, compliant, and efficient manner. It adopts the following design principles:

- Allow Training Data Providers (TDPs) to register their encrypted datasets via a contract service and host endpoints where these data sets can be accessed.
- Allow Training Data Consumers (TDCs) to access limited datasets to decide their data requirements and eventually enter into a digital contract with the provider. The agreement includes the terms of the arrangement (such as security and privacy constraints), the purpose for which datasets are being shared, the contract period, and the payment terms.
- Data sharing is enabled using Confidential Clean Rooms (CCRs), which are secure environments that provide hardware-based security and privacy for datasets and models.
- Once the training of models is completed the framework facilitates payment between the entities
- Although the DEPA Training framework is still in its early design stages, it shows promise to be able to democratize access to aggregate datasets safely and securely manner for the development and validation of AI models in industries such as travel, healthcare and finance, eventually leading to firms being able to offer customized and competitive product and services to the end customer.

RECOMMENDATIONS: WHAT THE WORLD CAN LEARN FROM INDIA

RECOMMENDATIONS: WHAT THE WORLD CAN LEARN FROM INDIA

India Stack has played a crucial role in enabling India's emerging data economy by providing the infrastructure to thrive in the digital age while emphasizing user consent, data privacy, and security.

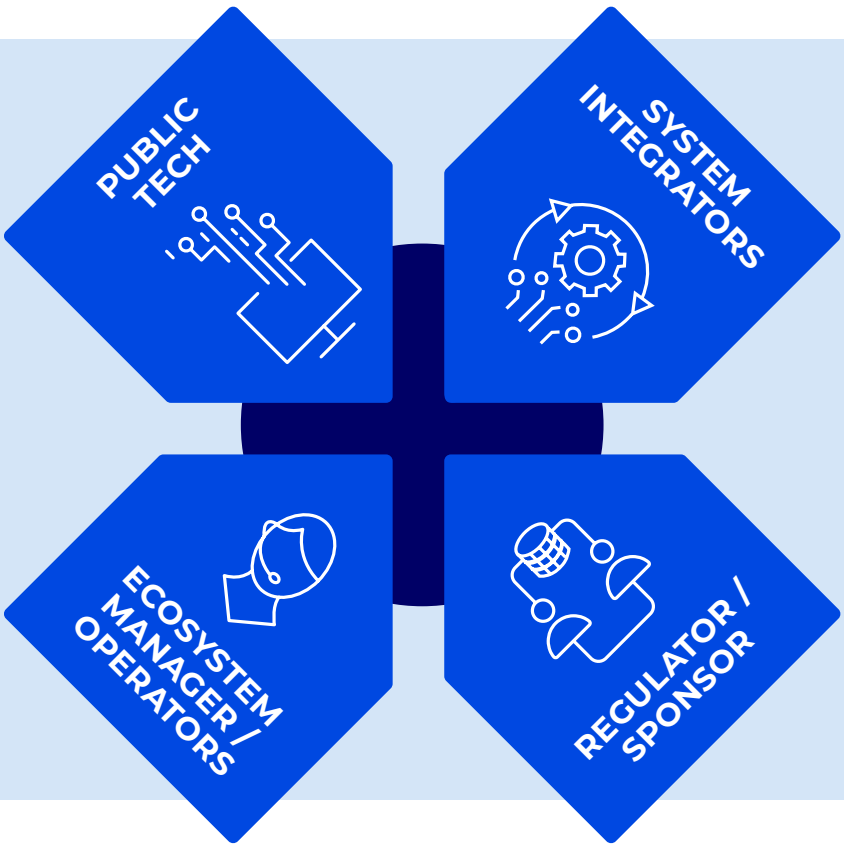
This is evidenced by the exponential growth of various data-driven sectors, from financial services to e-governance and healthcare, which have allowed the country to rise from a globally debilitating pandemic with consistently high GDP growth. With all its successes and challenges, India's experience in building the India Stack offers valuable lessons for other countries looking to embark on a similar journey. Whereas much of the assets in terms of protocols, software, policy templates, best practices, etc., behind India's DPIs are available freely for others to build their own DPIs, four crucial pillars must come together:

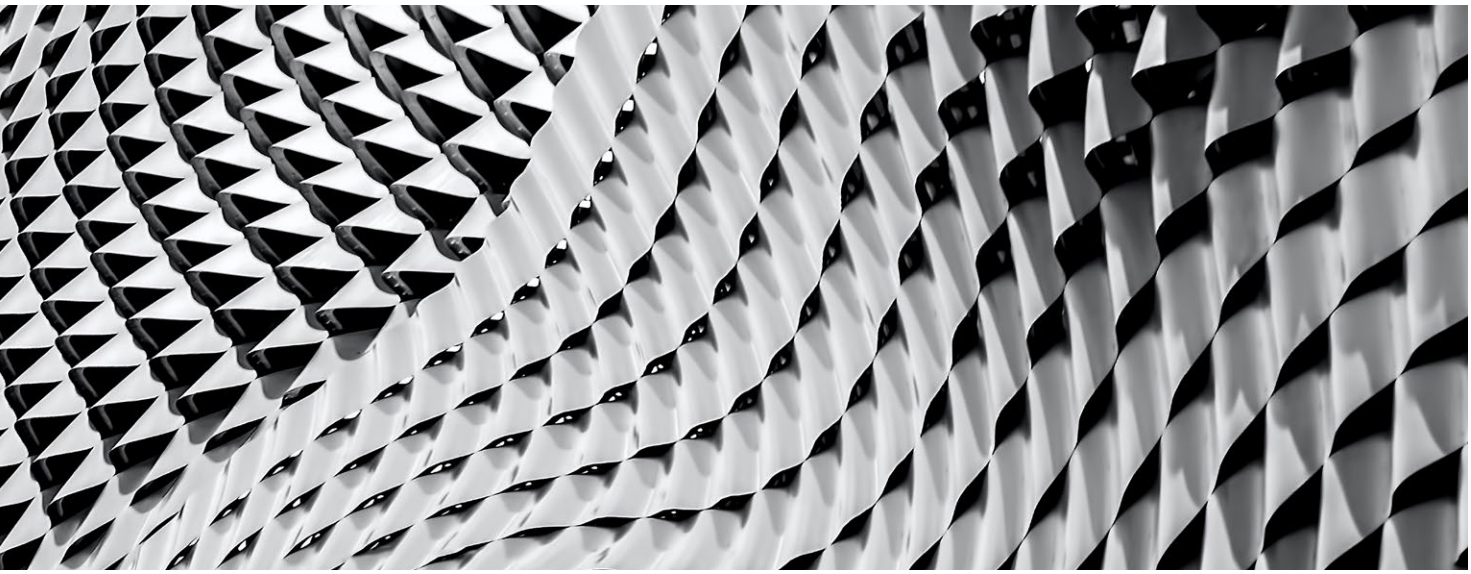
01
SPONSOR / REGULATOR

The successful implementation of any DPI requires a cohesive and collaborative relationship between the government, which is the primary sponsor, and the various regulatory bodies. The government needs to set the vision for the country's DPI, follow it up with an appropriate legal framework that defines the roles and responsibilities of regulators and other stakeholders, and provide the necessary funding to build and maintain it. The regulator, on the other hand, needs to ensure stakeholder participation while formulating the regulatory framework and subsequently be responsible for monitoring compliance and building trust in the operations of the DPI.

Figure 3. Four lessons from India's DPI Journey

Four things must come together





An open and constructive relationship dynamics between government and regulator, policy alignment, transparency and adaptability to changing socio-economic-political environment can go a long way in achieving the objectives laid out for the DPI while protecting the interests of all stakeholders.

02
ECOSYSTEM MANAGERS / OPERATORS

Ecosystem managers are institutional bodies that have a clear ownership and mandate to manage different layers of the DPI, like UIDAI (in the case of Aadhaar), NPCI (responsible for UPI), and Sahamati (in charge of the AA framework). As such, they are responsible for evangelizing and promoting the DPI, maintaining custody of the platform components, providing training, launching innovative frameworks and products, and ensuring the regulatory guidelines are followed.

The India Stack has been successful largely due to the public-private model for governance and implementation. Keeping the DPI architecture minimalistic and standards-driven has allowed the private sector to innovate, thus reducing the total cost of DPI ownership, while ensuring wider adoption and agility in innovating. Countries looking to scale their DPI should adopt a similar model to accelerate the adoption of DPI in their country.

03
SYSTEM INTEGRATORS

With a prominent involvement of the private sector, it is possible for technology providers, also known as system integrators, to act as intermediaries and facilitators, helping governments and public agencies to streamline the adoption of digital technologies and ensuring that various components of the infrastructure work together seamlessly. India's unique public-private approach has allowed several private players, including technology service providers, fintechs, big tech players, and traditional banks, to develop technology-driven use cases catering to their target customer base.

04
PUBLIC TECH

Lastly, at the core of building a DPI is the underlying technology. As discussed earlier, DPI technology must adopt design principles such as interoperability, extensibility, portability and standards-based protocols, while embedding a techno-legal framework that inherently safeguards data privacy, security requirements and user rights over personal data control. Doing so ensures that the primary tenets of building a low-cost DPI are realized, namely scalability, sustainability, inclusivity, and adaptability.

CONCLUSION

For a country the size of India, with all of its economic, social, and religious diversity, it is not unnatural that the implementation of India Stack gets its fair share of criticism around misuse, privacy, and socio-religious discrimination. Even as we write this paper, news of a significant data breach involving citizens' PII data at a third-party entity has raised the head of skepticism against the fool-proofness of the underlying infrastructure. Incidents such as these reinforce the need for stringent data privacy laws that enforce accountability on all stakeholders. It underscores the importance of not only having a strong techno-legal framework for data governance but continually improving it as the digital economy becomes increasingly interconnected.

However, what is irrefutable is that India Stack has played a significant role in reshaping the relationship between the government, businesses, and individuals in India. This is clearly evidenced by the positive on-ground impact it has had on the lives of billions of Indians. This transformation, shaped by technological advancements, legal and regulatory changes, and societal expectations, has contributed to evolving a new 'digital social contract' that has promoted inclusivity and citizen empowerment.

So, what does the world stand to gain by incorporating the principles and lessons from India's DPIs?

Firstly, countries can learn from India's top-down approach, where the government has taken the lead in setting the vision for the DPI, while other ecosystem players, having their roles and responsibilities clearly defined, have been provided the agility to adapt and innovate.

Second, countries can bolster digital inclusion by adopting India's strategies for providing digital identities and financial services to marginalized populations, ensuring previously underserved communities gain access to essential services, and making interactions between citizens and governments more efficient and user-friendly.

Third, learning from India's experiences in data protection and privacy regulations and resulting solutions like the DEPA framework, countries can strengthen their data security measures, ensuring that personal information remains safe in the digital realm.

Finally, governments can foster a robust innovation ecosystem by encouraging entrepreneurship and start-up growth, mirroring India's success in this field.

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