



DIGITAL PUBLIC INFRASTRUCTURE: THE BACKBONE OF FINANCIAL INCLUSION IN INDIA

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ABSTRACT

Digital public infrastructure has revolutionized the process of financial inclusion in India. By leveraging robust technology, strong legal and governance frameworks, and active stakeholders' participation and initiatives like JAM Trinity and UPI, India has transformed the delivery of financial services and has achieved an 80% financial inclusion rate within a span of 6 years. The core elements of DPI digital identity, secure payments, and data exchange have helped in the empowerment of millions of people, have reduced the digital and socio-economic divide, and have made the whole banking system more stable. However, the growing concerns of cybersecurity, infrastructural and digital literacy gaps, and the low availability of the internet in remote and rural areas remain to be addressed. To continue moving further in the right direction, the adoption of advanced technologies like blockchain and artificial intelligence and the integration of these with the DPI framework will need to be explored in order to create a sustainable and inclusive digital financial system.

KEYWORDS: *Digital India, Digital Public Infrastructure, Financial Inclusion, India Stack, UPI, India Stack*

INTRODUCTION:

Economic growth of a country is closely linked with that country's infrastructure development. Developing infrastructure is not a goal in itself; rather, it is a means to an end. With any infrastructural development, a country aims to derive social and economic benefits. Just like the physical infrastructure—such as roads, railways, and reservoirs—there is digital infrastructure.

The Digital Public Infrastructure (DPI) can be defined as a set of digital foundation blocks that enable the delivery of public services with an ultimate goal of economic growth. In simple terms, DPI enables seamless implementation of digital services through digital platforms. DPI encompasses a wide range of digital technologies and computer platforms (applications/software) that aim to create a common digital ecosystem that is accessible and inclusive for individuals and businesses and is beneficial to both the citizens and the government.

The 2023 G20 Digital Economy Ministers Meeting Outcome document defines DPI *as a set of shared digital systems that should be secure and interoperable and can be built on open standards and specifications to deliver and provide equitable access to public and/or private services at a societal scale and are governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, and competition and respect human rights and fundamental freedoms.*

In the era of digital revolution, where everything and everyone is interconnected, it becomes very crucial to design a reliable DPI. DPI at its core has three components, namely technology, governance, and community. Technology ensures the provision of interoperable building blocks, while robust governance frameworks help establish trust among users by incorporating predefined laws, privacy measures, and transparency. Finally, community participation, including collaboration with the private sector, drives innovation and addresses key issues, with a focus on the overall economic growth of the nation.

In the last decade alone, digital technology has revolutionized various aspects of human lives, be it communication through instant messaging and video calls, online shopping through e-commerce platforms, access to healthcare, or other services. DPI has been leveraged by many countries, and some notable examples of DPI include India's Aadhar identification system, Brazil's Pix fast payment system, Denmark's digital health record, Sweden's land ownership record, and Australia's Consumer Data Right. Financial inclusion and other financial services were made possible with the help of DPI.

DPI gained prominence during the COVID-19 pandemic, when physical movements of individuals were restricted. The COVID-19 pandemic exacerbated the problems of poverty, unemployment, and other macroeconomic challenges in the world, disrupting the progress of the United Nations Sustainable Development Goals. The pandemic stressed upon the need for speedy adoption and development of a digital ecosystem, thereby giving acceleration to DPI processes that had the potential to offer a pathway to address the critical issues, such as poverty, climate change, and financial inclusion, by improving focus on the implementation of sustainable development initiatives.

CORE ELEMENTS OF DIGITAL PUBLIC INFRASTRUCTURES:

There are three major elements of Digital Public Infrastructure. Over the past two decades, three main categories of capabilities have been prioritized as public infrastructure: digital identity verification, secure payment transfers, and safe data storage and sharing. These three elements often result in a public-private partnership and are governed by the government to ensure the transparency and trust among the general public. They are discussed separately in brief as under:

a) Digital Identity (ID):

Digital ID enables access to various digital services, ensuring that the benefits are provided exclusively to the intended users. Digital IDs should be interoperable so that they can support seamless authentication across diverse platforms and services. Digital ID is an element that can support initiatives like bank account opening, SIM registration, and direct-to-benefit (D2B) mass payment transfers from the government or any other public or private enterprise, as it was witnessed during the COVID-19 pandemic.

Digital ID, like Aadhar, also offered an alternative to the traditional KYC authentication process and enabled crores of individuals lacking conventional documentation to access banking and other services. On similar lines, other countries followed the India Stack and introduced their own digital ID programs, such as Nigeria, Philippines, Sri Lanka, Morocco etc, which helped these countries in enhancing their existing financial and health inclusion.

These systems and the technologies help in generating, storing, and verifying the digital identities. Credential verification utility such as e-sign further enhances the usefulness of digital identities, especially in financial services, particularly in the KYC process and payments.

b) Digital Payments:

As digital identities help in the first step towards financial inclusion, the Digital Payments Public Infrastructure provides a seamless, secure, and efficient way of transferring funds among individuals, businesses, and governments. The DPI helps digital payment in fostering interoperability across all platforms. The interoperability provides space for innovation and makes the digital payments affordable for both the businesses, i.e., financial service companies and banks, and the individuals, and the lower cost of the payments promotes inclusivity among consumers, despite their economic backgrounds. India's UPI is one of the most successful examples of this. In recent years, the digital payment landscape has completely changed and has removed barriers and enhanced user experience. Paired with the digital identity systems, DPI has helped bring India's unbanked population into the mainstream economic zone, and now everyone who owns a smartphone and has access to the internet is a part of this ongoing revolution. Despite such overwhelming numbers of UPI transactions, DPI ensures that these digital payment systems remain accessible and inclusive with minimal downtime. In December 2024, NPCI reported nil downtime for the UPI payments, which is outstanding considering the month-on-month increasing number of transactions and amount of transactions.

c) Data Sharing or Exchange:

Designing digital tools for a secure and seamless way of sharing the data and information is one of the most important milestones that India has achieved with DPI. Tools like DigiLocker made it easy for the Indian population to store and share their personal documents, such as PAN, Aadhar, driving license, mark sheets, etc. This government-owned service has made the verification process, especially for students and colleges, where verification of physical educational documents was a lengthy and challenging process.

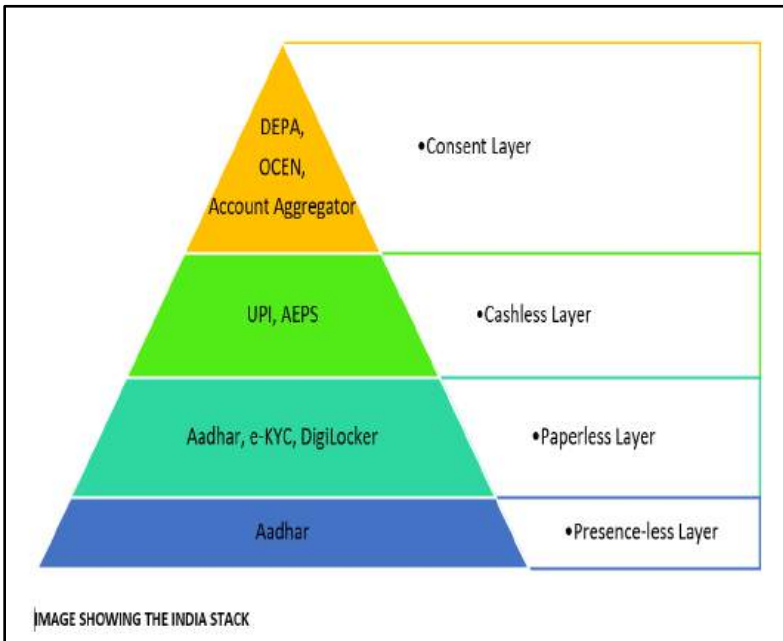
ICICI Bank has enabled the DigiLocker services for their customers to reduce the time and movement of physical documents for banking services. On similar lines, another DPI tool for sharing financial information, the Account Aggregator Service, was launched in September 2021. This platform allows individual customers to share their financial documents with financial institutions. Many banks, NBFCs, and insurance companies are now using account aggregators for fulfilling their data requirements for the purpose of loans. The secure way of consented access to the individual customer data saves a lot of time in the verification and authentication process and reduces overall time for the sanctioning process for a loan. On similar lines, to ensure seamless credit supply to the borrowers and further penetration and coverage of small business owners, programs like the Unified Lending Interface (ULI) and Open Credit Enablement Network (OCEN) have been launched by the RBI and Government of India. These platforms will use the DPI for enabling faster credit delivery across the nation. For the purpose of data sharing and giving users control over their data, the Data Empowerment and Protection Architecture (DEPA) framework has been put in place by the government. With the services of consent managers, DEPA will ensure that the user data is protected and shared only with the consent of the user, thus promoting trust among the stakeholders. Thus, the DPI structure will ensure timely delivery of credit with enforceable accountability, transparency and efficiency. In the financial sector, the data-sharing systems aid in risk management and create a space for providing innovative and inclusive financial services. DEPA has allowed banks to develop cash-flow-based lending by making the process of creditworthiness easier for the financial institutions.

INDIA'S DIGITAL PUBLIC INFRASTRUCTURE: A TRANSFORMATIVE JOURNEY

In India, DPI has been transformative in advancing financial inclusion. The 2023 G20 policy document, by the World Bank, highlights India's digital payment infrastructure—the JAM Trinity (Jan Dhan Scheme, Aadhar, and mobile phones)—as a key enabler. India achieved an 80% financial inclusion rate in six years, a monumental task that could have otherwise taken 47 years. To further monitor the progress, the RBI launched a financial inclusion dashboard, ANTARDRISHTI, in June 2023 that shows the commitment of the central bank in

The Indian government has taken several initiatives to build and enhance the DPI; some noteworthy initiatives are the National Optical Fiber Network (NOFN), the Bharat Net Project, and the National Broadband Mission to strengthen internet connectivity, especially in rural areas of the country. All such initiatives have helped lay the groundwork for robust DPI.

The concept of India Stack was born in the year 2009, with the launch of the biometric digital ID system, Aadhar. The concept of India Stack revolves around four layers, which are the consent layer, cashless layer, paperless layer, and presence-less layer.



India has made extraordinary strides in developing the much-needed and successful digital public infrastructure to support and accelerate the financial inclusion journey. The *India Stack* has transformed the way financial and other services are delivered and accessed. India Stack is a set of open APIs that includes digital public goods, namely, Aadhaar, UPI, U-WIN, API Setu, DigiLocker, Aarogya Setu, Government e-Marketplace (GEM), UMANG, Diksha, e-Sanjeevani, e-Hospital, e-Office, eCourt, POSHAN Tracker, SIDH, and NCD Platform. These projects and innovations reflect India’s commitment to inclusivity to address various socio-economic challenges.

Since its launch, about 1.41 billion people in India have enrolled under Aadhaar. Aadhaar has laid the foundation for the four layers of India Stack and has helped create a presence-less, paperless, and cashless ecosystem. This further became helpful in simplifying and digitalizing the e-KYC process and helped the banks and other institutions in making their services available to millions of people.

Followed by the success of the Aadhaar initiative, the Government of India launched the Digital India program in the year 2015, with an aim to empower citizens of the country by creating a digital ecosystem, incorporated with efficiency and transparent delivery of various public services. The key components of India Stack included Aadhaar, eKYC, digital lockers, UPI, eSign, direct benefit transfer, Aadhaar-enabled payment systems, etc. Eventually, the India Stack played a key role in achieving financial inclusion success by providing digital platforms for banking services. India’s robust DPI proved to be a game-changer, and, facilitating all essential services, the DPI platforms supported businesses and individuals, showcasing the power of digital public infrastructure as a driver of growth and resilience during.

The following image depicts the evolution of important milestones of India Stack and the major initiatives that led to the successful financial inclusion program of India.

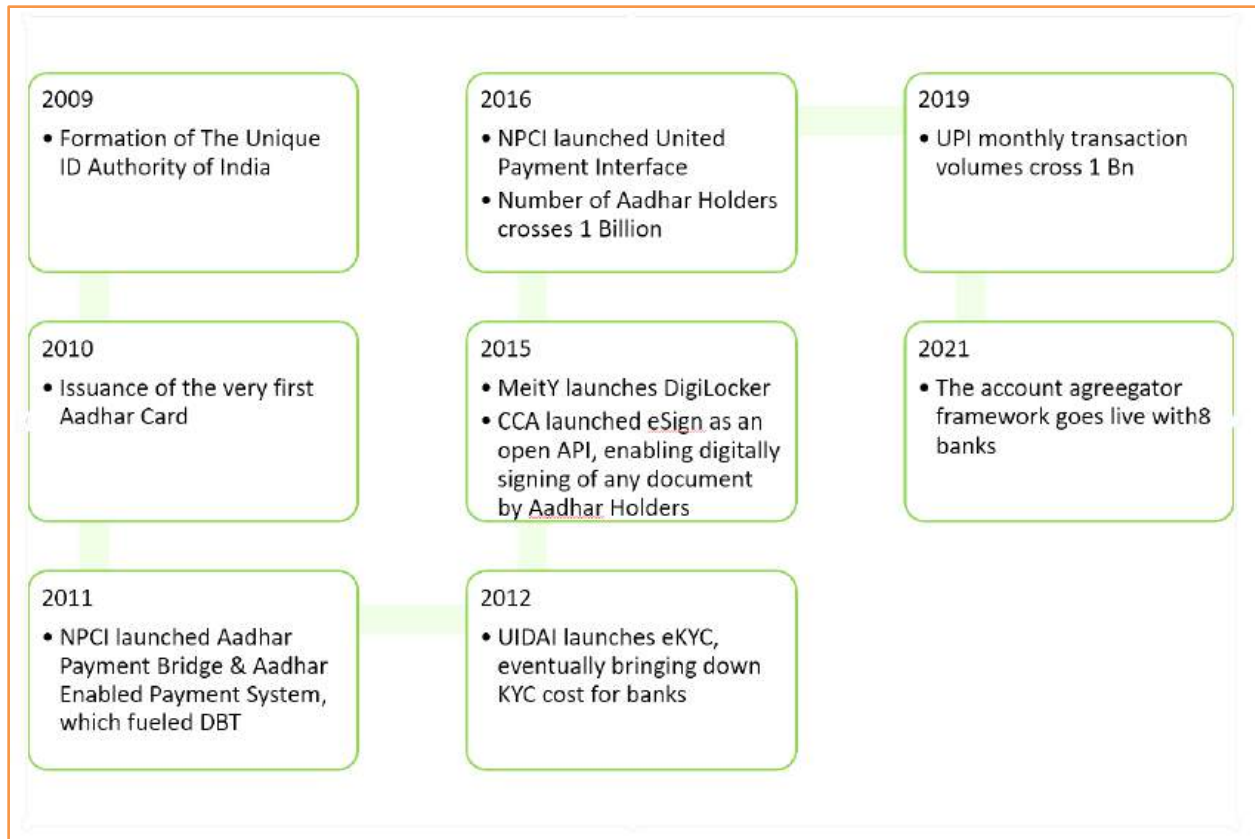


Image Source: Created using information displayed on <https://indiastack.org/>

DPI: AS AN ENABLER FOR FINANCIAL INCLUSION

Out of all the innovations, Aadhar and UPI have helped in achieving success in financial inclusion. As per a 22 July 2024, Press Information Bureau, press release, the number of adults with an account in a formal financial institution increased from 35% in 2011 to 77% in the year 2021, which not only signifies the declining gap between the rich and poor but also the narrowing gender divide. With most people having access to basic financial services, the government has been able to make large-scale direct-to-benefit transfers more efficiently. The benefit of India Stack was not limited to only individuals and governments; many private companies and start-ups, such as PayTM, Google Pay, BharatPe, and PhonePe, found substantial success in the area of digital payment. The success of UPI and financial inclusion in India has been supported by the expansion of smartphone holders in India, which, as per a Ministry of Fin report, were 116.50 crore as of 31 March 2024. India Stack shifted the fragmented technology project approach to cohesive digital infrastructure. India Stack has had a tremendous hand in the overall success of financial inclusion in India, a few key impacts being:

- **Widened Bank Account Penetration:** According to the Global Findex Database, 2021 of the World Bank, by 2021 formal banking covered 78% of the adults, which was 35% in the year 2017. DPI has enhanced the level of formal banking penetration in India. Since the inception of Jan Dhan Yojana, over 50 crores accounts have been opened and about 55.6% of Jan Dhan account holders are women and about 66.6% beneficiaries are located in rural and semi-urban areas of the country. DPI has also eased the

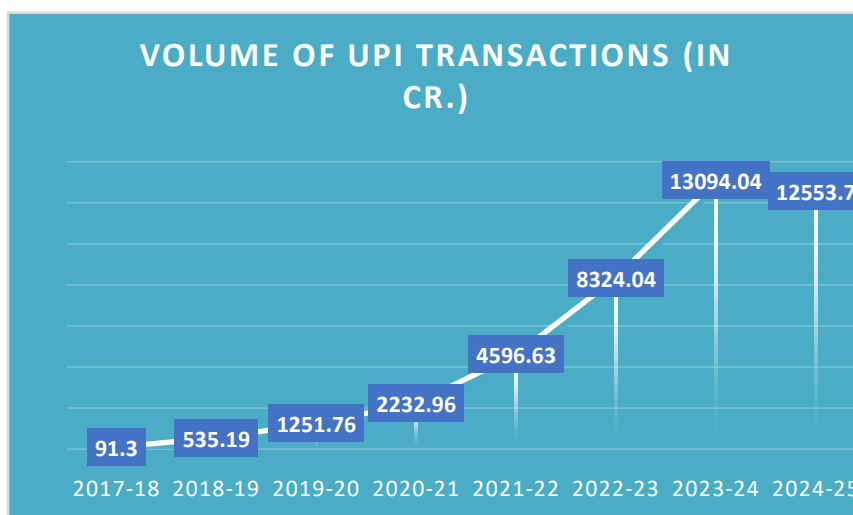
gender disparity, as the percentage of women having access to basic bank services has also increased substantially.

- Improved Credit Access:** The consent-based data sharing services enabled by account aggregation technology has helped bridge the gap in delivery of credit, especially to earlier exclusive population of the society. Recently launched programs like Unified Lending Interface (ULI) and Open Credit Enablement Network (OCEN) will further strengthen the credit delivery process in India. Earlier initiatives, like psbloansin59minutes, launched by the Indian Government, has proved to be successful and helped the banks in moving towards cash flow based funding.

According to the Data Capital Annual Report by Sahamati.org.in, a total value of Rs. 88,700 crores, loans, with 25% directed toward MSME units, have been disbursed using Account Aggregation Technology. Previously, in the absence of formal credit, many people in India relied on family, friends, or local moneylenders due to the country’s lower financial resilience compared to other developing economies. Fintech companies have addressed this gap by offering instant credit, supported by strong DPI infrastructure in the country.

- Digital Payment Revolution:** India’s United Payment Interface (UPI) is another successful example of DPI. The UPI platform facilitated 16.73 billion transactions, worth ₹ 23.25 trillion in Dec 2024, as per the latest NPCI data. The fact that makes UPI a prime example of DPI is its interoperability, which enables any payment or wallet app to offer payment services to customers of all member banks (currently, 1359) under the National Payment Corporation of India. Widespread adoption of UPI has also empowered small merchants and individual business owners, which has helped in bridging the gap between urban and rural economies. As of March 2024, about 40 to 48% of total payments in India are done using digital modes, and UPI is the main driver of digital payments in India.

The following graph shows the progress graph of UPI adoption in India, over the last few years:



Source digidhan dashboard, CFY VOLUME OF UPI IS NOT FOR FULL YEAR

- **Reduction in Leakages:** Tools like direct-to-benefit transfers, through Aadhar, have minimized the possibility of any subsidy leakage and enhanced transparency and trust. As per a report of Business Standard, Economic Affairs Secretary Mr. Ajay Seth revealed that DPI has helped in saving over USD 27 billion in government schemes.
- **Balancing efficiency and operational cost:** Most public sector banks used to have a larger section of their customers visiting their branches even for small payments and checking of balance in their accounts. With increased capacity of ATM and Cash Deposit Machines combined with UPI, has reduced the frequency of branch cash and transfer (RTGS / NEFT) transactions, small and frequent P2P and P2M transactions, and customer footfall in bank branches, thereby bringing down the total operational cost for many banks. Lesser dependence on cash will also eventually reduce the cash printing cost for the central banker. Central Bank Digital Currency, is another RBI initiative, with an aim to further decrease the reliance on cash and increase financial inclusion.
- **Increased Consumer Trust:** According to the Global Findex Database, 2021 report, by the World Bank, listed lack of trust was listed as one of the reasons for account inactivity. Consent-based data sharing and allowing users to control their journey have enhanced the level of trust between an enterprise and individuals, which in turn has increased user confidence and motivated the banks and other businesses to be innovative with their product and service offerings.

The India Stack has exemplified how successful implementation of DPI can drive inclusive growth, empower citizens, and prepare a path for a digital and inclusive economy. The success of India Stack has inspired other nations, and many emerging economies have started using the India Stack as a blueprint in order to advance societal and economic growth of their countries.

CHALLENGES:

While the DPI model of India has demonstrated substantial potential, it has even become a model that can be integrated and replicated by the other emerging economies of the world. The achievement and importance of DPI can be understood by the statement of India's Chief Economic Advisor, where he stated that DPI has the potential to add 60-100 basis points to India's GDP growth rate. However, even after this remarkable progress in driving India's financial inclusion, several challenges still persist in its full potential. These challenges cover areas like technology, privacy –security, socio-economic factors, and governance and if DPI has to achieve its potential then all these challenges have to be addressed with utmost focus.

- d) **Cyber-security and Data Privacy Concerns:** There have been many instances in the past where the Aadhar was in the new for security breaches, from reports of the database being sold on WhatsApp to the leakage of 1.6 million Aadhaar details in Jharkhand, and even the broader concerns around cybercrime; it's faced its share of criticism. When Aadhaar was first introduced, it didn't have any legislative backing and was challenged in courts, especially over linking it to services like domestic gas, but India's first biometric digital ID received its legislative backing when the Government of India introduced the Aadhaar Act in 2016, which became a foundation for the government's push for its mandatory linkage with services like

crop insurance, income tax returns, death certificates, and, most importantly, the bank accounts for the implementation of direct-to-benefit subsidy transfers. However, the security breaches still pose challenges, especially when there is a push for a unique ID linked to every important government service and especially when it causes serious financial damage to the ID holders.

Aadhar and basically digital identities are the foundations of successful DPI, and the success of DPI relies heavily on sensitive personal data, and that makes it vulnerable to cybersecurity threats and data breaches. With the growing volume of digital transactions, especially through UPI, it has become an appealing target for the fraudsters. Without robust frameworks to safeguard the privacy and hold parties accountable for all the breaches, then only public trust in DPI can be maintained.

- e) **Infrastructure Deficit in Remote Areas:** While the digital technology and internet adoption has surged in urban areas, the population living in rural and remote areas of the country, still faces significant issues in accessing the DPI services. Lower internet density combined with poor internet and network connectivity, and frequent power outages pose challenge in meeting the desired results. According to the Telecom Regulatory Authority of India July-Sept 2024, performance indicator report, the urban and rural internet subscribers per 100 population stood at 112.74% and 44.85%, respectively. Since, it is not always economically and geographically feasible to open the brick and mortar bank branches, the financial inclusion in rural and remote areas of the country will depend upon strong digital presence. This digital divide will need to be addressed with combined effort of public-private partnership.
- f) **Digital Literacy and Gender Disparity Challenges:** A large part of the Indian population still face challenges in understanding technology, and on top of it, gender disparities, especially in rural areas, hinder the effective usage of digital public infrastructure-led financial services. The issue of digital literacy and gender disparities is particularly found among the older generation and economically weaker sections, creating more divide in the adoption of digital financial services. Women in rural areas encounter additional challenges due to restrictive social settings and limited access to mobile devices and the internet that again hinders their ability to use DPI-based financial services. Although around 55% of beneficiaries who opened bank accounts under the Jan Dhan Yojana were women, but the active usage of those accounts remains low, highlighting the social-cultural hindrances that limit the overall engagement. These challenges underline the urgent need to improve digital literacy and address gender disparity to ensure full-fledged financial inclusion, which is not only restricted to only opening of accounts.
- g) **Policy and Governance Issues:** Seamless collaboration of all stakeholders, i.e., banks, fintech companies, RBI, telecom companies, and the government, is what is needed to continue the success of DPI in order to penetrate further in achieving financial inclusion to its 100%. Due to some fragmented efforts from any of the stakeholders, it can lead to delays or inconsistent results; for example, the account aggregator framework initially faced few setbacks due to the coordination of regulators, financial institutions, and technology companies. In addition to setting and implementing the right policy, the issue of transparency and governance, in order to build trust among the users, will always play a crucial part, particularly among people who are not technology friendly. Concerns about fraud, data misuse, and the absence of an effective grievance redressal system can further set the DPI and financial inclusion success backward.

h) Risk of Exclusion: Over-reliance on digital channels may leave certain strata of the population, such as the elderly, differently abled, or people who are not tech-savvy, therefore even when DPI is implemented 100%, we also we need to create a balanced financial ecosystem that doesn't exclude anyone from the formal banking system. In addition to this, in case of biometric or inefficiencies in the relevant data, especially in the case of credit, the DPI systems will need human intervention to remove any bias or discrimination.

Apart from all the above challenges, it should be ensured that DPI systems should not be led by monopolistic or oligopolistic structures to avoid high prices, limited or no competition, and restricted entries for other players. To avoid such issues and address the above challenges, DPIs need to be well governed and properly regulated; otherwise, the absence of competition may affect the quality of service and product and may also hinder the entry of innovative ideas and may make the DPI infrastructure outdated.

THE WAY FORWARD:

The future of digital public infrastructure lies in embracing the advanced technologies such as artificial intelligence and blockchain to make continuous progress in embracing innovation and promoting inclusivity. The integration of existing DPI systems can help in improving efficiency and service delivery and may also help in strengthening cybersecurity amidst the ongoing menace of digital fraud. Building on the success of UPI, the RBI has launched new initiatives like the Account Aggregator Framework, which would promote 'Open Banking.'. The advanced technologies at hand and supported by robust legal, governance, and regulatory policies, the success of UPI can be repeated in the space of cross-border payments and digital lending. Another revolutionary development is OCEN, which can enhance the lending capabilities of financial institutions to push further the process of financial inclusion in the right direction. DPI and policies must focus on user-centric interfaces, strong data privacy, and more investment in public-private partnerships to scale the DPI-backed services in rural and remote areas of the country. More attention will be required for addressing digital literacy and the gender divide for attaining equitable growth in the economy.

CONCLUSION:

From transforming and bringing impact in schemes like Jan Dhan Yojana, Suraksha Beema Yojana, Atal Pension Yojana, and Mudra Yojana, DPI has emerged as a revolutionary force. DPI has enabled financial inclusion and has empowered millions of people in the country by creating a robust ground for initiatives like UPI, Aadhar, and JAM Trinity, and the success of these initiatives is likely to lay the foundation for new initiatives such as the Account Aggregator Framework, OCEN, and Unified Lending Interface for the creation of a streamlined credit delivery robust ecosystem. The DPI evolution has not only improved the delivery of banking services and products, but it has proved how technology can be leveraged to address and tackle the socio-economic challenges.

The challenges, like the digital divide, ever-growing concerns of security and privacy issues with the rising number of fraud cases, and gaps in infrastructures, need immediate attention. The future of DPI in furthering financial inclusion lies in the integration of new and emerging technologies such as AI and blockchain. India's

DPI success exemplifies how the use of the right technology can not only create a model for the whole nation to rely upon but can also become a model for other emerging economies. With continuous efforts and the adoption of advanced technologies, DPI can continue driving economic and social empowerment and reduce inequality while paving the way for a robust and inclusive economy.

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BRIEF BIODATA



I joined State bank as a Probationary Officer in 2012. I am a Mathematics Graduate and also hold an MBA (Finance) degree. In addition to this I also hold certificates such as, CAIIB, CICC (Moody's), NSE's Certification in Investment Analysis and Portfolio Management and Certification in MSME & Working Capital Lending by CRISIL, Certificate in Climate

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