India–ASEAN Cooperation:

Pilot Study on Digital Public Infrastructure Collaboration

ERIA

Economic Research Institute
for ASEAN and East Asia

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List of Abbreviations

4G	Fourth Generation
AA	Account Aggregator
ABIS	Automated Biometric Identification System
AECC	ASEAN Economic Community Council
AePS	Aadhaar Enabled Payment System
AITIGA	ASEAN–India Trade in Goods Agreement
AOIP	ASEAN's Outlook on Indo-Pacific
APB	Aadhaar Payment Bridge
APEX	API Exchange
API	Application Programming Interface
ASEAN	Association of South East Asian Nations
ATM	Automated Teller Machine
B2B	Business to Business
BBPS	Bharath Bill Payment System
BC	Business Correspondent
BDCB	Brunei Darussalam Central Bank
BPJS	Badan Penyelenggara Jaminan Sosial Kesehatan
BPO	Business Process Outsourcing
CB	Capacity Building
CDD	Customer Due Diligence
COVID-19	Corona Virus Disease 19
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
DBT	Direct Benefits Transfers
DEFA	Digital Economy Framework Agreement
DIFAP	Digital Integration Framework Action Plan
DPI	Digital Public Infrastructure
DR	Depository Receipt
DT	Digital Technology
e-KYC	Electronically Know Your Customer
EAS	East Asia Summit
ERIA	Economic Research Institute for ASEAN and East Asia
FIP	Financial Information Provider
FIU	Financial Information User
FPS	Fast Payment Systems
FTA	Free Trade Agreement
G2G	Government to Government
G2P	Government to Person
GDP	Gross Domestic Product
GIFT	Gujarat International Finance Tec-City

GSTN	Goods and Services Tax Network
GVC	Global Value Chain
IBU	IFSC Banking Unit
ICT	Information and Communication Technology
ID	Identity
ID4D	ID for Development
IFSC	International Financial Services Center
IFSCA	International Financial Services Center Authority
IMF	International Monetary Fund
INSW	Indonesia National Single Window
IPO	Initial Public Offering
IPOI	Indo-Pacific Ocean Initiative
IPR	Intellectual Property Rights
ISEAS	Institute of Southeast Asian Studies
IT	Information Technology
ITA	Information Technology Agreement
ITO	Information Technology Outsourcing
ITU	International Telecommunications Union
JAM	Jan Dhan, Aadhaar, Mobile
KPI	Key Performance Indicator
KYC	Know Your Customer
LTE	Long Term Evolution
MA	Market Access
MDR	Merchant Discount Rate
MFI	Micro Finance Institution
MOSIP	Modular Open Source Identity Platform
MoU	Memorandum of Understanding
MPU	Myanmar Payment Union
MSME	Micro, Small and Medium Enterprises
NAPAS	National Payment Corporation of Vietnam
NBFC	Non-Banking Financial Companies
NCDB	National Centralised Database
NDI	National Digital ID
NDID	National Digital ID
NGO	Non-Governmental Organisation
NIH	National Information Hub
NPCI	National Payments Corporation of India
NRC	National Registration Card
NRI	Non Resident Indian
NSE	National Securities Exchange
NSPC	National Social Protection Council
NTM	Non-Tariff Measures
PFMS	Public Finance Management System

PKI	Public Key Infrastructure
PMJDY	Pradhan Mantri Jan-Dhan Yojana
PoS	Point of Sale
PSP	Payment Service Provider
QR	Quick Response code
RBI	Reserve Bank of India
RCEP	Regional Comprehensive Economic Partnership
RTA	Regional Trade Agreement
RTGS	Real Time Gross Settlement
SBI	Secure Biometric Interface
SDK	Software Development Kit
SFB	Small Finance Bank
SHG	Self Help Group
SME	Small and Medium Enterprises
UIN	Unique Identity Numbers
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UPI	Unified Payments Interface
USAID	U.S. Agency for International Development
WCO	World Customs Organisations
WTO	World Trade Organisation

Executive Summary

The 21st century has witnessed the transformative power of digitalisation, significantly reshaping global economic and cultural landscapes. This study focuses on the impact of Digital Public Infrastructure (DPI) on economic integration and cultural exchange, particularly between India and Southeast Asia. The historical ties between India and Southeast Asia provides wider potential business opportunities for creation of Digital Architecture enabling connected businesses to operate more efficiently, grow with innovation and meet the changing demands of customers.

India has established a robust DPI supported by various initiatives from the government, regulators, market, and civil society. Key components include Aadhaar, a comprehensive biometric identity system with 1.38 billion holders, enabling 1.96 billion authentications per month; the Jan-Dhan Scheme, a low-cost zero-balance bank account which delivered financial inclusion by onboarding over 500 million new accounts and manages more than US$24 billion in deposits; the Unified Payments Interface (UPI), a low-cost real-time bank-to-bank payment system facilitating more than 12 billion transactions every month via banks and fintech apps; the Direct Benefits Transfers (DBT) programme having delivered more than US$427 billion worth of cash and in-kind benefits covering 310 different government schemes managed by 53 ministries and saved US$42 billion in the last decade. These initiatives have significantly advanced financial inclusion, quick and wider credit access, penetration of insurance for needy and under privileged, and overall economic growth in India. Further, establishment of GIFT City is developing an ecosystem for economic activities on par with global regulations, taxation, other economic policies for free flow of financial and economic resources across the countries.

This report outlines below a comprehensive set of recommendations for the strategic implementation of DPI to support digital transformation efforts in ASEAN countries.

Enhance Physical IDs:

- Add digitally signed QR codes to physical ID cards to support e-authentication, e-KYC, and single sign-on.

- Allow multiple digitally verifiable IDs for different purposes (individual, business, tax).

Standardise Digital Payments:

- Set a common specification for QR codes to ensure wallet interoperability.

- Maintain money movement through banks while fintechs handle user experience.

Digitise Paper-Based Certificates:

- Include digitally signed QR codes to make certificates with verifiable credentials.

- Facilitate both synchronous and asynchronous data sharing with regulatory oversight.

Optimise Social Benefit Schemes:

- Integrate a G2P mapper to route money to any ID number, allowing for choice in bank accounts and reducing leakage.

- Design digital signatures and PKI for future DPI builds.

- Implement an Open API policy for third-party interface integration.

- Develop a volunteer policy to utilise individual capabilities and close capacity gaps.

Designing a DPI-Informed Digital Transformation Strategy is an eco-system wide effort. A well-run programme is led by a Financial Regulatory, Finance and IT Ministries, departments of the government which manage IDs (National ID, tax ID etc.) and social benefits programmes, banks and financial market participants, and a payment switch operator.

Figure 1: An eco-system view of how to build out DPI in a country
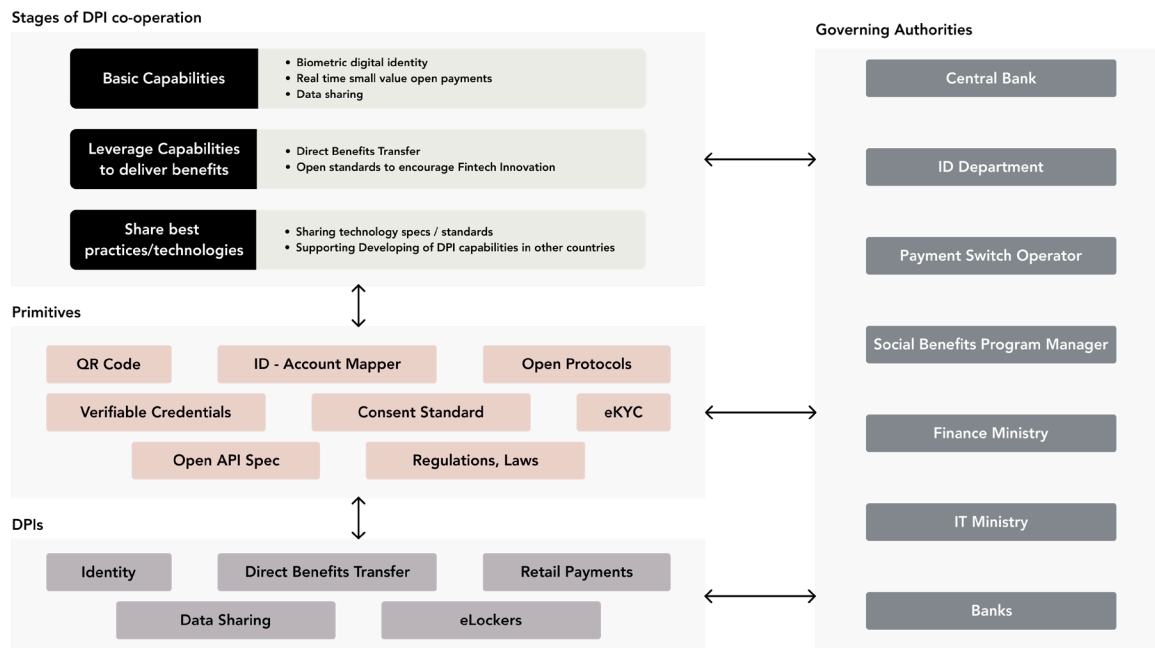
Implementation Strategy: Phased Approach

- **Phase 1: Planning and Alignment**: Define the vision, engage stakeholders, and conduct a needs assessment.

- **Phase 2: Pilot and Proof of Concept**: Implement the chosen first use case to demonstrate feasibility and gather feedback.

- **Phase 3: Scale and Integrate**: Expand DPI implementation to other use cases and sectors based on the success of the pilot phase.

- **Phase 4: Continuous Improvement**: Regularly evaluate and refine DPI systems to ensure they remain effective and secure.

Monitoring and Evaluation

- **Key Performance Indicators (KPIs)**: Develop KPIs to measure the success of DPI initiatives, including user adoption rates, transaction volumes, and service delivery improvements.

- **Feedback Mechanisms**: Establish mechanisms for continuous feedback from users and stakeholders to inform ongoing improvements.

For each country, here's what we recommend to be the initial steps on the path of building out world class DPI.

Here is a summary of our **country-wise recommendations:**

Given the state of digital infrastructure in **Cambodia, Lao PDR, Myanmar, and Timor-Leste**, we recommend that they start by building out a **national-scale digital ID system** which may be used to identify a unique individual digitally and correctly using technologies like biometrics and facial recognition. This will become the foundation for the next set of DPIs that can have second order impact on the rest of the economy including, but not limited to – Direct Benefits Programs, eKYCs which will accelerate bank account penetration and so on. India has an entity named MOSIP which is designed to apply all its learnings from its ID programme [Aadhaar] and apply it in the context of other countries

For **Indonesia, Malaysia, Thailand, Brunei, Viet Nam, and Philippine**s, we recommend that the prevailing national ID and payment systems be enhanced to make population-scale **benefits programme cheaper and leakage-proof**. This would involve enhancing the payment switch operator with an ID-Account mapper, advancing the national ID system to include an eKYC component and working with the banking regulators and the financial system to scale up bank account penetration to more than 80% for all citizens above the age of 15.

For **Singapore**, we believe that both India and Singapore would benefit more by integrating our financial systems more closely, by starting with the retail payment systems. Consider areas of improvement along the lines of citizens of either country being able to merchants in the others in a real time fashion, exchange rate risk and transaction costs minimised to handle such cross-border transactions.

The details of our findings and MOSIP's capabilities are provided later in this paper.

In conclusion, Digital Public Infrastructure has the potential to significantly enhance economic integration and cultural exchange between India and Southeast Asia. By addressing the challenges and implementing the proposed recommendations through a coordinated roadmap, both regions can harness the power of digital technologies to drive sustainable development and mutual prosperity.

Chapter 1

Introduction

Digitalisation has become a transformative force in the 21st century, reshaping the global landscape across economic and cultural dimensions. We explore how digitalisation is driving cross-country cooperation, with a focus on its impact on economic integration and cultural exchange. Additionally, we delve into historical ties between India and Southeast Asia to illustrate the long-standing relationships that continue to evolve in the digital age.

1. Economic Cooperation through Digitalisation

Digitalisation has significantly influenced economic cooperation by revolutionising trade and investment patterns worldwide. Global GDP has been steadily increasing, and digital technologies have played a crucial role in driving this growth. According to the World Bank, global GDP reached US$105 trillion in 2023[1], with digital technologies (DTs) contributing significantly to productivity gains and innovation across various sectors.

Recent studies (Castro, Fernandez, and Colsa, 2021; Brenner and Hartil, 2021) in the field of innovation and strategic management have argued that digitalisation can be considered a promising approach to support the process of sustainable transformation.

DTs can improve trade flows by reducing the costs of searching for, matching with, and communicating with international stakeholders (Hagsten and Kotnik, 2017). Second, DTs provide additional channels for marketing and sales, allowing companies to reach a broader base of customers and suppliers. Moreover, DTs enable firms to source inputs and organise production more efficiently, thus improving their productivity and becoming more competitive (Añón Higón and Bonvin, 2022; Fernandes et al., 2019). Additionally, advances in digitalisation can be leveraged to facilitate the outsourcing of non-core activities and support the integration into global value chains (GVCs).

One of the primary effects of digitalisation on economic cooperation is the expansion of cross-border trade. The growth in e-commerce platforms and digital marketplaces has enabled businesses to connect with consumers and suppliers globally, transcending geographical barriers. Worldwide e-commerce sales for B2B businesses have been steadily rising for the last decade, with the global B2B e-commerce market valued at US$36 trillion by 2026. Heavy industries such as advanced manufacturing, energy, healthcare, and professional business services segments drive the majority of this B2B sales value.[2]

Furthermore, digitalisation has facilitated the rise of global supply chains, where goods are manufactured, assembled, and distributed across multiple countries. This interconnectedness has led to greater efficiency and cost-effectiveness in production processes. According to the World Trade Organization (WTO)[3], merchandise trade reached US$23.8 trillion in 2023[4], with digital technologies playing a critical role in facilitating the movement of goods and services across borders.

2. India and Southeast Asia: Historical and Economic Ties

The historical relationship between India and Southeast Asia dates back thousands of years, characterised by trade, cultural exchange, and diplomatic ties. The maritime Silk Road facilitated the exchange of goods, ideas, and religious beliefs between the two regions, shaping their shared history and cultural heritage.

India's economic ties with Southeast Asia have strengthened in recent decades, driven by factors such as geographical proximity, historical linkages, and complementary economies. India's 'Look East' policy, launched in the early 1990s, aimed to enhance economic and strategic cooperation with Southeast Asian countries, leading to the establishment of various trade agreements and partnerships.

India's 'Look East Policy', enunciated in 1992, was implemented in two phases. The first phase (1991–2003) focused on the development of trade and investment linkages with the ASEAN members. The second phase, which started in 2004, expanded the policy to include strategic relations such as security dialogues, political consultations, and joint military exercises with both ASEAN and non-ASEAN countries such as Japan, the Republic of Korea, and Australia. In 2011, US Secretary of State Hillary Clinton, on a visit to India, emphasised the need for India to be more active in the Asia-Pacific region. She appealed to India to 'Act East' instead of just 'looking east.' In 2014 the then External Affairs Minister declared that India was now ready to 'Act East.'[5]

According to the Ministry of Commerce and Industry, India's, imports from the Association of Southeast Asian Nations (ASEAN) is US$79.33 billion for the financial year 2023–24, while exports to ASEAN are US$41.21 billion for the corresponding period. India's imports constitute 12% from ASEAN, indicating ASEAN as India's third-largest partner in imports, while exports to ASEAN are 9%, ranking ASEAN as India's 13th largest export destination.

3. Business-to-Business Cooperation between India and Southeast Asia

Digitalisation has played a crucial role in facilitating B2B cooperation between India and Southeast Asia, enabling companies from both regions to collaborate and create value-added partnerships. One prominent example is the growth of business process outsourcing (BPO) and information technology outsourcing (ITO) services, where Indian companies provide technology and back-office support to businesses in Southeast Asia.

Indian IT firms such as Tata Consultancy Services (TCS), Infosys, and Wipro have established a strong presence in Southeast Asia, providing services such as software development, cloud computing, and digital transformation solutions to companies in the region. These partnerships have helped Southeast Asian businesses enhance their technological capabilities and competitiveness in the global market.

Moreover, digitalisation has facilitated collaboration between startups and small and medium-sized enterprises (SMEs) in India and Southeast Asia. Online platforms and digital marketplaces have enabled startups to connect with investors, mentors, and potential partners across borders, fostering innovation and entrepreneurship in both regions.

Additionally, digitalisation has streamlined trade and logistics processes, reduced transaction costs and improved supply chain efficiency for businesses in India and Southeast Asia. Digital platforms for trade facilitation, such as electronic customs clearance systems and online trade documentation services, have simplified cross-border transactions and enabled faster movement of goods between the two regions.

4. Digitalisation and Cultural Exchange

Digitalisation has also played a crucial role in fostering cultural exchange, improving soft skills, and maintaining harmonious relations and understanding between countries. Social media platforms, online forums, and digital content-sharing platforms have enabled people from diverse cultural backgrounds to connect and interact in ways never before possible. This virtual connectivity has facilitated the exchange of ideas, values, and perspectives, breaking down stereotypes and fostering empathy and mutual respect.

Moreover, digitalisation has democratised access to cultural content, allowing people from different countries to explore and appreciate each other's cultures. Streaming services, online libraries, and digital archives provide easy access to music, literature, films, and artworks from around the world, enriching cultural experiences and promoting cross-cultural dialogue.

5. India and Southeast Asia: Cultural Bonds

The cultural ties between India and Southeast Asia have deep historical roots, dating back to ancient times. The spread of Hinduism and Buddhism from India to Southeast Asia led to the development of vibrant cultural traditions and artistic expressions in the region. The architectural marvels of Angkor Wat in Cambodia and Borobudur in Indonesia stand as a testament to this shared heritage.[6]

In modern times, cultural exchanges between India and Southeast Asia continue to flourish, facilitated by digital technologies. Bollywood movies and Indian television serials enjoy immense popularity in Southeast Asia, while Southeast Asian cuisines and martial arts have gained a following in India.[7] Social media platforms such as Facebook and Instagram have become virtual hubs for sharing cultural experiences and promoting cross-cultural understanding between the two regions.

6. Challenges and Opportunities

While digitalisation has opened new avenues for cross-country cooperation, it also poses challenges that need to be addressed. One of the primary challenges is the digital divide, where disparities in access to technology hinder the participation of certain countries and communities in the digital economy. According to the International Telecommunication Union (ITU), only 67% of the world's population had access to the internet in 2023, highlighting the need for greater investment in digital infrastructure and literacy.

Additionally, concerns about data privacy and cybersecurity pose risks to cross-border cooperation in the digital realm. The proliferation of cyber threats, such as hacking and data breaches, underscores the importance of establishing robust regulatory frameworks and

international cooperation mechanisms to safeguard digital transactions and information exchange.

However, amidst these challenges, digitalisation also presents immense opportunities for enhancing cross-country cooperation. The rise of digital platforms and virtual collaboration tools has made it easier for businesses, governments, and civil society organisations to connect and collaborate across borders. For instance, virtual summits and conferences have become commonplace, allowing leaders and policymakers to discuss pressing issues and explore opportunities for cooperation in real time.

7. Outcomes from the 20th ASEAN–India Summit

At the landmark event of the ASEAN–India Summit of September 2023, the Indian Prime Minister, Mr Narendra Modi, held extensive discussions with ASEAN partners on strengthening of the ASEAN–India Comprehensive Strategic Partnership and charting its future course. The Prime Minister reaffirmed ASEAN's centrality in the Indo-Pacific and highlighted the synergies between India's Indo-Pacific Ocean Initiative (IPOI) and ASEAN's outlook on the Indo-Pacific (AOIP). He emphasised the need to complete the review of ASEAN–India FTA (AITIGA) in a time-bound manner.

The Prime Minister presented a 12-point proposal for strengthening India–ASEAN cooperation, covering connectivity, digital transformation, trade, and economic engagement, addressing contemporary challenges, people-to-people contacts, and deepening strategic engagement. The salient points are as follows[8]:

- Establishment of multi-modal connectivity and economic corridor that links South-East Asia–India–West Asia–Europe.

- Offered to share India's digital public infrastructure stack with ASEAN partners.

- Announced ASEAN–India fund for Digital Future focusing on cooperation in digital transformation and financial connectivity.

- Announced renewal of support to the Economic and Research Institute of ASEAN and East Asia (ERIA) to act as a knowledge partner for enhancing our engagement.

- Called for collectively raising issues being faced by the global south in multilateral fora.

- Invited ASEAN countries to join the Global Centre for Traditional Medicine being established by WHO in India

- Called for working together on Mission LiFE

- Offered to share India's experience in providing affordable and quality medicines to people through Jan-Aushadhi Kendras

- Called for a collective fight against terrorism, terror financing, and cyber-disinformation.

- Invited ASEAN countries to join Coalition for Disaster Resilient Infrastructure.

- Called for cooperation in disaster management.

- Called for enhanced cooperation on maritime safety, security, and domain awareness.

- Two Joint Statements, one on Maritime Cooperation, and the other on Food Security were adopted.

- In addition to India and ASEAN Leaders, Timor-Leste participated in the Summit as an Observer.

8. Key Elements of the India–ASEAN Relationship

The geopolitical landscape of the Asia-Pacific region has undergone significant transformations over the past 2 decades, primarily influenced by the rise of China and the strategic responses of the United States. For ASEAN, this evolving international order, characterised by Sino–US competition, presents considerable challenges.

India's emergence as a significant global player has coincided with ASEAN's search for new strategic partners. According to the United Nations Department of Economic and Social Affairs, India's population is projected to surpass that of China. Economically, India achieved an average annual growth rate of 5.5% from 2002 to 2022, and projections by Morgan Stanley suggest that its GDP could exceed US$7.5 trillion by 2031, up from US$3.5 trillion today. Furthermore, India has seen improvements in internal stability, with reductions in religious and caste violence, terrorist attacks, and riots over the first 2 decades of this century compared to the preceding 2 decades.

The latest survey by the ISEAS–Yusof Ishak Institute[9] revealed that India is increasingly viewed as a viable 'third party' partner for ASEAN, with 11.3% of respondents favouring India, ranking it behind the European Union (42.9%) and Japan (26.6%). Seah et al. (2023) also mentions that, additionally, trust in India has risen significantly across ASEAN countries, with overall trust increasing from 16.6% in 2022 to 25.7% in 2023, accompanied by a corresponding decrease in distrust levels. The survey highlights three important challenges of Southeast Asia – fear of unemployment and economic recession, intense weather events, climate change consequent adverse effect on economies, and widening socio economic gaps and rising income disparity.

India has made extensive efforts to reduce the unemployment, income disparities, unemployment and improving public health by establishment of Digital Public Infrastructure (DPI) and digitalisation. Studies (Ahamed and Al-Roubaie, 2013; and Faiza, Yamada, and Pratomo, 2021) have found that digitalisation has income-generating and poverty-reducing effects that can reduce income inequality and contribute to shared prosperity and inclusive growth. Recent evidence shows that digitalisation can positively impact public health through the intermediary channel of suppressing income inequality (Wang and Xu, 2023) in developing countries. Thus, an examination of India's DPI would be helpful to ASEAN to address the challenges.

Chapter 2

DPI: Overview and Cross-Country Comparison

1. Status of Digital Public Infrastructure in ASEAN Member Countries

The digital landscape in the ASEAN member countries presents a diverse and evolving ecosystem of digital public infrastructure. This section delves into the status of key components of digital infrastructure, including internet penetration, identity systems, payment mechanisms, data sharing frameworks, and the digitisation of government services, across each ASEAN country individually. By examining the unique advancements and challenges in digital infrastructure within the ASEAN region, a comprehensive understanding of the digital transformation journey in these countries emerges. Let us explore the digital footprints of each ASEAN Member State to uncover the intricacies of their Digital Public Infrastructure (DPI) frameworks.

1.1. Government IDs

The digital capabilities of government-recognised identification (ID) systems primarily are: (i) digitally stored records; (ii) digital verification or authentication for in-person transactions; and (iii) digital authentication for online transactions.

The ID4D Global Dataset as mentioned in Metz, Casher, and Clark (2021) estimates that as of 2021, 850 million people globally do not have official proof of their identity. This analysis is based on primary data collection from ID authorities (2021–2022), data from the 2021 World Development Report's Global Data Regulation Survey, and desk research.

In more than 90% of countries globally, ID systems now rely on digital data; two-thirds of countries offer at least a basic type of digital identity verification or authentication for in-person transactions; and about 40% of countries – primarily high-income ones – have a digital ID ecosystem that enables fully remote, secure authentication for online transactions. These findings suggest that, in addition to the estimated 850 million people globally who do not have official identification, many more do not have official, digitally verifiable identity credentials or credentials that would allow them to securely transact in online contexts. The survey reveals that at least 1.1 billion people do not have a digital record of their identity; 1.25 billion people do not have a digitally verifiable identity; and 3.3 billion people do not have access to a government-recognised digital identity to transact online securely.

The foundations of digitalisation are ensuring inclusivity and trust – The digitalisation of Civil Register and ID systems drive efficiency, transparency, and convenience for users in the public and private sectors. Digitalisation can strengthen the security and reliability of identity documents and enable new modes of identity verification and authentication that allow for higher-assurance transactions completing quickly and in a more user-friendly way. Desai et. al (2023) observe that when digital identification systems are designed as digital public infrastructure – that is, as open resources for the public and private sector to innovate on top of – there is even more scope for compounding benefits, such as creating new opportunities for digital service delivery and expanding the digital economy, including e-commerce and online employment opportunities. At the same time, digitalisation also introduces new risks, such as possible exclusion of certain

vulnerable individuals and groups due to gaps in digital connectivity and lack of skills or technology failures. The second most important risk is data breaches and misuse on an extended scale and excess dependency on or lock-in by vendors. The third risk is financially unsustainable investments in high-tech solutions that are not well-suited to local contexts. As systems' digital capabilities advance, these risks need to be carefully managed.

Table 1: Status of government ID systems across ASEAN

	Personal Identity			
	Population (Mn)	Coverage	Digital Data	Digital Verification
Brunei	0.5		✓	✓
Myanmar	55.8	87.8%	✓	✓
Cambodia	17.1	89.6%	✓	✗
Indonesia	279.1	96.7%	✓	✓
Lao PDR	7.5	55.3%	✓	✗
Malaysia	33.4	95.9%	✓	✓
Philippines	112.9		✓	✓
Singapore	5.9	96.9%	✓	✓
Thailand	68.3	98.9%	✓	✓
Timor Leste	1.4		✓	✗
Viet Nam	100.3	97%	✓	✓

Source: World Bank data on country wise 2022 population[10]; Metz, Casher, and Clark, 2024, Volume 1; Metz, Casher, and Clark, 2024, Volume 2.

1.2. Real-Time Digital Payments

Payment and settlement systems are mechanisms established to facilitate the clearing and settlement of monetary and other financial transactions. Secure, affordable, and accessible payment systems and services promote development, support financial stability, and help in expanding financial inclusion.

New applications of technology to financial services, often referred to as 'fintech', have accelerated in recent years. These developments have implications for how transaction accounts are provided, accessed, and used as they underpin new products and services, such as instant payments, and enable new access modes, such as electronic wallets.

Fast (retail) payment systems (FPSs) have been (or are being) developed in many countries. FPS is a system in which the transmission of the payment message and the availability of the final funds to the payee occur on a real-time basis and on a 24/7 basis. While closed-loop systems can also be nearly real-time and available 24/7, FPSs are payment infrastructure that facilitates payments between account holders at multiple Payment Service Providers (PSPs) rather than just

between the customers of the same PSP. The adoption speed is much like that of wholesale real-time gross settlement (RTGS) systems. An interesting observation is that early adopters are predominantly emerging markets rather than advanced economies.

In addition to state-of-the-art processes for customer onboarding and the related KYC checks, PSPs can enhance customer behaviour profiling, conducting (technical) front-end profiling of customer usage patterns for mobile devices, browsers, etc, covering a large number and wide range of technical attributes; (business) back-end profiling of customer transactions; and additional third-party provider profiling.

Cumbersome and costly customer due diligence (CDD) requirements are one of the factors constraining PSPs' ability to strike a balance between costs and functionality and to design transaction accounts that meet the needs of the target population. Digital IDs can help financial institutions comply with the customer identification and verification components of CDD.[11] First, digital ID supports e-KYC processes, thereby lowering transaction costs for providers through the near elimination of paperwork as well as the burden of keeping paper records and facilitating audit and forensics through the electronic storage of information. From a user perspective, cost savings can be passed on to consumers through lower fees. Furthermore, new clients may find the process of opening an account less cumbersome when it entails e-KYC[12] instead of paper-based documentation.

In addition, digital ID infrastructures can help realise the opportunity to digitalise government payments. For example, digitalised databases of records, compared with physical ledgers stored in a local office, make it easier to verify a person's records remotely, creating efficiencies for service delivery and allowing ID agencies to replace credentials and records that have been lost, stolen, or destroyed. Digital authentication mechanisms facilitate automated transactions that are more secure and reliable than manual authentication (i.e. visually comparing a person presenting an ID against their photo) and can reduce the amount of personal information revealed in a transaction (e.g. attribute-based credentials). The use of automated biometric recognition (e.g. fingerprints or iris scans) can help ensure that identities are unique (i.e. that people cannot enrol multiple times) and provide a convenient, password-free method of authentication.

Table 2: Status of Payment Systems across ASEAN

Country	Real-Time Payments						
	Public infrastructure for small value payments	Linked to Personal Identity	Mobile payment	P2P	Merchant Payments	G2P Payments	Open API
Brunei	✗	✗	✗	✗	✗	✗	✗
Myanmar	✓	✗	✓	✓	✓	✗	✓
Cambodia	✓	✗	✓	✓	✓	✗	✓
Indonesia	✓	✓	✓	✓	✓	✓	✓
Lao PDR	✗	✗	✗	✗	✗	✗	✗
Malaysia	✓	✓	✓	✓	✓	✓	✓
Philippines	✓	✓	✓	✓	✓	✓	✓
Singapore	✓	✓	✓	✓	✓	✓	✓
Thailand	✓	✓	✓	✓	✓	✓	✓
Timor Leste	NA (US$ is currency)	NA	NA	NA	NA	NA	NA
Viet Nam	✓	✓	✓	✓	✓	✓	✓

Source: Monetary Operations – BDCB.[13] NimbleAppGenie (April 2024)[14]; Cambodia's Bakong surpasses 10 million accounts – Khmer Times[15]; Ramandeep Bhamra (April 2021). Cambodia: New Transaction Amounts & Know Your Customer Procedures for Financial Institutions & Payment Service Providers[16]; Bank of the Lao P.D.R[17]; PromptPay[18]; NAPAS FASTFUND 247.[19]

1.3. Data sharing and Open banking

Open banking is defined as the sharing and leveraging of customer-permission data by banks with third-party developers and firms to build applications and services and to initiate payments. Retail customer data held by banks (e.g. customer transactions, personal identification data, and customer financial history) is permissioned by the bank's customer to be accessed by a third party (and possibly shared onwards with fourth parties). Individual jurisdictions may define open banking differently.

Open banking initiatives may vary from country to country with respect to their nature and scope. Some initiatives are driven by regulatory requirements (e.g. in the European Union) so that banks are required to share certain customer data with authorised third parties. These requirements may or may not include the use of a standardised, common API. Regulators' objectives include increasing competition and levelling the playing field for new market entrants, as well as fostering innovation. Other open banking initiatives are driven by the industry (e.g. in the United States)

and/or championed by public authorities (e.g. in Singapore). Regarding the scope of the data shared, open banking initiatives may be confined to transaction account data only or extend to a broader range of financial accounts.

Table 3: Status of Data Sharing and Open Banking Standards across ASEAN

	Data Sharing			
	Document		Data	
	Goverment2Person	Company2Company	Goverment2Person	Company2Company
Brunei	✘	✘	✘	✘
Myanmar	✘	✘	✘	✘
Cambodia	✘	✘	✘	✘
Indonesia	✘	✘	✘	✘
Lao PDR	✘	✘	✘	✘
Malaysia	✓	✘	✓	✘
Philippines	✘	✘	✘	✘
Singapore	✓	✘	✓	✘
Thailand	✘	✘	✘	✘
Timor Leste	✘	✘	✘	✘
Viet Nam	✘	✘	✘	✘

Source: MyGDX | Malaysian Government Central Data Exchange.[20] IMF (Oct 2023). Digitization in Brunei and Singapore.[21] National Digital Identity and Government Data Sharing in Singapore[22] – World Bank.

2. Country-Specific Overview of Digital Public Infrastructure in ASEAN

In this section, we delve into the digital public infrastructure (DPI) developments across various ASEAN countries. Each country is actively pursuing initiatives to enhance its digital ecosystem, focusing on digital identity, payments, data sharing, and access to government services. By examining these efforts, we gain insight into the unique challenges and strategic approaches each country employs to foster digital transformation and drive economic growth.

2.1. Brunei

The digital public infrastructure in Brunei is undergoing development with a focus on digital transformation and enhancing connectivity. The authorities in Brunei launched the Digital Economy Master Plan 2025 to accelerate digital transformation efforts, with strategic initiatives aimed at improving digital infrastructure and services. However, overall progress has been deemed insufficient due to various reasons, impacting industry and the economy. The country has allocated funds for projects such as the Government Data Centre, Cloud Infrastructure, IT Central Procurement project, and the National Education Management System[23] to support digital endeavours.

In Brunei, digital identity and authentication, payments, data sharing, and accessing government services are key components of the digital public infrastructure. The absence of specific data protection legislation poses challenges for businesses involved in processing personal data, hindering growth opportunities. The country's rank in the Global Innovation Index has fluctuated, indicating areas of weakness in knowledge and technology outputs, e-participation, government online services, and ICT access. Efforts are needed to deepen private sector involvement in utilising digital technologies to create new services and improve innovation.

The Digital Economy Master Plan in Brunei emphasises the importance of digital infrastructure in driving economic growth and innovation. The plan includes projects like the Digital Identity Project and the Digital Payment Hub Project, which are crucial for establishing a robust digital ecosystem. The country's focus on public sector-driven projects highlights the government's role in spearheading digital initiatives to enhance service delivery and promote digital transformation. Strengthening data protection laws and fostering public–private partnerships are essential for creating a conducive environment for digital innovation and growth in Brunei.

The National Information Hub (NIH) is a key flagship project under Brunei's Digital Economy Master Plan 2025, aimed at enabling secure sharing of data within the government. Launched in June 2021, the NIH facilitates[24] collaboration by allowing six agencies to function as Data Providers and nine as primary Data Users, with plans to expand participation further by 2022. The storage capacity and functionality[25] of this Hub will be further improved with the current implementation of a National Centralized Database (NCDB) infrastructure.

The NIH is part of Brunei's efforts to transform into a smart nation through digital transformation. It is one of three key flagship projects identified under the Smart Nation Platform, along with the Digital Identity and Digital Payment Hub initiatives. The NIH underscores Brunei's commitment to leveraging technology for efficient governance and improved public services by enabling secure data exchange and storage amongst government agencies.

In the context of digital trade facilitation, Brunei is working towards enhancing cross-border transactions and reducing trade costs through digital technologies. The country's digital infrastructure plays a vital role in streamlining trade processes, improving logistics, and facilitating secure data sharing. Initiatives like the Digital Economy Master Plan and public sector-driven projects are instrumental in promoting digital connectivity and trade facilitation. Collaborative efforts between government, businesses, and international organisations are essential for leveraging digital technologies to drive economic growth and enhance trade efficiency in Brunei as per the IMF [26] (2023) report.

In conclusion, Brunei's digital public infrastructure is evolving to support digital identity, payments, data sharing, and government services. The country's focus on digital transformation and innovation underscores its commitment to enhancing connectivity and fostering a conducive environment for digital growth. By investing in digital infrastructure and promoting digital initiatives, Brunei aims to position itself as a digital leader in the region, driving economic development and improving service delivery for its citizens. Collaborative partnerships and strategic investments in digital technologies are key to realising the full potential of digital public infrastructure in Brunei.

2.2. Cambodia

Cambodia has been actively developing its digital public infrastructure to support the growth of its digital economy and society. A key initiative in this effort is the development of a comprehensive identity infrastructure. The National Social Protection Council (NSPC) [27] is planning to implement an integrated ICT-based service delivery system, which includes creating a universal and easily verifiable identification mechanism. This system will allow every resident to access public and social services efficiently.

Another critical component of Cambodia's digital infrastructure is its payment system. According to Setha (2024), during the 80th session of UNESCAP, the Bakong payment system was highlighted as a significant initiative that promotes mobile banking and digital financial services. This system enhances financial inclusion by enabling unbanked individuals and small businesses to participate in the formal economy.

The Cambodian government has also launched several initiatives to promote digital entrepreneurship and innovation. These initiatives include programmes for startups, incubation support, mentorship, and funding opportunities, as noted by Setha (2024). Furthermore, the development of a digital platform for informal economy enrolment aims to formalise and empower informal businesses, fostering economic growth and inclusivity.

The digitisation of services is driven by the need for greater efficiency in administering programmes. This includes minimising transaction costs and increasing transparency in identifying and managing beneficiaries. Such digital advancements are crucial for effective and timely social protection responses[27], particularly during emergencies like the COVID-19 pandemic.

Internet penetration in Cambodia has seen some fluctuations over recent years. In 2021, the World Bank reported that 60.15% of the Cambodian population used the internet. By early 2022, this rate had increased to 78.8% of the total population[28], before slightly decreasing to 67.5% in 2023. Despite these variations, a significant portion of the Cambodian population actively uses the internet, demonstrating the widespread reach of digital infrastructure.

These developments highlight Cambodia's commitment to building robust digital public infrastructure, which is essential for fostering innovation, promoting economic growth, and enhancing social welfare.

2.3. Indonesia

Indonesia has made significant strides in developing its digital public infrastructure, with plans to launch a digital ID, instant digital payments service, and a data exchange platform in the second half of 2024. These initiatives aim to create a comprehensive digital ecosystem that enhances access to government and private sector services, covering sectors like healthcare, education, social welfare, and police services (Macdonald, 2024). The introduction of a digital identity ecosystem will streamline access to public services, eliminating the need for physical identification and simplifying processes like document processing, healthcare registration, and education enrolment as mentioned by Macdonald (2024).

In parallel, Indonesia has progressed in digital infrastructure development, with a mobile phone penetration rate of 77% and 59% of the population already engaged in social media platforms. The government is focusing on expanding digital services, including e-government, e-taxation ecosystems, and the National Social Security Agency (BPJS) system, to enhance public service accessibility[29] and efficiency. Initiatives like the MPN G3 system for state revenues and platforms like E-Filing and Indonesia National Single Window (INSW) are enhancing public services through digital platforms, promoting financial inclusion by distributing cash social assistance directly to residents' bank accounts.

Moreover, Indonesia is leveraging digital public infrastructure to deliver nationwide conditional cash transfers for training provision, exemplified by the Kartu Prakerja Program. This initiative showcases the use of DPI, including API integration for systems supporting cash transfers, biometric verification, data exchange, and secure payment disbursement, ensuring fast, large-scale, and inclusive delivery of conditional cash transfers in a secure manner. Supangkat et al. (2023) have said that the integration of DPI in social protection programmes is crucial for responding effectively to challenges like the COVID-19 pandemic, ensuring that benefits reach the right recipients promptly and securely.

The country's digital infrastructure opportunity includes efforts to attract investment in data centres, critical for supporting the digital economy, financial markets, and employment. Indonesia has eased investment barriers[29] and provided incentives to attract investors in data centres, offering tax exemptions for significant investments. However, the energy-intensive nature of data centres poses environmental challenges that need to be addressed through innovative financing and technology options to ensure sustainable and inclusive digital infrastructure projects as purported by Wijaya (2023). The government's strategic plan for 2020–2024 includes the construction of national data centres, 4G network implementation, and the development of smart cities through fibre optic connections and base transceiver stations in rural areas.

In conclusion, Indonesia's digital public infrastructure development is advancing rapidly, with a focus on enhancing identity verification, expanding digital services, leveraging DPI for social programmes, and investing in critical data centre infrastructure. These efforts aim to improve public service delivery, promote financial inclusion, and drive economic growth through a robust and inclusive digital ecosystem.

2.4. Lao PDR

Lao PDR is undergoing a digital transformation, with efforts focused on improving digital infrastructure and connectivity. Runde, Bandura, and Lee (2022) say that despite investments in digital infrastructure, Lao PDR lags in digital adoption compared with other countries in East and Southeast Asia. They also say that the country faces challenges related to internet access, with just 43% of the population having internet access in 2020, compared with 70% in the East Asia and Pacific region. Additionally, Lao PDR has a lower rate of mobile phone subscriptions, with 61 subscriptions per 100 people, compared to almost 126 subscriptions per 100 people in the East Asia and Pacific region. These figures highlight the digital divide and the need for enhanced digital infrastructure to improve connectivity and access to digital services.

One of the key barriers to digital adoption in Lao PDR is affordability, with high costs associated with internet access. The average cost of fixed broadband in Lao PDR is US$53.41 per month, higher than in neighbouring countries like Cambodia and Thailand. Runde et al. (2022) say that rural communities face technology gaps due to geographical challenges, with limited access to fixed broadband and digital devices. Legal and regulatory frameworks also need strengthening to support the digital economy, including legislation to safeguard personal data, provide consumer protection, and establish guidelines for data collection. Strengthening these frameworks is essential for creating a conducive environment for digital transformation and enhancing digital services in Lao PDR.

The digitalisation of Lao PDR presents opportunities for improving government transparency, business environments, and human capital. The COVID-19 pandemic has accelerated digital reforms in Lao PDR, prompting the adoption of digital technologies in various sectors. To enhance the business environment and prepare the workforce for a digital future, the U.S. Agency for International Development (USAID) and development partners can support the Lao government in formalising the workforce, implementing digital payment systems, expanding internet protection rights, and integrating digital literacy curriculums. Runde et al. (2022) also say that digital transformation can simplify barriers to conducting business in Lao PDR, improve government services, and enhance the quality of education and human capital in the country.

In the context of Lao PDR, digital identity and authentication, payments, data sharing, and accessing government services are crucial components of the digital public infrastructure. Efforts to enhance digital identity and authentication can improve security and streamline access to services. Implementing digital payment systems can facilitate financial transactions and promote financial inclusion. Data-sharing initiatives can enhance collaboration between government agencies and service providers, improving service delivery and efficiency. Accessing government services digitally can enhance transparency, convenience, and accessibility for citizens, contributing to a more efficient and responsive governance system in Lao PDR.

To further advance digital infrastructure in Lao PDR, it is essential to address the barriers to digital adoption, strengthen legal and regulatory frameworks, and invest in digital literacy and skills development. By focusing on affordability, accessibility, and regulatory frameworks, Lao PDR can bridge the digital divide, enhance connectivity, and leverage digital technologies to drive economic growth and innovation. Collaborative efforts between government, development partners, and the private sector are crucial for building a robust digital ecosystem that benefits all citizens and contributes to sustainable development in Lao PDR.

2.5. Malaysia

Malaysia has been actively developing its digital public infrastructure to support the growth of its digital economy and society. A key focus has been on creating a robust digital identity infrastructure, which is essential for enhancing security, efficiency, financial inclusion, and access to public services for citizens. According to Zulkifli et al. (2024), the National Digital Identity (NDID) Program aims to provide a secure and efficient way for citizens to access digital services, ensuring that personal data is collected, processed, used, and protected appropriately.

In addition to identity infrastructure, Malaysia has been enhancing its payment infrastructure to support digital transactions. Various digital payment systems, such as the MPN G3 system for state revenues and the E-Filing system[30] for tax reporting by residents and entities, have been implemented to streamline financial transactions and improve financial inclusion (Khalid and Yang, 2024).

The Malaysian government has also been actively digitising various services. This includes e-government and e-taxation ecosystems, as well as the National Social Security Agency (BPJS)[30] system. These initiatives aim to improve public service delivery, enhance financial inclusion, and promote digital literacy amongst citizens.

To facilitate seamless data exchange amongst government agencies, private sector entities, and citizens, Malaysia has been developing data-sharing platforms. This effort includes establishing common standards for economy-wide data-sharing arrangements and enhancing data infrastructure to support real-time decision-making.

Significant progress has also been made in internet penetration. Khalid and Yang (2024) note that Malaysia has achieved a mobile phone penetration rate of 77% of the total population, with 59% of the population already having a social media presence. This widespread adoption of internet services has created opportunities for digital entrepreneurship and innovation, further driving the growth of the digital economy.

These developments demonstrate Malaysia's commitment to building robust digital public infrastructure, which is crucial for fostering innovation, promoting economic growth, and enhancing social welfare.

2.6. Myanmar

Myanmar's digital public infrastructure is undergoing significant development, with a focus on enhancing connectivity and digital services across the country. The government has launched initiatives such as the Digital Economy Development Committee (Myint, 2023) and the Myanmar Digital Economy Roadmap to drive digital transformation.

In terms of digital identity and authentication, Myanmar has made progress with the implementation of the National Registration Card (NRC) system as reiterated by Burgess (2019). As of 2020, over 37 million NRC cards had been issued, providing a foundational digital identity for citizens (Pushp and Ahmed, 2023). However, challenges remain in ensuring universal coverage and integrating the NRC with other digital services.

Digital payments in Myanmar have seen growth, with the introduction of mobile money services and the expansion of financial inclusion initiatives. As of 2019, there were over 18 million mobile

money accounts, representing a significant increase from previous years. Llanto, Navarro, and Ortiz (2016) say that the government has also launched the Myanmar Payment Union (MPU) to facilitate interoperable digital payments across banks and mobile money providers.

Data sharing and accessing government services through digital means are areas where Myanmar is making efforts. KPMG (2013) shows that the government has established the National Data Center and is working on developing a National Data Sharing Platform to enable secure data exchange amongst agencies. However, progress has been limited (KPMG, 2013), and the country still faces challenges in terms of data governance, interoperability, and digital literacy amongst citizens and government officials.

Overall, Myanmar's digital public infrastructure is still in its early stages, with significant room for improvement. The government's commitment to digital transformation is evident through various initiatives, but challenges persist in terms of infrastructure development, digital skills, and regulatory frameworks. Stimson (2021) says that continued investment and collaboration with international partners will be crucial for Myanmar to harness the full potential of digital technologies for economic and social development.

2.7. Philippines

The digital public infrastructure in the Philippines encompasses various components such as digital identity and authentication, payments, data sharing, and accessing government services. Each of these aspects plays a crucial role in the country's digital transformation.

The Philippines has embarked on initiatives like the PhilSys national ID programme to provide digital identities to its citizens. PhilSys aims to create a unique identification system[31] for all Filipinos, enabling secure and authenticated access to various services and benefits. The programme integrates privacy-by-design[32] principles to ensure data protection and security, which is vital for building trust in digital identities.

Digital payment systems are another integral part of the Philippines' digital public infrastructure. These systems facilitate secure and efficient transactions, with initiatives like the National Cash Transfer Program leveraging digital payments to reach beneficiaries. This ensures transparent and timely disbursement of funds. Strengthening personal data protection and enhancing digital security are key focus areas in the country's digital payment ecosystem, ensuring that financial transactions are both safe and reliable.

The Philippines is also working on improving data-sharing mechanisms to enhance service delivery and accessibility. By leveraging digital infrastructure, the country aims to streamline data-sharing processes, ensure data security, and promote interoperability amongst government agencies and service providers. This facilitates efficient information exchange and enhances the delivery of public services, making it easier for citizens to access the services they need.

Accessing government services online is another critical component of the Philippines' digital public infrastructure, promoting convenience, efficiency, and transparency. Initiatives like the e-governance bill focus on shifting bureaucratic processes to the digital space for faster service delivery and improved public engagement. By digitising paper-based processes, the government aims to enhance accessibility to services and foster collaboration between the public and private sectors. This shift not only speeds up service delivery but also improves public engagement.

Overall, the digital public infrastructure in the Philippines is geared towards enhancing digital identity and authentication, enabling secure payments, facilitating data sharing, and improving access to government services through efficient and technology-driven solutions.

2.8. Singapore

Singapore has built a robust digital public infrastructure that enables secure digital identity, seamless payments, and efficient data sharing across government agencies and the private sector. At the core of this infrastructure lies the National Digital Identity (NDI) system, known as Singpass, which provides a secure and convenient way for citizens and residents to access online services as purported in Cooper, Marskell, and Chan (2022).

As of 2021, over 2.5 million individuals had signed up for Singpass, with over 1.5 million using the mobile app (Cooper et al., 2022). The system supports a wide range of transactions, from accessing government services to making payments and signing documents electronically. Cooper et al. (2022) also say that Singpass is integrated with Myinfo, a personal data-sharing platform that allows users to securely share their personal information with authorised entities, reducing the need for repetitive data entry.

The digital public infrastructure also includes the API Exchange (APEX), a government data-sharing platform that enables seamless data exchange between agencies. Cooper et al. (2022) discuss APEX, which supports over 2,000 APIs from more than 45 different agency projects, covering approximately half of all government agencies in Singapore. The platform processes an average of 100 million transactions per month, with peaks exceeding 300 million transactions.

In terms of digital payments, Singapore has implemented PayNow, a real-time payment system that allows users to transfer funds using mobile numbers or Singpass. Desai, Marskell, Marin, and Varghese (2023) say that as of 2021, over 3.3 million Singapore bank account holders had registered for PayNow. They also note that the system has facilitated cross-border payments, with users able to send money daily from Singapore to Thailand through PromptPay.

Singapore's digital public infrastructure has enabled the government to provide a wide range of online services, improving efficiency and convenience for citizens and businesses. Cooper et al. (2022) and Desai et al. (2023) point out that the integration of digital identity, data sharing, and payments has allowed for the development of innovative solutions, such as the ability to register a new business entirely online. By investing in this foundational infrastructure, Singapore aims to drive digital transformation and enhance its competitiveness in the global digital economy.

2.9. Thailand

Thailand's digital public infrastructure is undergoing a significant transformation to enhance connectivity and digital services across the country. The 20-year Thailand Digital Economy and Society Development Plan, initiated in 2016, outlines a strategic roadmap for complete digital transformation by 2027, positioning Thailand as a global leader in the digital economy. Saffa (2024) and Jongwanich (2023) say that the plan is structured into three phases: digital foundations, digital inclusion, and full digital transformation, focusing on improving digital infrastructure, fostering digital innovation, and enhancing digital manpower to drive economic growth and innovation.

Efforts to improve digital infrastructure in Thailand are evident through initiatives aimed at ensuring reliable and high-speed connectivity in both urban and rural areas. The country's commitment to digital innovation and entrepreneurship is reflected in policies promoting a conducive environment for startups and businesses to thrive, contributing to Thailand's digital transformation. Additionally, Saffa (2024) says that the emphasis on enhancing digital literacy and skills development underscores the importance of a skilled workforce to excel in the digital economy.

Thailand's digital payment landscape has seen significant progress with the implementation of real-time payment systems like PromptPay, enabling seamless fund transfers using mobile numbers or digital identities. Niyawanont and Niyawanont (2021) say that the widespread adoption of digital payment solutions is evident, with over 3.3 million bank account holders registered for PayNow[33], facilitating secure and efficient financial transactions in the country.

Data sharing plays a crucial role in Thailand's digital infrastructure, with initiatives like the Thailand Government Information Exchange and the establishment of a government data catalogue to promote seamless data exchange between government agencies and the private sector. These efforts aim to enhance service delivery, reduce redundancy, and improve efficiency by leveraging digital identities and digital signatures amongst government agencies.

Accessing government services in Thailand has been revolutionised by the digital public infrastructure, allowing citizens to conduct a wide range of transactions online. The country's digital government implementation has led to improved rankings in the United Nations' e-Government Development Index, positioning Thailand as a leader in digital governance within ASEAN. Malisuwan and Sriyakrai (2017) purport that the digitalisation of services has not only enhanced efficiency but also increased accessibility and convenience for users, reflecting the success of Thailand's digital transformation efforts.

2.10. Timor Leste

Timor-Leste's digital public infrastructure is undergoing significant development to enhance connectivity and service delivery across the country. Kemp (2023) says that as of early 2023, there were 670.6 thousand internet users in Timor-Leste, with an internet penetration rate of 49.6%. Additionally, the country had 354.6 thousand social media users, equivalent to 26.2% of the total population.

The e-Government Development and Infrastructure Project in Timor-Leste aims to address limited access to public services, particularly in rural areas, where infrastructure connectivity is underdeveloped. From ADB (2022) we see that approximately 70% of the population living in rural areas face challenges in accessing public services, emphasising the importance of digital infrastructure in improving service delivery and reducing poverty levels. The project aligns with the country's strategic development plans, focusing on promoting good governance, improving public service delivery, and enhancing access to government services to reduce poverty and promote gender equality.

In terms of mobile connectivity, Timor-Leste had 1.44 million cellular mobile connections in early 2023, equivalent to 106.6% of the total population. Kemp (2023) says that these figures highlight

the increasing digital adoption and connectivity in the country, showcasing the importance of digital infrastructure in enhancing communication and access to information.

Efforts to enhance digital identity, payments, data sharing, and government services in Timor-Leste are crucial for empowering citizens and improving service delivery. The country's digital public infrastructure plays a key role in facilitating secure digital transactions, promoting data exchange between government agencies, and enhancing access to essential services. Desai, Marskell, and Marin (2023) say that by leveraging digital technologies, Timor-Leste aims to bridge the digital divide, promote financial inclusion, and empower communities through efficient and accessible digital services.

Digital public infrastructure can enable essential society-wide functions and services such as identification, payments, and data exchange. Desai, Marskell, and Marin (2023) also evaluate that it is foundational and cross-cutting, complementing and working together at policy, process, and technology levels. By enabling sectoral applications to be easily built 'on top' and focusing on public benefit, digital public infrastructure positively transforms how people and businesses access services and economic opportunities, making them more inclusive by removing physical and cost barriers.

2.11. Viet Nam

Viet Nam's digital infrastructure has experienced significant growth, with a high percentage of internet users and social media users. Dharmaraj (2023) quote that as of January 2023, Viet Nam had recorded 77.93 million internet users, constituting approximately 79.1% of the national population. The rise of e-commerce, online payments, and ride-hailing services has contributed to the growth of the digital economy in Viet Nam. The country's digital economy revenue was estimated to be worth US$166.4 billion in 2022, accounting for 14.26% of its GDP, with expectations of further growth in the coming years.

The Ministry of Information and Communications in Viet Nam is actively working on developing the country's digital infrastructure, with a focus on areas such as international fibre-optic cable development. Dharmaraj (2023) notes that the government aims to ensure the secure and sustainable advancement of Viet Nam's digital infrastructure, leveraging new technologies like the Internet of Things (IoT), cloud computing, artificial intelligence (AI), blockchain, and 5G/6G. Viet Nam stands out as a country with a notably high percentage of internet users, with recent statistics showing 77.93 million internet users, constituting approximately 79.1% of the national population.

Viet Nam's digital transformation agenda includes key focus areas such as cloud computing, digital platforms, e-commerce, the Make in Viet Nam Industry, and cybersecurity. The country's digital economy is projected to expand significantly, reaching approximately US$45 billion by 2025, with an annual growth rate of 20% between 2023 and 2025.[34] The digital economy growth is not only fuelling economic growth but also generating fresh employment prospects and improving the quality of life for its residents.

The digital infrastructure in Viet Nam is driving the country's digital transformation, with a focus on digital government, digital economy, and digital society. The government's vision for digital government in Viet Nam aims to build a digital society, a digital economy, and digital government services that are accessible, responsive, and tailored to the needs of its citizens. Initiatives such as the National Digital Transformation Program and the National AI Strategy[35] are positioning Viet

Nam as a leading hub for AI and digital innovation in Southeast Asia. The government is investing heavily in digital infrastructure, including high-speed internet, to support the growth of the digital economy and improve public services.

In conclusion, Viet Nam's digital public infrastructure is a key driver of economic growth and innovation, with a strong focus on digital identity, payments, data sharing, and government services. The country's digital economy is rapidly expanding, driven by increasing internet penetration, e-commerce growth, and investments in emerging technologies.[35] By leveraging digital technologies and fostering a conducive environment for innovation, Viet Nam is poised to become a digital leader in the region, with a strong emphasis on enhancing service delivery, promoting economic growth, and improving the quality of life for its citizens.

3. Digital Public Infrastructure Development Priorities for Each ASEAN Country

The following table outlines proposed digital public infrastructure (DPI) priorities of various countries in Southeast Asia. Each country is actively working towards enhancing its digital ecosystem through initiatives focused on digital identity, payment systems, regulatory frameworks, and data sharing. Key initiatives include leveraging MOSIP and NPCI International to develop DPI infrastructure, expanding banking penetration through digital verification similar to Jan Dhan account in India, and setting up frameworks for consented data sharing along the lines of Account Aggregator in India. These efforts aim to promote financial inclusion, streamline benefits transfer systems, and ensure secure and efficient digital transactions across the region.

Table 4: DPI Priorities for ASEAN countries

Country	DPI Priorities
Brunei	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments infrastructure • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Cambodia	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Indonesia	• Expand direct benefits transfer system leveraging DPI infrastructure • Set up regulatory framework and standards for consented data sharing between private players as well as by government
Lao PDR	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Malaysia	• Expand direct benefits transfer system leveraging DPI infrastructure • Set up regulatory framework and standards for consented data sharing between private players
Myanmar	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Philippines	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Singapore	• Set up regulatory framework and standards for consented data sharing between private players
Thailand	• Expand direct benefits transfer system leveraging DPI infrastructure • Set up regulatory framework and standards for consented data sharing between private players as well as by government
Timor Leste	• Leverage MOSIP and NPCI International to develop DPI infrastructure including digital identity and payments • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification
Viet Nam	• Leverage MOSIP to develop digital identity • Expand banking penetration leveraging digital identity and regulations supporting use of digital verification

Chapter 3

Evolution of DPI in India

Following our comprehensive overview and comparison of Digital Public Infrastructure (DPI) across ASEAN member countries in Section 0, we now shift our focus to the evolution of DPI in India. This section delves into India's extensive journey in developing and implementing DPI initiatives, highlighting the government's pivotal role, the impact of central bank-led fintech initiatives, and the contributions of market-led innovations and civil society reforms. By understanding the trajectory of DPI in India, we can glean valuable insights and potential best practices that can be shared with and adapted by ASEAN countries to enhance their own digital infrastructures.

1. Introduction

Over the past 3 decades, the digital revolution has rapidly transformed global economies, with a notable acceleration in developing countries. This revolution has progressed more swiftly than the industrial or agricultural revolutions, significantly driven by major players such as China and, increasingly, India. The proliferation of digital technologies in these regions has profoundly reshaped financial infrastructure, enhancing both efficiency and financial inclusion.

In India, the evolution of the government's payment systems now enables direct disbursements to individuals and firms via bank accounts, facilitating seamless fund transfers and real-time digital transactions between businesses and customers. This transformation has democratised innovation and entrepreneurship, allowing digital innovations to be commercialised at lower costs compared to traditional technologies. Consequently, the divide between innovators and entrepreneurs has diminished, fostering an environment where innovation and entrepreneurship are increasingly intertwined.

While the definition of fintech remains fluid, it generally encompasses technologically enabled financial innovations in areas such as fund transfers, payments, borrowing, lending, asset management, and insurance. Key Fintech activities include mobile app payments, cryptocurrency investments and transactions, peer-to-peer lending, crowdfunding, loan and insurance comparison websites, and robo-advice for investments and asset management.

In developed economies, fintech is predominantly a private-sector phenomenon involving business and household transactions. However, applying this perspective to India overlooks the significant impact of financial technology in revolutionising the payment systems, especially in promoting inclusion and development. A critical aspect of India's fintech infrastructure development pertains to individuals and households. The capability to perform digital transactions necessitates identity verification, bank accounts, and access to digital communication tools like mobile phones. Furthermore, access to investment and savings instruments requires financial services that were traditionally offered through physical bank branches but are now accessible via digital platforms.

In recent years, India has made significant strides in each of these areas, building a robust financial technology infrastructure that supports its burgeoning digital economy.

2. Government-led DPI Initiatives

2.1. Aadhaar: Comprehensive Biometric Identity System

To participate in cashless financial transactions, individuals must possess proof of identity. In a vast and diverse country like India, where two-thirds of the population resides in rural and often remote areas, providing such proof poses a significant challenge. Until less than a decade ago, India lacked a systematic programme for providing proof of identity to its residents. While theoretically anyone could apply for a passport or driver's license, the practicalities of doing so were daunting for many, especially women in rural areas, due to the distant locations of the relevant offices and the lack of necessary documents.

Remarkably, nearly all residents of India now possess an identity card known as the Aadhaar card. Initiated in September 2010, the Aadhaar programme has issued over 1.2 billion cards to date. This card provides definitive proof of identity, backed by biometric data. Each Aadhaar card includes the individual's name, gender, address, a 12-digit unique identification number, and a photograph. Verification is straightforward: a device connected via Wi-Fi to a central database scans the individual's fingerprints and iris, matching them against stored records to confirm identity.

The Aadhaar initiative has fundamentally transformed identity verification in India, overcoming the logistical and bureaucratic barriers that previously hindered the provision of identity documents. This comprehensive biometric identification system has become a cornerstone of India's efforts to facilitate digital transactions and promote financial inclusion, particularly in rural areas where traditional identity documentation was previously inaccessible.

2.2. The Jan-Dhan Scheme: Universal Financial Inclusion through Bank Accounts

Proof of identity is merely the first step toward achieving financial inclusion. Its true potential is unlocked only when coupled with additional financial instruments, the most fundamental being a bank account. For fintech innovations to be effective, they must be built on the foundation of bank accounts, as instruments such as checks, credit cards, and digital wallets require bank accounts to operate efficiently.

Establishing banking infrastructure across India's vast and diverse landscape has been a significant challenge. Opening bank branches in villages with populations under one thousand is not economically viable. In the 1980s, India attempted to expand banking services to remote areas using public funds, but this proved unsustainable, leading to the abandonment of the initiative following the 1991 economic reforms. According to the World Bank's Global Findex Report, only 53% of Indians over the age of 15 had bank accounts in 2014.

To address this gap, one of Prime Minister Narendra Modi's first major initiatives was the Pradhan Mantri Jan-Dhan Yojana (PMJDY), or the Prime Minister's People's Wealth Scheme. Launched on 15 August 2014, PMJDY aimed at large-scale financial inclusion through a significant expansion of bank accounts. The initiative set a world record for the most bank accounts opened in a single week, with 18,096,130 accounts opened from 23 to 29 August 2014, earning it a place in the Guinness Book of Records.

The government facilitated this achievement by mobilising public sector banks to organise camps nationwide, allowing individuals to open bank accounts in a matter of hours. By 2017, the

proportion of Indians over the age of 15 with bank accounts had risen to 80% according to the World Bank's Global Findex Report. As of 28 February 2018, the total number of accounts under PMJDY stood at 312 million, with deposits totalling US$12 billion.

Despite these impressive numbers, a significant proportion of households still do not utilise bank accounts for savings and investment purposes. However, the Jan-Dhan Scheme has laid a critical foundation for financial inclusion, creating opportunities for further integration of financial services into the lives of millions of Indians.

2.3. The Public Finance Management System (PFMS)

Originally conceptualised in 2009 to track fund disbursements from the central government to states, PFMS has undergone significant development, emerging as a comprehensive solution for financial processing, monitoring, and reporting. By integrating disparate financial systems and leveraging Aadhaar verification and direct benefit transfer (DBT), the government aims to address longstanding issues of leakage and inefficiency in public expenditure.

In recent decades, technological advancements have revolutionised fiscal management practices worldwide, offering unprecedented opportunities for governments to streamline processes, enhance transparency, and combat corruption. India's PFMS exemplifies this paradigm shift, representing a concerted effort to modernise financial infrastructure and improve the efficacy of public expenditure. Originally conceived as a mechanism for tracking intergovernmental fund transfers, PFMS has evolved into a multifaceted platform for end-to-end financial management, encompassing processing, monitoring, reconciliation, and reporting functions.

Since its inception, PFMS has undergone iterative development, driven by the imperative to address systemic inefficiencies and enhance fiscal accountability. Initially designed to monitor funds disbursed by the central government to states through the Planning Commission, PFMS has expanded its scope to encompass a wide range of financial transactions, including expenditure tracking, utilisation monitoring, and revenue reconciliation. By providing a unified platform for financial management, PFMS aims to facilitate real-time tracking of fund flows and ensure optimal utilisation of resources at the grassroots level.

A critical challenge facing India's fiscal governance framework has been the pervasive issue of leakage and fraud in public expenditure. Historically, government programmes have been plagued by instances of ghost beneficiaries, multiple benefit collections, and diversion of subsidised resources. Recognising the urgent need to address these vulnerabilities, the government has leveraged Aadhaar verification and DBT mechanisms to enhance transparency and accountability in welfare delivery. By linking entitlements to Aadhaar-seeded bank accounts and adopting a targeted approach to subsidy disbursal, the government has succeeded in eliminating millions of ghost beneficiaries and curbing illicit practices such as wage skimming and diversion of subsidised goods.

The deployment of PFMS and associated technological interventions has yielded tangible benefits in terms of fiscal savings, efficiency gains, and improved service delivery. Estimates suggest that the adoption of Aadhaar-enabled DBT has resulted in savings amounting to approximately 10%[36] of transferred benefits, underscoring the cost-effectiveness of technology-enabled fiscal reforms. Furthermore, by enhancing transparency and reducing opportunities for corruption, these

initiatives have bolstered public trust in the integrity of government programmes and paved the way for sustainable fiscal governance.

2.4. Direct Benefits Transfers

Perhaps the most stand out use case for DPIs is Direct Benefit Transfers (DBT) from the government. To prevent leakages, the Indian government introduced the DBT mechanism in 2013 for transferring benefits of various government schemes directly to bank accounts utilising Aadhaar features as one key component. The DBT is not a social assistance programme. It is a mechanism to consolidate and control data on direct benefit transfers from multiple sources for different government schemes managed by various ministries.

Alonso et al. (2023) cite that India has used the Aadhaar-based DBT to deliver benefits worth more than US$427 billion across 310 different government schemes managed by 53 ministries[37] and saved US$42 billion (Alonso et al., 2023).

At present, according to Ministry of Finance data, 54% of DBT payments are channelled through Aadhaar-linked accounts and 46% through bank accounts. DBT is also used for in-kind transfers (e.g. the PDS); in this instance the Aadhaar authentication is used to access subsidised grains.

Once the beneficiary list is provided by scheme holders (Central Government or State), the government's public finance system (PFMS) sends the beneficiary bank account details to the bank, and it is validated through the bank account number or Aadhaar number to proceed to the payments through RBI and NPCI clearing houses, respectively. PFMS evolved as a robust payment and reconciliation platform integrated with 600+ banks for verification of bank accounts and with NPCI for validation of accounts linked with Aadhaar numbers.

Figure 2: Direct Benefit Transfer Workflow for Aadhaar Linked Accounts
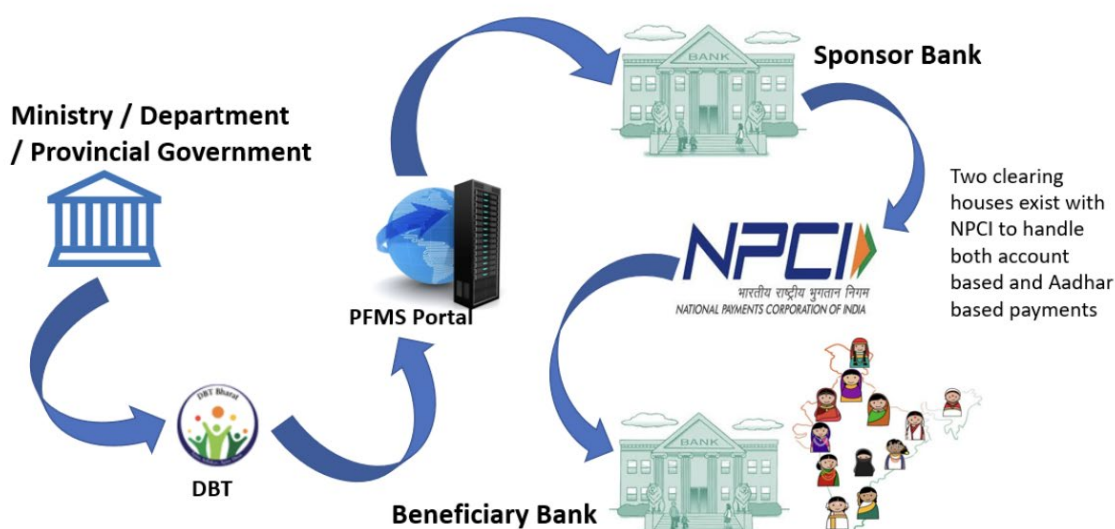
Source: Alonso, C., T. Bhojwani, E. Hanedar, D. Prihardini, G. Uña, and K. Zhabska (2023), Stacking up the Benefits: Lessons from India's Digital Journey. Washington, DC: International Monetary Fund.

Key enablers:

The main enablers of the DBT are the 'JAM trinity' – Jan Dhan, Aadhaar, and Mobile – that addressed identification issues and provided a delivery mechanism for social assistance programmes built upon DPI initiatives. The first pillar, the Jan Dhan financial inclusion initiative, broadened access to bank accounts and financial services. Identification of beneficiaries is done through Aadhaar, the second pillar of JAM trinity. The bank accounts are also linked with Aadhaar numbers (Aadhaar Enabled Bank Accounts), and this is key for channelling government benefits electronically. The third pillar is the Mobile network, consisting of more than 960 million phones serving as an effective information exchange platform, especially in rural areas. It also enables households to use apps for accessing their banking information.

Figure 3: Direct Benefit Transfer Beneficiaries (in millions, by type)
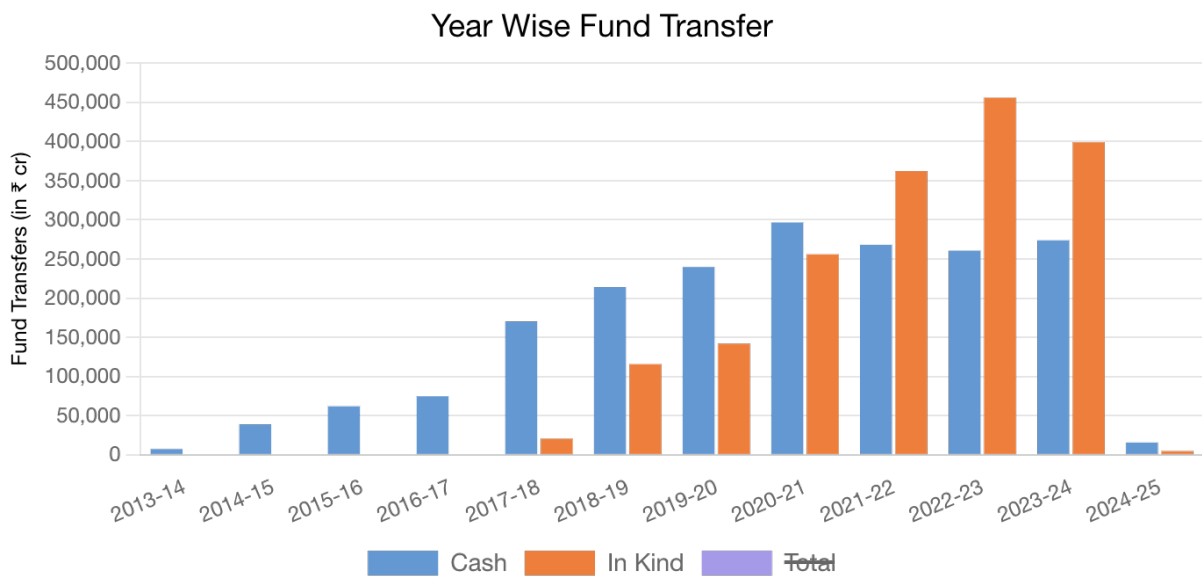
Source: DBT Bharat. Government of India.[37]

Figure 4: Direct Benefit Transfer Payments (by number of beneficiaries)

Year Wise DBT Beneficiaries (Non-Unique)

*Sum total of beneficiaries across schemes
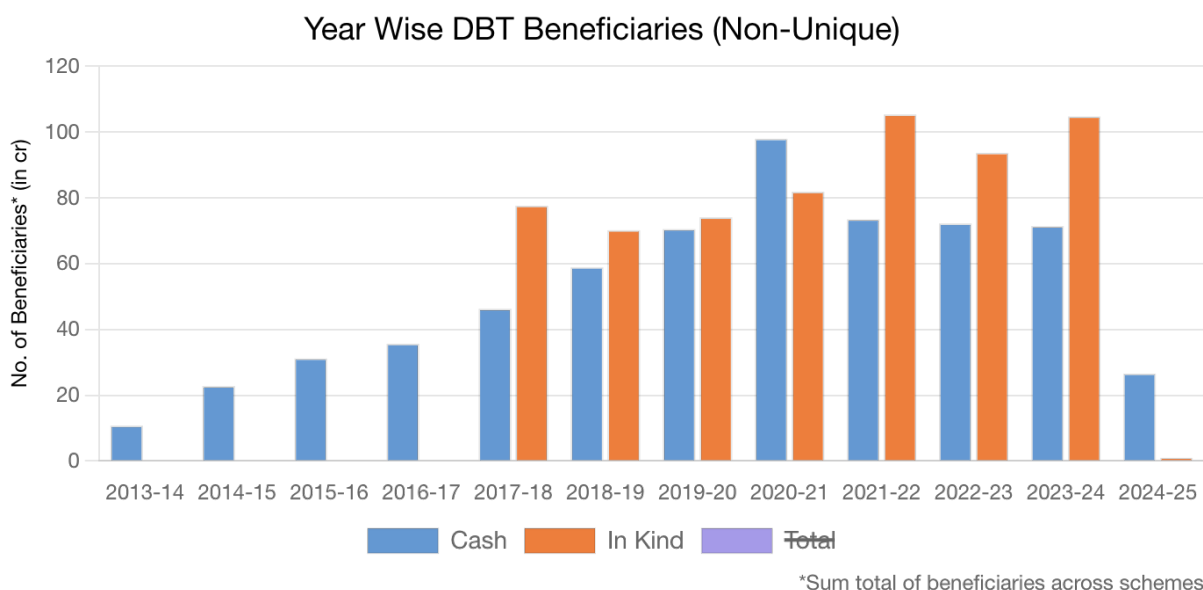
Source: DBT Bharat. Government of India.[37]

3. Central Bank Led Fintech and DPI Initiatives

3.1. Unified Payments Interface: A Low-Cost Bank-to-Bank Payments System

The National Payments Corporation of India (NPCI), a not-for-profit organisation owned by a consortium of major banks and promoted by the Reserve Bank of India, is authorised to operate various retail payment systems in the country. The NPCI has developed the Unified Payments Interface (UPI), an instant real-time payments system designed to facilitate inter-bank transactions. UPI enables real-time fund transfers between two bank accounts via a mobile platform, withdrawing funds from the payer's bank account and depositing them directly into the payee's account.

This system differs from traditional mobile wallets, which require preloading a specified sum of money from the payer's bank account into the wallet's account for future transactions. Consequently, wallet-based transfers are limited to users of the same wallet. In contrast, UPI allows direct bank-to-bank transfers, enabling transactions for nearly all customers with accounts in one of the 71 banks that subscribed to UPI as of February 2018.

Following the demonetisation announcement in November 2016, electronic transactions surged from 671.5 million to 1.1 billion by February 2018, a 63.5% increase in just 15 months. In value terms, electronic transactions rose from Rs. 94 trillion ($1.5 trillion) to Rs. 115.5 trillion (US$1.8 trillion) over the same period, representing a 22.9% increase. This discrepancy indicates that the government's strategy to promote digitisation amongst individual customers, who typically conduct lower-value transactions, has been successful.

UPI transactions have experienced particularly rapid growth. Starting from a modest 0.3 million transactions in November 2016, they had soared to 171.4 million by February 2018. In value terms, UPI transactions increased from 0.9 billion rupees to 191 billion rupees over the same period.

The government provides the UPI platform free of charge, with only the banks' transaction fees applying. Given the competition amongst banks, these charges are likely to remain low, positioning UPI to potentially surpass other transaction platforms. Since credit and debit card transactions typically incur higher fees, their long-term viability is questionable. As merchants increasingly recognise the value of accepting payments via UPI, its adoption is expected to grow further, potentially dominating the digital payments landscape in India.

Figure 5: Architecture of UPI
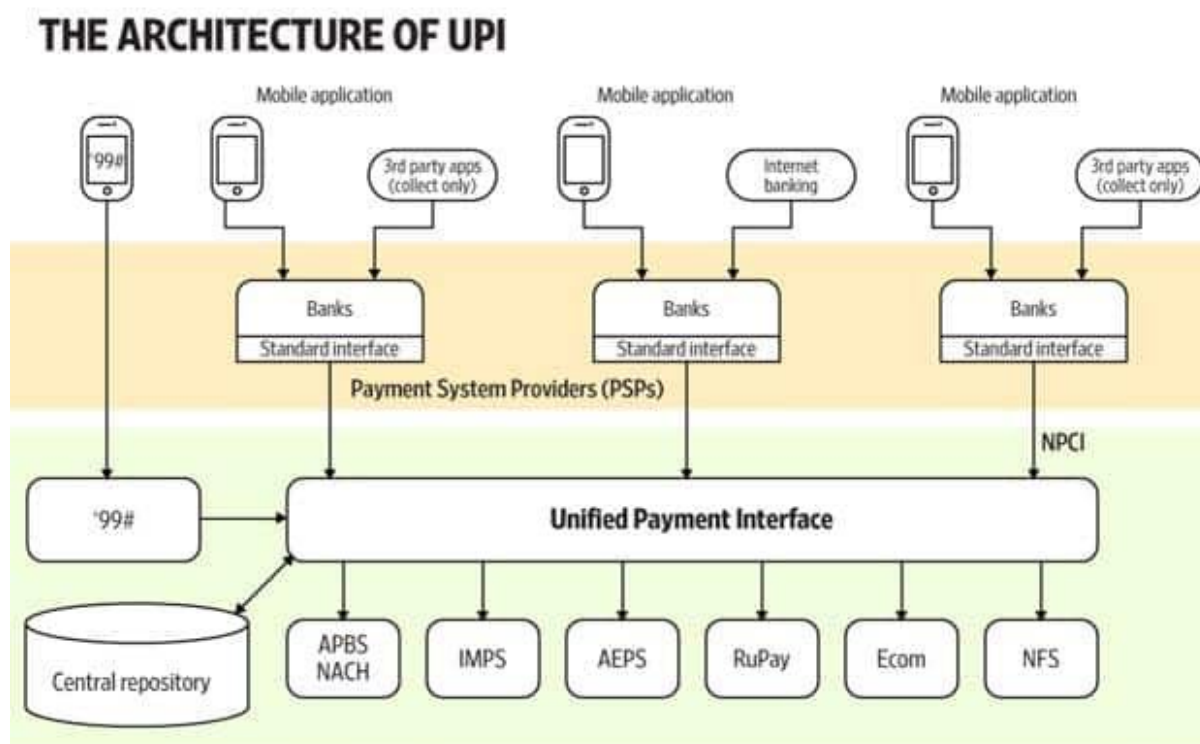
Source: How UPI Works (Livemint).[38]

The Following Provides a step-wise illustration of the UPI Architecture:

1. User: Initiates transactions through a PSP app after logging in, facilitating peer-to-peer transactions with a few taps on a smartphone.

2. PSP (Payer): Validates the user and forwards the transaction request to NPCI for processing.

3. NPCI UPI ecosystem: Manages the transaction flow, forwarding requests to the PSP (Payee) for further processing.

4. PSP (Payee): Utilises NPCI APIs to identify account details of the Payer's bank for transaction completion.

5. Remitter Bank: Validates and confirms the account deduction request from the Beneficiary Bank.

6. Beneficiary Bank: Validates and confirms the account credit request from the Remitter Bank.

7. NPCI: Notifies all involved parties about the transaction status, ensuring transparency and security.

3.2. The Business Correspondent Model: Bringing Financial Services to Unbanked Areas

While individuals can make and receive transfers using bank accounts and mobile phones, access to other banking services is essential. Notably, individuals need the ability to carry out cash deposits and withdrawals and to use their bank accounts for savings and investment. However, access to bank branches, often located far from rural villages, remains a significant challenge. To address this issue, the government initiated the Business Correspondent (BC) model in 2006, targeting areas without bank branches.

A BC is a representative engaged by a bank to provide banking and financial services in underserved locations. These services include opening bank accounts, collecting cash deposits, disbursing small loans, recovering loan instalments, and selling bank products such as insurance, mutual funds, and pension schemes. Banks are fully responsible for the actions of their BCs, ensuring accountability and service quality.

The Reserve Bank of India (RBI) allows various entities to serve as BCs, including Non-Governmental Organizations (NGOs), Micro-finance Institutions (MFIs), post offices, Section 25 companies, retired bank employees, teachers, government employees, military personnel, and individual owners of kirana, medical, and Fair Price shops. Additionally, agents of Small Savings schemes, insurance companies, petrol pump owners, and authorised functionaries of Self-Help Groups (SHGs) linked to banks can also act as BCs. The RBI advises banks to maintain reasonable and fair charges for BC services.

BCs utilise mobile devices, Point of Sale (PoS) machines, and micro-ATMs to facilitate fund transfers across bank accounts via the UPI protocol. Data indicates that the BC model has been highly effective in extending basic banking services to rural areas, outpacing the expansion of traditional brick-and-mortar branches. This model has played a crucial role in promoting financial inclusion by bridging the gap between formal banking services and remote, unbanked communities.

3.3. Payment Banks

To further enhance the reach of digital payments, the Government of India introduced payment banks launched in August 2015 with the grant of 'in principle' licenses to 11 of the 41 applicants (Pramani and Iyer, 2023). The recipients of the license were given 18 months to fulfil all requirements after which they could begin operations. Bharti Airtel, a telecommunications company, was the first to go live as a payments bank in March 2017. Others to go live include India Posts and Paytm. A few others such as Tech Mahindra and Sun Pharmaceuticals surrendered their licenses. Payments banks are registered as public limited companies under the 2013 Companies Act with a license from RBI. They are not commercial banks, though the license from RBI grants them permission to perform some of the banking functions including remittance services, mobile payments, fund transfers, issuance of ATMs, debit card services, net banking

services, and sales of third-party financial products such as insurance and mutual funds. However, payment banks are not allowed to advance loans or issue credit cards. Currently, payment banks are allowed to accept deposits up to INR 200,000 and can pay interest on them. They earn part of their profit by depositing the funds received in banks that pay higher interest than what they pay their customers. They also earn profits by charging a merchant discount rate (MDR) on transactions undertaken by deposit holders. Other sources of revenue may include data monetisation, cross-selling of financial products, and forming credit access platforms. There are six payment banks active in India and their deposit base continues to grow.

3.4. Small Finance Banks

Small Finance Banks (SFBs) in India represent a significant policy initiative aimed at enhancing financial inclusion and expanding access to financial services amongst underserved and unbanked segments of the population. The primary objectives of setting up small finance banks in India are to further financial inclusion by:

- Providing savings vehicles and credit facilities to small business units, small and marginal farmers, micro and small industries, and other unorganised sector entities

- Providing an alternative to existing institutions that cater to the underserved and unbanked segments.

- Using high-tech, low-cost operations to keep costs down.

SFBs operate under the regulatory purview of the RBI, adhering to the prudential norms and guidelines established under the Banking Regulation Act, of 1949. These banks are mandated to maintain a minimum paid-up equity capital of Rs. 200 crore and a capital adequacy ratio of 15% of their risk-weighted assets, ensuring robust financial health and stability.

SFBs are authorised to perform a comprehensive range of banking activities, including accepting deposits, providing credit, issuing ATM/debit cards, and offering Internet banking services. However, their engagement with complex financial products such as derivatives and foreign exchange transactions is restricted. Furthermore, to align with their financial inclusion mandate, at least 25% of SFB branches must be located in unbanked rural areas.

SFBs now nearing 1% of the total deposit base in India despite their newness in the eco-system. There are now 11 SFBs active.

3.5. Account Aggregator

The Account Aggregator (AA) system in India constitutes a transformative initiative aimed at revolutionising the accessibility and management of financial data for individuals and enterprises. Spearheaded by the Reserve Bank of India (RBI), this system forms a critical component of India's broader financial inclusion agenda.

Financial inclusion and data empowerment are pivotal to fostering sustainable economic growth. The AA system in India epitomises an innovative approach to enhancing financial transparency and accessibility. By consolidating financial data from disparate sources, the AA system facilitates a more integrated and user-centric financial ecosystem.

System Architecture and Key Features

The AA system is characterised by a structured framework that encompasses data aggregation, user consent mechanisms, security protocols, and standardised data formats.

Data Aggregation: Account Aggregators (AAs) are entities authorised by the RBI to collect and disseminate financial information from various financial institutions, including banks, non-banking financial companies (NBFCs), insurance companies, and mutual funds. AAs act as intermediaries, aggregating data from these institutions and providing consolidated financial information to users or authorised entities.

User Consent-Based Model: Central to the AA framework is a stringent user-consent mechanism. Financial data is shared only upon explicit consent from the user, ensuring robust data privacy and control. Users retain the discretion to specify the data to be shared, the recipients, and the duration of access.

Security and Encryption: Data exchanged within the AA system is encrypted end-to-end, guaranteeing secure transmission. Importantly, AAs do not store the data; they facilitate its transfer between Financial Information Providers (FIPs) and Financial Information Users (FIUs).

Standardisation: Data is transmitted in a standardised format, enhancing its usability and facilitating efficient analysis by financial institutions for diverse applications, including credit assessment and financial planning.

Benefits

The AA system presents multiple advantages that can significantly enhance the financial landscape in India:

Enhanced Credit Access: By providing a comprehensive financial profile of individuals and businesses, the AA system can significantly improve credit accessibility. Lenders benefit from a more accurate assessment of creditworthiness, leading to more informed lending decisions.

Improved Financial Planning: Aggregated financial data enables the provision of personalised financial advice and planning services, benefiting both individuals and businesses.

Efficient Financial Management: Users can manage all their financial accounts through a unified platform, streamlining financial management processes.

Data Privacy and Control: The AA system empowers users with control over their financial data, reinforcing data privacy and security.

Participants in the AA Ecosystem

The AA ecosystem involves three principal categories of participants:

Account Aggregators (AAs): Licensed entities responsible for data aggregation and dissemination.

Financial Information Providers (FIPs): Institutions such as banks, NBFCs, asset management companies, and insurance providers that hold user financial data.

Financial Information Users (FIUs): Entities that utilise financial data to offer services like lending, investment advisory, and financial planning.

Figure 6: Account Aggregator Ecosystem
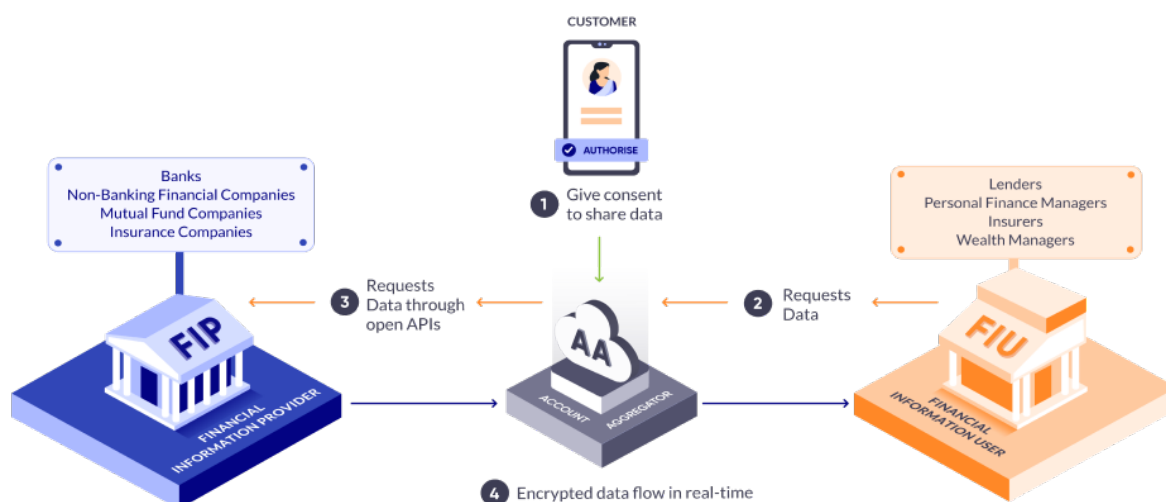
Source: Sahamati – Collective of the Account Aggregator Ecosystem[39].

Regulatory Framework

The AA system operates under the regulatory oversight of the RBI, which has established comprehensive guidelines and operational standards to ensure data security, user consent, and interoperability. The regulatory framework is designed to foster trust and promote widespread adoption of the AA system.

Current Status and Adoption

As of the current status, 18 AAs have been licensed by the RBI and 14 are operational. Most major banks and financial institutions have joined the AA network as FIPs, and 600+ fintech companies and financial service providers are participating as FIUs.[39] There are now more than 2 billion accounts accessible via AA. The services have been used 76 million times and are growing at 22% month-on-month.

4. Market-Led Fintech and Financial Services Initiatives

4.1. Paytm payments wallet

Paytm (pay through mobile) began as a digital wallet in 2010. The founder started the company with a US$2 million investment of his own. Paytm wallet allows a user to transfer funds directly into a recipient's account using a QR code or mobile number. By May 2018, the company had seven million offline merchants spread over India's 600 districts. The first of these numbers rose from just one million at the beginning of 2017. The annualised gross transactions value of the company crossed US$20 billion in February. This represented a four-fold increase over the previous year. The number of transactions using Paytm far exceeds the total number of debit card transactions.

This momentum directly accelerated mobile digital payments in India. This approach was comparable to closed-loop models of AliPay and PayPal. By August 2018, Paytm had 300 million registered users. This figure compares with 520 million Alipay users and 237 PayPal users around the same time. On average, one in three Indians already uses Paytm. It IPO-ed in 2021 and is currently valued at around US$3 billion.

Launched in 2010, Paytm began as a digital wallet with an initial investment of US$2 million from its founder. The Paytm wallet enables users to transfer funds directly to a recipient's account using a QR code or mobile number. By May 2018, Paytm had expanded to seven million offline merchants across India's 600 districts, up from just one million at the beginning of 2017. The company's annualised gross transaction value surpassed US$20 billion in February 2018, marking a four-fold increase from the previous year. The volume of transactions conducted via Paytm significantly exceeds that of debit card transactions, accelerating the adoption of mobile digital payments in India.

Paytm's model is comparable to the closed-loop systems of AliPay and PayPal. By August 2018, Paytm had 300 million registered users, compared with 520 million AliPay users and 237 million PayPal users at that time. Consequently, approximately one in three Indians uses Paytm. The company went public in 2021 and is currently valued at around US$3 billion.

Paytm's rapid growth and widespread adoption have played a crucial role in advancing digital payments in India, providing a robust platform for financial transactions and contributing to the broader digital economy.

As part of the company's evolution, it was recently subjected to a series of stringent regulatory measures by the Central Bank, which has throttled its efforts to grow its Payments Bank business. While ideas from the technology industry have been a foundational pillar of its growth strategy, it seems that the time is ripe to learn lessons around risk and compliance from the Financial Services industry next.

4.2. Leveraging Mobile Technology for Digital Transactions

Once an individual possesses proof of identity and a bank account, only a mobile phone stands between them and the ability to transact digitally. By the time Aadhaar and Jan Dhan accounts were launched, India was already experiencing a mobile revolution. As recently as 1999, there were fewer than 40 million phones in the entire country, equating to just 3.5 phones per 100 individuals. However, the New Telecom Policy of 1999 catalysed a rapid expansion. The entry of private players, coupled with declining costs due to technological advances and tariff-free imports, transformed mobile phones from a luxury to a necessity.

At its peak, India added 40 million phones every 2 months – exceeding the total number of phones accumulated in the first 120 years since the telephone was introduced in India. Today, there are 1.2 billion phones in the country, with half a billion in rural areas. On average, rural households of five people own nearly three phones, while urban households of four own six phones.

Bank accounts and mobile phones form the foundational infrastructure for a digital payment system, enabling individuals to transfer money and make payments digitally. However, for these bank accounts and mobile phones to function effectively as transaction instruments, an

intermediary platform is essential. In this area as well, India has demonstrated significant innovation.

India's convergence of widespread mobile phone adoption with the establishment of Aadhaar and Jan Dhan accounts has created a robust ecosystem for digital financial transactions. This synergy has enabled millions of individuals to engage in the digital economy, fostering financial inclusion and driving economic growth.

4.3. Jio mobile and broadband

By leveraging a unique configuration devoid of 2G or 3G legacy services, Jio, a new telecoms operator, has revolutionised the telecommunications landscape, offering free voice calls and affordable 4G Internet to millions of users. Through aggressive pricing strategies and innovative business models, Jio has rapidly expanded its subscriber base, driven down broadband costs, and catalysed the widespread adoption of digital technologies across the country.

By capitalising on its Greenfield 4G LTE network and innovative pricing structures, Jio has democratised access to high-speed Internet and transformed the digital landscape. This paper delves into the key features and implications of Jio's innovative approach, highlighting its role in driving inclusive growth and digital empowerment.

Unlike traditional telecommunications providers burdened by legacy infrastructure, Jio entered the market with a clean slate, enabling it to offer cutting-edge services at unprecedented affordability. By eliminating national roaming charges and providing free voice calls to any network, Jio has created a seamless and cost-effective communication ecosystem for consumers. Moreover, its disruptive pricing strategy, offering 4G Internet at just 10 cents per gigabyte and providing smartphones effectively free of cost, has democratised access to digital connectivity for millions of Indians.

The meteoric rise of Jio since its launch in September 2016 is emblematic of its profound impact on the telecommunications sector. Within a span of just 22 months, Jio amassed a staggering 215 million subscribers, setting new benchmarks for subscriber acquisition in the industry. This exponential growth trajectory, fuelled by competitive pressures induced by Jio's disruptive model, has exerted downward pressure on broadband service prices, driving a surge in digital adoption and usage across India.

The democratisation of digital access facilitated by Jio's innovative approach holds significant implications for inclusive growth and socioeconomic development. By lowering barriers to entry and expanding connectivity to underserved regions, Jio has empowered millions of individuals with access to information, communication, and digital services. This democratisation of digital infrastructure is poised to catalyse a virtuous cycle of economic empowerment, entrepreneurship, and social inclusion across the country.

4.4. Zerodha and Groww: Enhancing Retail Participation in Capital Markets

Historically, the Indian mutual funds industry experienced modest growth in retail investor onboarding, with monthly additions ranging between 3,000 to 4,000 investors until the year 2020.[40] The onset of the COVID-19 pandemic catalysed a substantial shift towards digital

platforms, which, in conjunction with strategic governmental initiatives, has revolutionised the landscape of retail participation in the capital markets.

Post-2020, the Indian mutual funds sector witnessed an unprecedented surge in retail investor onboarding, facilitated primarily by the adoption of digital onboarding processes. The monthly influx of new investors soared to 4–5 million, reflecting a paradigm shift in market dynamics. This substantial increase can be attributed to the rapid digital transformation spurred by the pandemic, which necessitated and normalised the use of digital financial services amongst the general populace.

India has maintained its position as the world's largest derivatives market by volume for the past 5 years. Notably, 40% of these volumes are concentrated in the hands of two prominent non-bank FinTech startups: Zerodha (Agarwal, 2023) and Groww. The founders of these startups credit their remarkable growth and market penetration to the Indian government's DPI projects (Keshre, 2023; Kamath, 2023), which have provided a robust infrastructure for digital financial transactions and services.

The success of Zerodha and Groww underscores the pivotal role of the government's DPI projects in enhancing financial inclusion and market accessibility. Initiatives such as the UPI, Aadhaar-enabled e-KYC, and the Digital India campaign have created an enabling environment for FinTech innovation. These projects have not only streamlined onboarding processes but also instilled greater confidence amongst retail investors, contributing to the rapid expansion of the investor base. Until 2020, the entire Indian mutual funds industry was onboarding 3,000–4,000 investors per month. Post Covid (Agarwal, Swami, and Malhotra, 2024), thanks to digital onboarding, the industry is now getting 4–5 million customers per month.

India has had the world's largest derivatives market by volume for 5 years. Forty percent of the volumes are controlled by two non-bank FinTech startups – Zerodha and Groww.

Both their founders attribute their rise to the government's DPI projects.

4.5. Accelerating credit penetration through FinTech NBFCs

According to the Report of the Working Group on Digital Lending commissioned by RBI in 2021, it was observed that lending through digital mode relative to physical mode is still at a nascent stage for banks (₹1.12 lakh crore via digital mode vis-à-vis ₹53.08 lakh crore via physical mode). In contrast, NBFCs are experiencing a higher proportion of lending through digital mode (₹0.23 lakh crore via digital mode vis-à-vis ₹1.93 lakh crore via physical mode).

Figure 7: Trend of Loans through Digital Channels
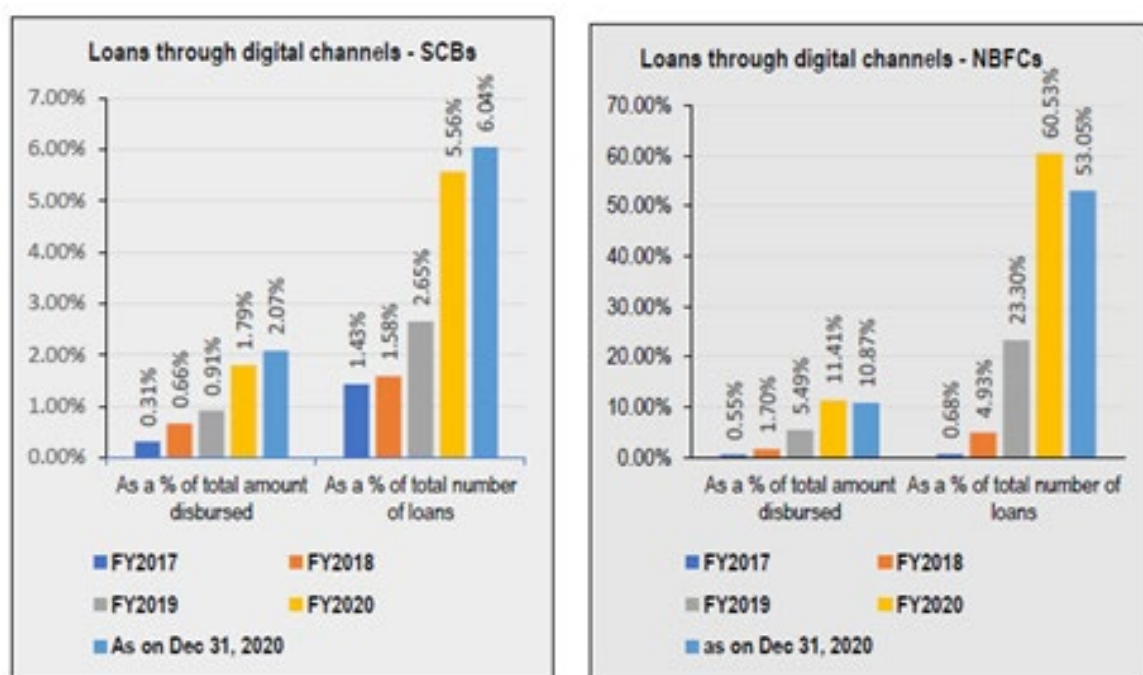
Source: Report of the Working Group on Digital Lending including Lending through Online Platforms and Mobile App.^{Error! Bookmark not defined.}

In 2017, there was not much difference between banks (0.31%) and NBFCs (0.55%) in terms of the share of total amount of loan disbursed through digital mode whereas NBFCs were lagging in terms of total number of loans with a share of 0.68% vis-à-vis 1.43% for banks. Since then, NBFCs have made great strides in lending through digital modes. The overall volume of disbursement through digital modes for the sampled entities has exhibited a growth of more than twelvefold between 2017 and 2020 (from ₹11,671 crore to ₹1,41,821 crore).

Factors Spurting Growth of Digital Lending in India

The ubiquity of information and communication technologies has affected most conventional financial products in India and created newer products. Digital lending is driven by a combination of supply-side and demand-side factors. In India, unmet credit demand of younger cohorts, low financial inclusion, technological advancements and increasing internet penetration are going to be the strong drivers. However, trust in technology, data security and customer protection

considerations will play a critical role in determining the extent of FinTech adoption. India accounts for the greatest number of Digital Lending Applications in the world. India's vision towards becoming a cash-light economy combined with the growth of public digital infrastructure and the demand for financial inclusiveness, makes it a front runner in the digital lending technology arena. The growth drivers have come from both the supply as well as the demand side, as shown in Figure 8 below.

Figure 8: Supply Side Drivers of Fintech Growth

Technological Advancements
- Mobile internet
- Application Programming Interfaces (APIs)
- Alternative Data
- Vertical Seacrh Engines
- Artificial Intelligence
- Big Data Analytics
- Cloud Computing
- Distributed Ledger

Government Initiatives
- Jan Dhan Yojana
- Aadhaar Enrolment
- Digital India
- IndiaStack
- Startup Ecosystem

Supply Side Drivers

Regulatory Enablers
- Framework for Account Aggregators and Peer to Peer Lending Platforms
- App based NBFCs
- Regulatory Sandbox
- Reserve Bank Innovation Hub
- Financial Inclusion Initiatives

Internet/ Mobile Penetration
- Accessibility and Availability of Smart Phones
- Internet Subscribers: 776.45 million(Sep 20)
- Broadband Connections: 726.32 million (Sep 20)
- Mobile Connections: 1151.73 million(Oct 20)

Source: Report of the Working Group on Digital Lending including Lending through Online Platforms and Mobile Apps.**Error! Bookmark not defined.**
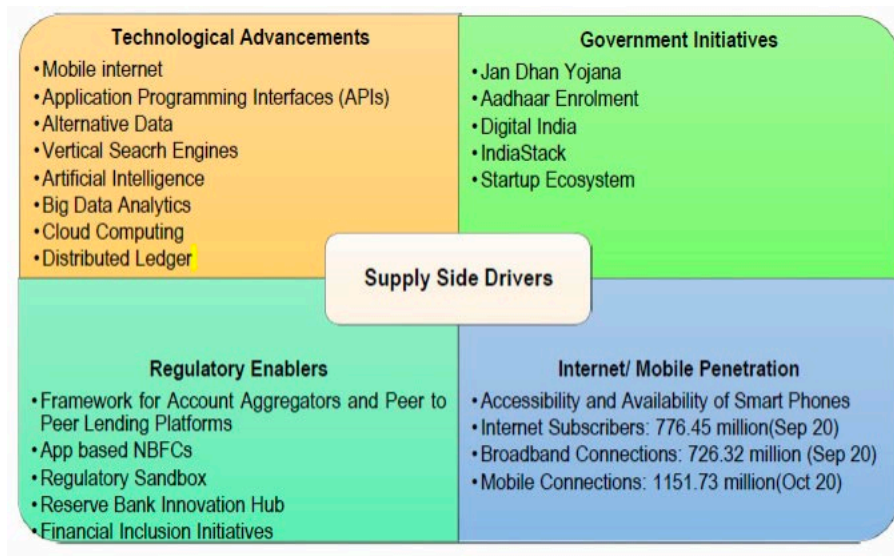
Figure 9: Demand Side Drivers of Fintech Growth

Demographics
- Higher proportion of young population
- Digital natives
- Aspirational consumers (driven by life style needs)

Economic Development
- Increase in per capita GDP at constant prices to ₹108620 in 2019-20 from ₹78348 in 2013-14
- Increase in per capita net national income at constant prices to ₹108620 in 2019-20 from ₹68572 in 2013-14

Demand Side Drivers

Unmet Demand
- Low credit penetration to informal economy/sub-prime or first time borrowers
- Reluctance of traditional banks to lend to small borrowers with low or nil credit history

COVID 19 Pandemic
- Pandemic induced financial stress
- Reduced mobility and social distancing
- Reduced employment and wages

Source: Report of the Working Group on Digital Lending including Lending through Online Platforms and Mobile Apps.**Error! Bookmark not defined.**

5. Civil Society-Led Reforms

5.1. Implications of the September 2018 Aadhaar Ruling by the Supreme Court

India has established an impressive low-cost infrastructure to facilitate digital transactions, largely supported by the Aadhaar biometric identity system. However, a Supreme Court ruling in September 2018 introduced significant challenges to its usage. The ruling permits the government to use Aadhaar for taxation purposes and disbursement of funds to citizens, ensuring that these critical functions continue to benefit from the biometric system.

Conversely, the ruling restricts private sector access to Aadhaar biometric data for identity verification purposes. This restriction presents a major setback for private entities such as commercial banks, mobile service providers, and digital wallets, which had relied on Aadhaar for efficient Know Your Customer (KYC) processes. As a result, these entities must now seek alternative methods to fulfil KYC requirements, complicating identity verification and potentially increasing costs.

In response to the ruling, the government is contemplating new legislation aimed at balancing data privacy with the need for efficient identity verification. The proposed legislation would grant private operators access to Aadhaar-based verification, contingent on the approval of the Aadhaar holder, while ensuring robust data privacy protections. However, until such legislation is enacted, private entities are barred from using Aadhaar databases for identity verification.

This ruling underscores the need for a robust and privacy-compliant framework to support digital transactions, ensuring both security and accessibility for all stakeholders in India's digital economy.

6. Summary of India's DPI capabilities

To encapsulate the breadth and depth of India's Digital Public Infrastructure (DPI) capabilities, we summarise the key components and achievements in Table 5. This comprehensive overview highlights the critical elements that have contributed to India's success in implementing robust and scalable DPI systems. The table serves as a foundation for understanding the various initiatives, their impacts, and their roles in driving digital transformation in India.

Table 5: Summary of India's DPI Capabilities

Name	Definition	Launch	Penetration / Impact
Identity Layer			
Aadhaar	A 12-digit unique identification number that is linked to biometrics (fingerprints, iris, face) demographic (name, age, gender, address), and optional contact details (email, phone number)	2009	1.38B holders 1.96B Authentications per Month
eKYC	Electronic authentication of a customer's identity using their Aadhaar details	2013	250M per month.18.8B cumulative.
eSign	Service enabling Aadhaar holders to digitally and remotely sign documents with a legally valid electronic signature	2016	
GSTN	A unique 15-digit identifier is assigned to businesses and individuals who are registered under the GST regime in India. It is used to track and manage the tax liabilities and compliance of registered taxpayers under the GST system.	2017	14M taxpaying businesses
Payments Layer			
AePS	An interoperable financial system allowing customers to access and transact on their bank accounts by authenticating their Aadhaar	2010	200M tons per month
APB	System for electronically channeling the Government benefits and subsidies in the Aadhaar Enabled Bank Accounts (AEBA) of the intended beneficiaries.	2011	88% of govt benefits are delivered via APB
UPI	Unified Payments Interface is an instant real-time payments system	2016	12.2B tons worth US$225B per month
BBPS	Integrated bill payment system providing a centralised platform for the payment of telephone bills, utility bills, etc.	2016	250M Txns per Quarter. US$7.5B in value
Data Layer			
DigiLocker	Digitalisation service that provides an account in the cloud to every Aadhaar holder to access authentic documents	2015	263M users. 6.7B docs issued.
Account Aggregator	Enables consented access and sharing of any person's digital financial information securely amongst financial institutions regulated by Financial Sector Regulators, viz., RBI, Securities and Exchange Board of India (SEBI), Insurance Regulatory and Development Authority of India (IRDAI), Pension Fund Regulatory and Development Authority (PFRDA)	2021	63M Accounts linked. 64M data sharing requests.

Source: How UPI Works[41], Aadhaar, eKYC data[42]: AePS[43] , GSTN[44], UPI[45], BBPS[46], DigiLocker[47], Account Aggregator.[48]

To further illustrate India's prominent position within the global fintech landscape, we present an overview of leading fintech ecosystems worldwide. The following table provides a comparative analysis of key metrics, highlighting the scale, growth, and funding dynamics of fintech sectors in various countries. This data underscores India's significant achievements and potential in the fintech domain.

Table 6: Leading Global Fintech Ecosystems

	US	UK	India	Canada	China	Australia	Indonesia
No of fintechs (2023)	34,034	12,775	10,244	3,965	3,717	3639	334
CAGR in no of fintechs (2020–23)	11%	10%	14%	10%	5%	6%	3%
Funding (US$) (Jul 18–Jun'23)	$225B	$63B	$25B	$10.5B	20 B	$8.6B	$3.93B
No of deals (Jul 18 to Jun'23)	6,562	2,184	2,236	572	589	346	215
No of unicorns (Jul 23)	170	37	25	7	38	3	7

Note: The source for Indonesia is referenced separately. The time-period for Indonesia is 2017–22.
Source: Technology & Data for Venture Capital, Corp Dev, Investment Banks in Tracxn.

6.1. Case Study: MOSIP | Digital ID systems for all governments

MOSIP, the Modular Open-Source Identity Platform, is a digital foundational identity system that assists governments and organisations in implementing identity systems. It offers basic functions like acquiring and processing identity data, generating Unique Identity Numbers (UINs), and authenticating individuals for accessing services. MOSIP is modular, allowing countries to configure their systems independently[49] and avoid vendor lock-in.[50] It is open-source, based on open standards, and designed with principles like data privacy, no vendor lock-in, and security by default.[51] MOSIP aims to provide tools for digital transformation, emphasising human-centric design and good governance principles.[52] According to the compliance toolkit of MOSIP, the platform prioritises security, inclusivity, and transparency, offering adopters the freedom to customise their identity systems while ensuring data security and human-centric technology solutions. MOSIP fosters a global ecosystem of technology developers, academics, and decision-makers to drive digital transformation and meet evolving needs. Additionally, MOSIP provides a Compliance Tool Kit[52] for partners to test product compliance with MOSIP specifications, ensuring adherence to standards like Secure Biometric Interface (SBI), Software Development Kit (SDK), and Automated Biometric Identification System (ABIS). Sung (2023) notes that it is currently being implemented in nine countries – Philippines, Morocco, Sri Lanka, Uganda, Ethiopia, Republic of Guinea, Sierra Leone, Burkina Faso, and Togolese Republic.

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7. Guiding principles of India's design for other countries

These five technology architecture principles illustrate how DPI efforts can be architected to be distinct from traditional digitisation efforts: 1) interoperability; 2) minimalist, reusable building blocks; 3) diverse, inclusive innovation by the ecosystem; 4) a preference for remaining federated and decentralised; and 5) security and privacy by design.

When implemented, these technical principles help DPIs achieve societal outcomes such as inclusion, user choice, innovation, scale of delivery, speed of services, public trust, and competition in markets.

7.1. Interoperability

Interoperability is foundational to the DPI architecture. It emphasises the seamless integration of various systems and platforms, ensuring that different technologies can work together efficiently. This principle is critical in avoiding the fragmentation of digital ecosystems and promoting cohesive digital experiences for users.

- **Policy Implications**: Governments and regulatory bodies need to establish and enforce standards that facilitate interoperability. This involves international collaboration to ensure that systems across borders can communicate effectively.

- **Technical Design**: Developers must prioritise open standards and protocols that enable different systems to interoperate. This reduces redundancy and fosters innovation by allowing new technologies to build on existing infrastructure.

- **Economic Impact**: Interoperable systems reduce costs associated with transitioning between different technologies and platforms. This fosters a competitive market environment, benefiting consumers and businesses alike.

7.2. Minimalist and Reusable Building Blocks

The principle of using minimalist and reusable building blocks advocates for creating simple, modular components that can be easily combined and repurposed. This approach enhances the flexibility and scalability of digital systems.

- **Policy Implications**: Encouraging the use of modular components can lead to more efficient use of resources and faster deployment of digital solutions. Policy frameworks should support the development and sharing of these components.

- **Technical Design**: By focusing on minimalism, developers can create more maintainable and adaptable systems. Reusability ensures that components can be easily integrated into different projects, reducing development time and costs.

- **Economic Impact**: The reuse of building blocks can significantly lower development costs and time to market, fostering a more dynamic and responsive digital economy.

7.3. Diverse and Inclusive Innovation

Diverse and inclusive innovation is crucial for ensuring that digital public infrastructure serves all segments of society equitably. This principle advocates for the inclusion of diverse perspectives in the design and implementation of digital solutions.

- **Policy Implications**: Policymakers must create environments that encourage participation from underrepresented groups in the tech industry. This includes educational initiatives and support for minority-owned tech enterprises.

- **Technical Design**: Developers should prioritise accessibility and inclusivity in their designs, ensuring that digital tools are usable by people of all abilities and backgrounds.

- **Social Impact**: Inclusive innovation can bridge the digital divide, promoting social equity and ensuring that all communities benefit from technological advancements.

7.4. Federated and Decentralised Design

The principle of federated and decentralised design advocates for distributing control and ownership of digital systems to avoid central points of failure and abuse of power.

- **Policy Implications**: Decentralisation requires regulatory frameworks that balance the distribution of power with the need for oversight and security. Policies must promote fair competition and prevent monopolistic practices.

- **Technical Design**: Decentralised architectures, such as blockchain, can enhance security and resilience. Federated systems allow for local autonomy while maintaining overall coherence and interoperability.

- **Economic Impact**: Decentralisation can democratise access to digital resources and services, fostering innovation and competition. It can also mitigate risks associated with central points of control, enhancing the overall stability of digital ecosystems.

7.5. Security and Privacy by Design

Security and privacy by design is a principle that integrates these considerations into the core architecture of digital systems from the outset, rather than as afterthoughts.

- **Policy Implications**: Strong data protection regulations and enforcement mechanisms are essential to safeguard user privacy and security. Policymakers must ensure that organisations adhere to these standards.

- **Technical Design**: Developers must adopt best practices in secure coding and privacy-preserving technologies. This includes encryption, secure authentication methods, and data minimisation techniques.

- **Social Impact**: By prioritising security and privacy, digital systems can build and maintain public trust. This is crucial for the widespread adoption and success of digital public infrastructure.

Chapter 4

Regulatory Policies and Initiatives: India and ASEAN

India and the ASEAN nations exhibit significant political, economic, and social diversity, resulting in varying socio-economic agendas and diverse political and governance frameworks. These disparities are mirrored in their approaches to digitalisation and e-commerce, reflecting distinctive policy landscapes. This section endeavours to outline both the commonalities and distinctions amongst these countries concerning the implementation of digital policies, e-commerce regulations, as well as data protection and privacy measures.

1. Digital Policies

Several nations within ASEAN have exhibited a robust dedication to the digital agenda by crafting concrete blueprints, strategies, and frameworks for execution. We give examples of various countries and their digital agendas below.

a. Singapore: Singapore has introduced the Digital Government Blueprint, a 5-year strategy that builds upon previous e-government initiatives to leverage digital technology for the provision of stakeholder-centric services. The Key Performance Indicators (KPIs) were to ensure that a minimum of 70% of eligible government systems migrate to the commercial cloud by 2023 and reduce the time required to integrate and share core data for cross-agency projects to no more than seven working days. This enabled 95% of transactions (by volume) to be conducted digitally from start to finish, achieving the targeted range of 90–95%. This also achieved the target for the number of officers trained in data analytics and data science.

b. Thailand: It has initiated the three-year Digital Government Development plan (2016–2019) to establish a blueprint for identifying governmental digital capabilities in alignment with national objectives. The Thai government is actively involved in enhancing the nation's digital economy via the Thailand 4.0 initiative. This strategy is geared towards fostering innovation, creativity, research, and development, as well as advancing higher and green technologies. Under this initiative, resources are allocated to the development of digital infrastructure, such as the expansion of a broadband network reaching villages nationwide. This initiative facilitates greater access to online resources, narrowing the digital divide and stimulating economic growth through e-commerce.

c. Malaysia: The Malaysian Public Sector ICT Strategy Plan (2016–2020) sets forth a new ICT vision consistent with the national transformation agenda, aimed at propelling Malaysia towards developed nation status by 2020, and delineates strategies for various ministries and agencies to implement ICT initiatives.

d. Similarly, the Cambodian ICT Masterplan 2020 represents a concrete strategic effort to position Cambodia as a hub for ICT in Southeast Asia.

e. Indonesia has yet to formulate a comprehensive digital policy.

Regarding the digital policies of India and ASEAN countries, the status of selected components is outlined below. At the ASEAN level, the ASEAN Digital Integration Framework Action Plan (DIFAP) 2019–2025 furnishes a comprehensive framework for facilitating digital trade.

2. Data Privacy and Localisation

As data flows across borders increase, concerns regarding data privacy and security have emerged in numerous countries. ASEAN nations have implemented various regulations, including laws, acts, and additional decrees, to address data privacy and security, each at different stages of implementation.

a. Singapore, for example, has enacted the 'Personal Data Protection Act, of 2012' to complement sector-specific legislative frameworks.

b. Thailand recently introduced its 'Personal Data Protection Act,' effective from May 2020.

c. Brunei has a 'Data Protection Policy, 2014,

d. Lao PDR has the 'Lao PDR Electronic Data Protection Law' enacted in 2017, along with the 'Law on Prevention and Combating of Cyber Crime (2015).

e. Viet Nam and Myanmar: Laws on general personal data protection laws are absent, but sector-specific regulations are in place.

f. Indonesia missed the 2018 deadline for the 'Personal Data Protection Bill' set by the Communication and Information Ministry. However, on 10 October 2019, the government issued a regulation on Electronic (Network and Information) Systems (GR 71/2019), introducing significant changes to data localisation requirements, personal data protection, and government authority to block access to negative content, amongst other provisions. The transfer of personal and transaction data is prohibited, with requirements for local storage of financial and protected private data.

g. In India, the 'Personal Data Protection Bill 2018' is awaiting approval in Parliament.

h. Malaysia: There are conditional data flows with no local storage mandate.

i. India: The Reserve Bank of India (RBI) issued two directives in 2018, mandating that all authorised payment system operators and banks store payment systems data exclusively within India.

j. Cambodia: Cambodia has not signed the Information Technology Agreement ITA 1 or ITA 2.

3. Digitisation of Trade

Cross-border e-commerce can help promote trade between ASEAN and India. The ASEAN–India FTA is an example of how e-commerce development leads to increased trade value. This is because e-commerce support leads to the development of a digital economy and connectivity, and its lower entry costs help start-ups and micro, small, and medium-sized enterprises (MSMEs) access local and global markets. E-commerce will help MSMEs and marginalised groups in both

economies to diversify their client base at lower costs while providing consumers with access to a diverse choice of products.

4. International and Regional Agreements

ASEAN member countries actively participate in various bilateral, plurilateral, and multilateral agreements and forums about digital connectivity and e-commerce. The scope of these engagements varies, ranging from commitments within the World Trade Organization (WTO) to the exchange of best practices. Regarding multilateral technological agreements such as the Information Technology Agreement (ITA)-I (signed in December 1996) and its expanded form, ITA-II (signed in December 2015). While seven ASEAN member countries and India have ratified ITA-I, only Malaysia, the Philippines, Singapore, and Thailand have ratified ITA-II (refer to Table). In recent times, concerns have arisen amongst countries like India and Indonesia regarding commitments in the digital sector and e-commerce within multilateral frameworks. On 25 January 2019, 77 WTO member countries launched plurilateral negotiations on global trade rules in e-commerce to address issues such as data localisation and digital trade facilitation. Six ASEAN members are part of this negotiation group (Shah, Chugan, and Kumar, 2022) and India is not amongst them. Exporting DPI to other ASEAN nations necessitates India to be a part of this plurilateral group so that data localisation and digital trade facilitation will be automatically taken care of. As can be seen in Table 7, India has not entered ITA-II either.

Table 7: International and Regional Information technology agreements across ASEAN

| Countries	ITA-I	ITA-II	WTO Plurilateral Group on E-commerce as of 2023
Brunei	✓	✗	✓
Cambodia	✗	✗	✗
Lao PDR	✗	✗	✓
Malaysia	✓	✓	✓
Myanmar	✗	✗	✓
Philippines	✓	✓	✗
Indonesia	✓	✗	✗
Singapore	✓	✓	✓
Thailand	✓	✓	✓
Viet Nam	✓	✗	✗
India	✓	✗	✗

Source: Shah, Chugan, and Kumar (2022).

5. Digital Economic Framework Agreement

In September 2023, the ASEAN economic ministers-initiated negotiations for the ASEAN Digital Economy Framework Agreement (DEFA) during the ASEAN Economic Community Council (AECC) meeting. This agreement is considered a landmark for the region's digital economy, demonstrating ASEAN's commitment to a digitally interconnected future.

The framework aims to position ASEAN as a leading digital economy by fostering enhanced digital cooperation, facilitating regional digital integration, and promoting inclusive growth and development. Its core elements include Digital Payments and E-Invoicing, Talent Mobility and Cooperation, Collaboration on Emerging Topics, Competition Policy, Cross-border E-Commerce, Digital Trade, Digital ID and Authentication, Cross-border Data Flows and Data Protection, and Online Safety and Cybersecurity. These nine elements emphasise collaboration within the digital ecosystem, aiming to unlock the potential of ASEAN's digital economy, which is expected to contribute up to US$2 trillion to the regional economy by 2030.

Figure 10: ASEAN Fintech Projection
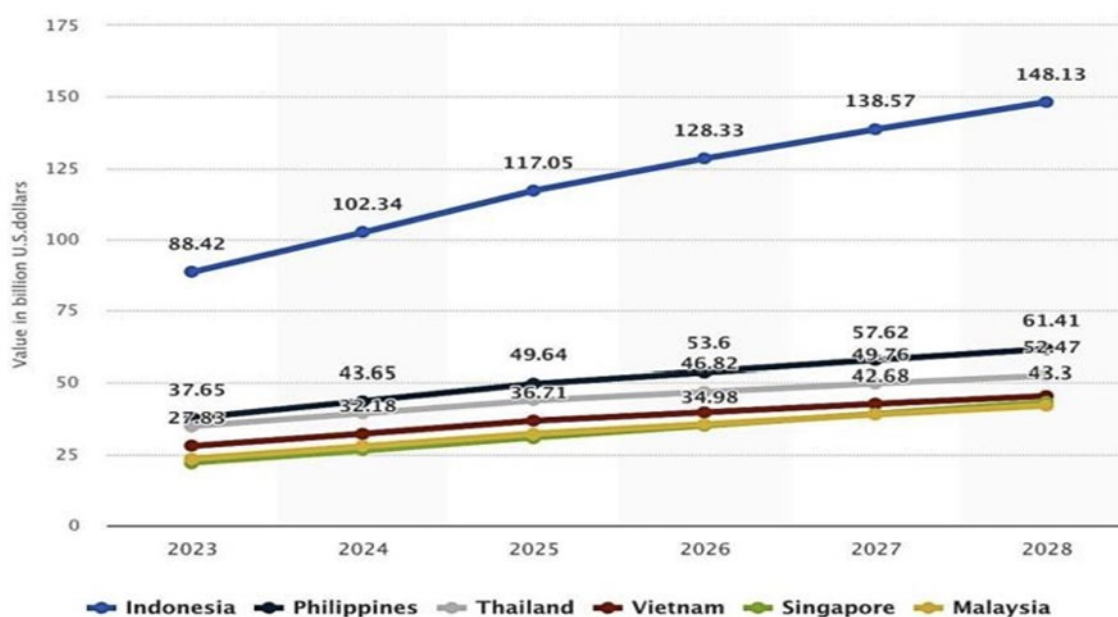
Source: Rohman, I.K., K.N. Gunawan, and A. Johanes (2024), 'The ASEAN Digital Economy Framework Agreement: Uniting or Dividing?', RSIS Commentaries, 044-24.

DEFA aims to establish an open, secure, interoperable, competitive, and inclusive regional digital economy. This agreement would enhance ASEAN's cooperation in digital ecosystems, including developing a digital-ready workforce and preparing micro, small, and medium-sized enterprises for digital transformation. The agreement is also designed to address the digital and development gaps amongst ASEAN members.

Table 8: Trade Agreements across ASEAN Nations

This table lists the various agreements signed by ASEAN member countries. They are as follows:

CPTPP: Comprehensive and Progressive Agreement for Trans-Pacific Partnership

RCEP: Regional Comprehensive Economic Partnership

ASEAN E-commerce agreement: digital infrastructure, regulatory frameworks, electronic payments, consumer protection

DEPA: digital identities, data protection, and cross-border data flows

Country	CPTPP	RCEP	ASEAN E-commerce agreement	DEPA
Brunei	✓	✓	✓	
Cambodia		✓	✓	
Indonesia		✓	✓	
India				
Lao PDR		✓	✓	
Malaysia	✓	✓	✓	
Myanmar		✓	✓	
Philippines		✓	✓	
Singapore	✓	✓	✓	✓
Thailand		✓	✓	
Viet Nam	✓	✓	✓	

Source: Shah, Chugan, and Kumar (2022).

Until recently, India had been negotiating the Regional Comprehensive Economic Partnership (RCEP), which included ASEAN, Australia, China, Japan, New Zealand, and the Republic of Korea. This agreement has provisions on e-commerce. India opted out of RCEP in November 2019, after 7 years of negotiations.

Four ASEAN member countries – Singapore, Malaysia, Brunei Darussalam, and Viet Nam – are part of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP, signed on 8 March 2018), which has provisions on e-commerce and digital trade, focussing specifically on cross-border e-commerce trade between the 11 member countries. Indonesia and Thailand are amongst the countries who have an interest in joining the agreement in the future. With tariff reductions, e-commerce players in these countries, especially SMEs, can see

improvements in online sales and better integration into global supply chains. For instance, ASEAN member countries like Viet Nam have recently signed a trade agreement with the European Union (on 30 June 2019), demonstrating their openness to taking regulatory commitments in the ICT sector and their willingness to reduce tariffs.

Amongst the free trade agreements that ASEAN has signed, the ASEAN–Australia–New Zealand Free Trade Agreement, 2020, has a chapter on e-commerce that aims to promote and enhance cooperation in the areas of electronic authentication and digital certificates, online consumer protection, data protection, paperless trading, etc.

The most comprehensive agreement on e-commerce is the 'ASEAN Agreement on E-commerce', which was signed on 12 November 2018 after nine rounds of negotiations involving representatives from member countries. The agreement is a starting point for facilitating cross border e-commerce trade by lowering specific non-tariff barriers and enhancing digital connectivity within the region. There is a commitment to cooperate in areas including ICT infrastructure, education and technology competency, online consumer protection e-commerce, legal and regulatory frameworks, electronic payments and settlements, trade facilitation, intellectual property rights, competition, cybersecurity and logistics to facilitate e-commerce. Unlike ASEAN, India has yet to sign an agreement that includes regulatory commitments in e-commerce. The agreements signed by India mostly have provision for co-operation and non-binding commitments. However, India has reduced tariffs through its free trade agreements with ASEAN and its member states like Thailand.

CPTPP agreement includes the regulatory provisions of Paperless Trading, custom duties, Electronic Authentication, Domestic Electronic Transactions Framework, Electronic Signatures, Personal Information Protection, Online Consumer Protection, Principles of Internet accessibility and usage for e-Commerce, Information flow across borders via electronic means, Non-Discriminatory procedure of digital products, Computing Facilities positioning, Internet Interconnection Charge Sharing, Unsolicited Commercial Electronic Messages, dispute resolution, Source Code and Cybersecurity. Signing this agreement can catapult India's chances of exporting DPI to the member countries such as Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Viet Nam.

On the other hand, when compared to the CPTPP's requirements, the RCEP's provisions on digital commerce are less stringent and comprehensive as it allows the Parties to determine the necessity of implementing reasonable public policy in the respective trade agreement. Moreover, the provision does not exclude a party from taking 'whatever step it deems necessary to preserve its fundamental security interests, without conflicting other Parties.'

Rahman and Rahman (2022) explores the digital trade provisions in RTA's during the COVID-19 pandemic. Their paper examined the RTAs' provisions for digital trade and how the pandemic will further encourage their incorporation. India post Covid-19 pandemic should renegotiate the terms and sign RCEP or CPTPP.

Rahman et al. (2023) find that the developing countries within RCEP appear to have benefitted from FDI inflows, as it significantly affects their forward participation rate in positive direction in relation to their developed counterparts. Similarly, the positive impact of trade openness on backward participation is more pronounced in RCEP member countries with a developing country status relative to developed countries.

Figure 11: Regional Trade Agreements: Existing and Prospective for India
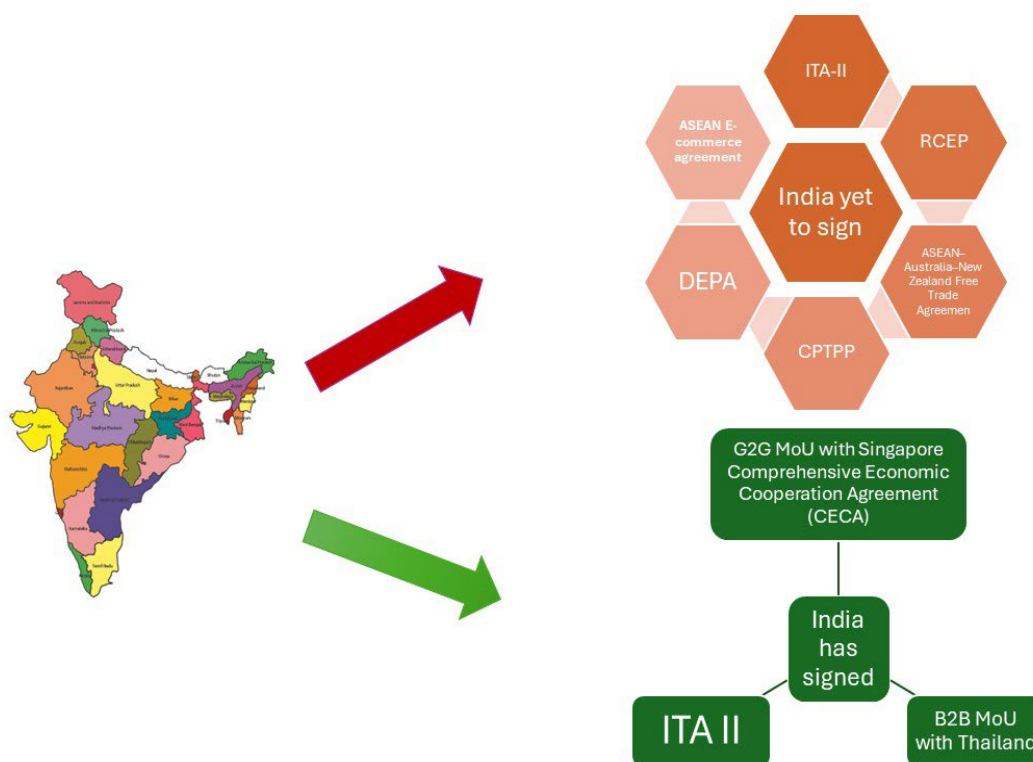
Source: The figure was constructed using data from Rahman and Rahman (2022).

The range of potential issues includes the eight topics of major concern – digital services, cybersecurity and data protection, digital taxation, digital payments, data or digital sovereignty, competition law and antitrust policies, assisting MSMEs in the digital domain, and effectively managing the growth of new technologies. In Asia, a lack of standardised norms presents barriers to intra-regional data transfers and data privacy protection. However, data transfer across borders can make valuable and essential advances to trade. It would be optimal if digital trade laws were synchronised throughout the broadest group of countries, primarily for MSMEs.

6. ASEAN and India DPI collaboration in Securities Markets

Following our discussion on trade and its pivotal role in economic development, we turn our focus to Gujarat International Finance Tec-City (GIFT City). This section explores how GIFT City, as India's first operational smart city and international financial services centre, complements and enhances trade by providing a robust infrastructure for financial innovation and international business. Understanding the development and impact of GIFT City provides insight into how financial hubs can drive broader economic growth and facilitate global trade.

GIFT City is a planned business district in the Indian state of Gujarat. India International Exchange (IFSC) Limited (India INX), the inaugural international exchange at GIFT IFSC, was officially launched by the Honourable Prime Minister of India, Shri Narendra Modi, on 9 January 2017, and commenced its operations on 16 January 2017. Regulated by the IFSC Authority, this exchange offers investors a trading window of 22 hours, enabling transactions in a diverse array of financial

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market products, including index and single stock derivatives, commodity derivatives, currency derivatives, and debt securities.

Equipped with a cutting-edge electronic platform, the Exchange facilitates trading, clearing, and settlement of a broad spectrum of global benchmark products across major asset classes such as securities, equity derivatives, precious metals, base metals, energy, and bonds. India INX's technological infrastructure forms the cornerstone of its operations and contributes significantly to its functionality and advancement, boasting an impressive response time of four microseconds. Additionally, the Exchange provides a tier-III equivalent data centre colocation facility for its members.

As of July 2021, the average daily turnover at the exchange stood at US$14.97 billion, commanding an 84% market share[53] amongst exchanges operating within IFSC.

6.1. Listing of ASEAN securities on GIFT city exchanges

Subsidiaries of BSE and NSE, India INX and NSE IFSC respectively, were allowed to set up stock exchanges at GIFT City.

GIFT City offers investors 22 hours of trading in a range of financial market products such as index and single stock derivatives, commodity derivatives, currency derivatives, and debt securities. The Exchange provides a state-of-the-art electronic platform to facilitate trading, clearing, and settlement of the widest range of global benchmark products across all major asset classes, including securities, equity derivatives, precious metals, base metals, energy, and bonds. India INX's technology is the base of its business and a key contributor to the Exchange's functioning and development with a response time of four microseconds. The Exchange also has a tier-III equivalent data centre colocation facility for its members. The average daily turnover at the exchange for the month of May'23 was US$4.46 billion, with a 73 percent market share amongst the exchanges at IFSC. India INX has also introduced the Global Securities Market platform, which is a pioneering concept in India, offering issuers an efficient and transparent method to raise capital. The platform offers a debt listing framework at par with other global listing venues such as London, Luxembourg, Singapore, etc. To date, the Global Securities Market has established US$72+ billion in MTN programmes and more than US$51+ billion in bonds issued with 134 issuances. The issuer mix is a healthy one with banks (SBI, EXIM Bank, HDFC Bank, ICICI Bank), supranational (Asian Development Bank), state-owned finance corporations (NTPC, PFC, REC), and several others (Reliance, Adani Green, Adani Port). India INX also has an exclusive green listing platform established as per ICMA's Green Bond Principles and Climate Bonds Initiative which provides an ideal platform for global investors to invest. India INX has also entered into a Memorandum of Understanding with the Luxembourg Stock Exchange for the development and promotion of ESG and green finance in the local market.

NSE IFSC recently announced trading in 50 popular US stocks like Apple, Amazon, and Tesla in the form of unsponsored depository receipts for Indian investors. This has created a lot of interest amongst investors who have been looking for easy ways to get exposure to these stocks. While the stock exchanges in GIFT City were primarily set up for easy access to Indian stocks and derivatives for NRIs and foreigners, this is the first product for onshore Indian investors. The announcement from NSE says that they are launching trading in 50 US stocks through unsponsored depository receipts. Currently, this product is in the regulatory sandbox (test), which

means that NSE IFSC will only be able to onboard a fixed number of customers. More customers will be allowed only once IFSCA gives the final approval on the product. Trading is open from 8 PM IST until 2.30 AM IST. Since some of these US stocks are valued between hundreds to thousands of dollars per share, trading in fractionals or owning shares of these companies in multiples of US$10 to US$20 is also allowed.

The depository receipts (DRs) that will trade on NSE IFSC will be unsponsored, which means that the companies themselves would not be issuing the DRs. NSE IFSC would have partnered with an international custodian who will hold the shares in the US on behalf of NSE IFSC, and the custodian will then issue DRs to the NSE IFSC depository account in India. A T+3 day settlement, which means stocks or DRs once bought will get credited after three days (it is two days in India) to the demat account. Similarly, funds from stocks sold will get credited after three days. While currently there are only 50 stock DRs offered by NSE IFSC, this list is bound to go up to a lot more over time. Some major stocks from ASEAN countries can also be included in this list.

6.2. Setting up of a banking unit at GIFT city by ASEAN countries

IFSCA has issued the International Financial Services Authority (Banking) Regulations 2020 providing the regulations for opening an office/branch at IFSC. Section 3 of the regulation states that Indian and Foreign Banks shall require a license to set up an IFSC Banking Unit (BU or IBU) for which an application has to be made by the parent bank.

According to this regulation the parent bank shall provide necessary capital for the BU, subject to a minimum of US$20 million, a no objection certificate must be obtained from the home regulator and an undertaking stating that the bank shall provide liquidity for the BU whenever needed for the operations.

Advantages of an IBU at GIFT

At GIFT CITY, the Indian as well as foreign banks can set up an IFSC Banking Unit (IBU). The IBUs facilitate a base for world class International Banking services in the country. These banking units are treated at par with a foreign branch.

For banks, the light touch regulatory environment presents enormous opportunities to expand existing business and develop new business. Expanding wealth, accelerating cross border trade, and growing investment reflect these opportunities. The advantages of such offshore banking are Security and protection of your capital, especially during times of instability, Privacy and service levels, Convenience and accessibility to funds, Favourable tax laws leading to savings on deposits, savings and investments, Access to international investment opportunities, Preferential foreign exchange services, and Superior lending, leveraging, and credit facilities. ASEAN member countries can have the advantages of superior credit facilities and preferential foreign exchange services. They can also protect their capital from instability in their own nations.

Table 9: List of Services Offered by IFSC

Service	Types	Asset classes	Regulations
International Banking	Wholesale Banking, Retail Banking, Treasury Management, and Merchant Banking by setting up International Banking Units (IBUs)	Foreign trade financing, foreign exchange trading, transfer of funds across national boundaries (foreign currency deposits), foreign borrowing and lending, and foreign investment	IFSCA Banking Regulations, 2020
Capital Markets	Two exchanges a. India INX b. NSE-IFSC which is operational for more than 20 + hours daily	Index Derivates, Commodity Derivatives, and Currency Derivatives.	Market Infrastructure Institutions Regulations, 2021, Issuance and Listing of Securities Regulations, 2021 and Capital Market Intermediaries Regulations, 2021
Insurance & Reinsurance	Reinsurance and retail insurance, particularly for the Indian diaspora living abroad	Insurance and Reinsurance products	(Registration of Insurance Business) Regulations, 2021 as well as (Insurance Intermediary) Regulations, 2021.
International Bullion Exchange		the bullion spot delivery contract and bullion depository receipt (with bullion as underlying	
Aircraft Leasing and Financing	80% of the total commercial fleet operating under lease compared with the global average of 53% (PWC, 2021)	Aircraft Leases	

Source: Shah, Chugan, and Kumar (2022); PWC (2021)[54]; IFSCA Banking Regulations (2020).[55]

Figure 12: Banking Ecosystem in GIFT IFSC
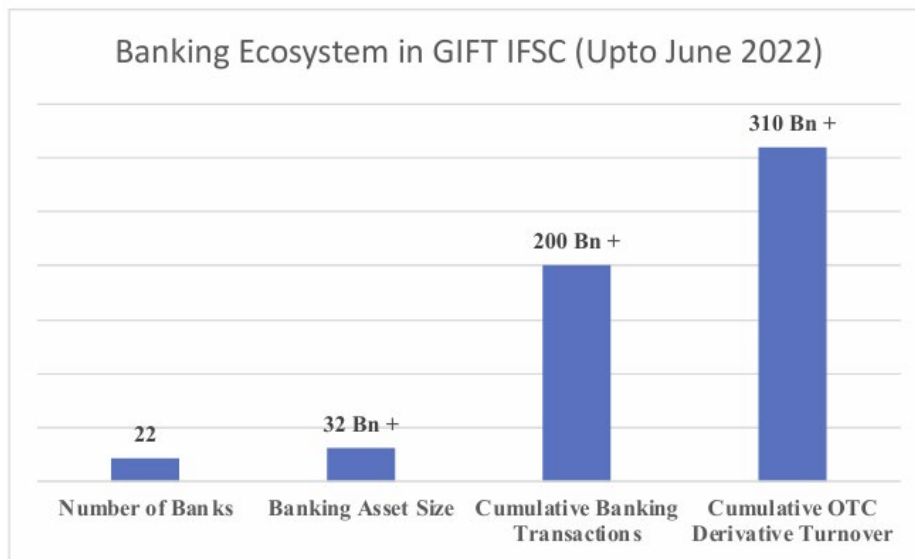
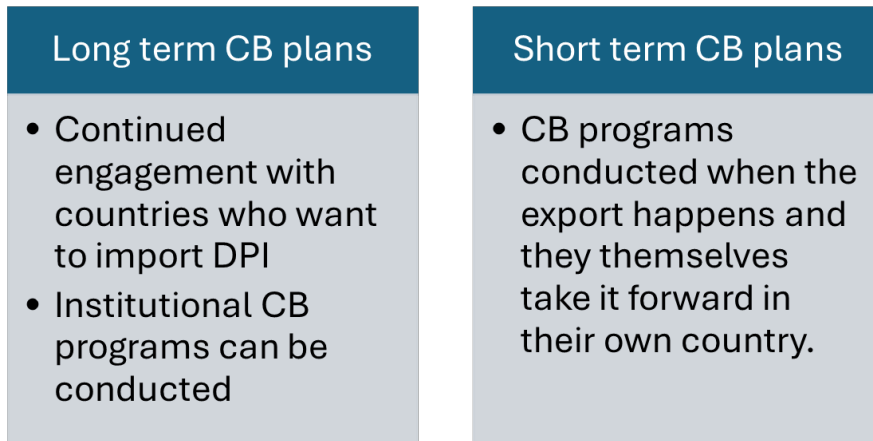Source: Shah, Chugan, and Kumar (2022).

7. ASEAN-India Fund for Digital Future

Prime Minister Narendra Modi attended the 20th ASEAN–India Summit and the 18th East Asia Summit (EAS) in Jakarta on 7 September 2023. He announced the ASEAN–India fund for Digital Future focusing on cooperation in digital transformation and financial connectivity.
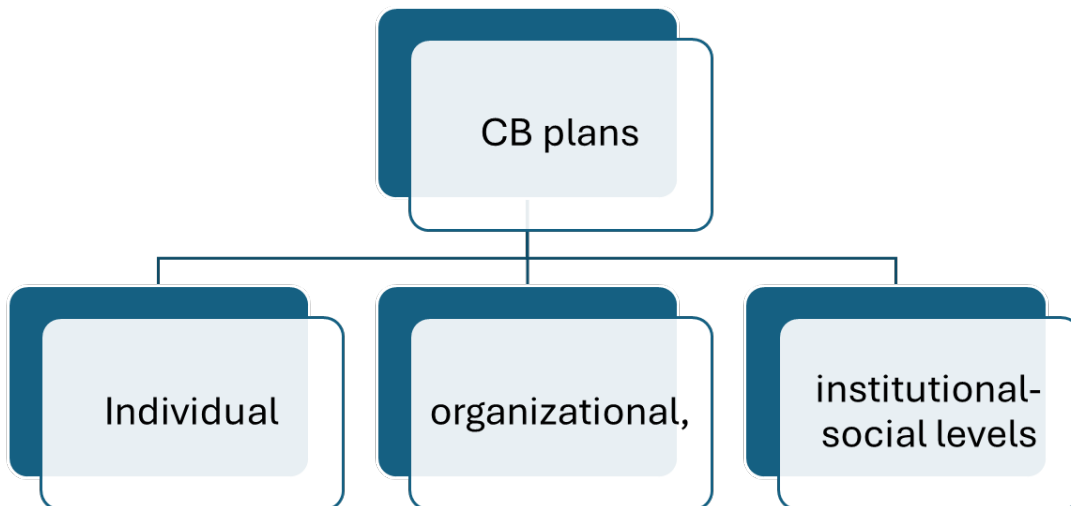
8. Capacity Building

Capacity building (CB) has a wide range of meanings Capacity building (CB) has a wide range of meanings (Craig, 2007). From a general standpoint, however, CB may be defined as the collection of activities, resources, and supports aimed to promote individual, institutional, and social skills and abilities. To gain a better understanding of the concept, CB may be looked upon from nine dimensions: (1) learning opportunities and skill development; (2) resource mobilisation; (3) partnership/linkages/networking; (4) leadership; (5) participatory decision making; (6) assets-based approach; (7) sense of community; (8) communication; and (9) digital competencies.

Figure 13: Capacity Building Plans

Long term CB plans	Short term CB plans
• Continued engagement with countries who want to import DPI • Institutional CB programs can be conducted	• CB programs conducted when the export happens and they themselves take it forward in their own country.

Source: Author's view.

Figure 14: Capacity Building Plans at Multiple Levels

CB plans

Individual | organizational, | institutional-social levels

Source: Author's view.

India, a US$3 trillion economy, aspires to be at the forefront of a digital transformation driven by FinTech innovations. Its Aadhaar card – a unique identification number that connects over 1.4 billion citizens into a digital system – has been heralded as a significant achievement. India has developed a range of public-facing digital infrastructures that have transformed its people's lives.

In terms of developing digital skills, India has a tremendous advantage and is positioned as the Global Digital Talent Nation, with one in every three employees possessing digital skills. Other ASEAN members must improve this aspect of digital connectivity. Consequently, India can contribute to the group by assisting other members with capacity building. India has an inherent and natural advantage due to its favourable demographic dividend, producing some of the brightest minds in the finance and IT sectors.

9. Conclusions

The Asia-Pacific region is currently the world's most dynamic digital market, thanks to its thriving internet economy and mobile-first consumer culture. Both exports and imports of ICT goods in the Asia-Pacific region have increased significantly, particularly in 2020. The dividends from the digital age will benefit countries that have the right regulations in place, positively impacting their economic and social development (Godoy and Heal, 2016). Therefore, market-friendly regulations are a prerequisite for market innovation.

As digital trade grows in the Asia-Pacific region, particularly in digitally tradeable services, the need for legal measures to support it also increases. The Regional Trade Agreements (RTAs) discussed in this section have become major laboratories for new norms and standards in the absence of a broad-based WTO mandate for digital trade (Wu, 2017). Regulators should be mindful of all aspects of digital trade and e-commerce to facilitate the healthy export of Digital Public Infrastructure. While these agreements cover certain provisions of the digital economy and electronic transactions, they do not address critical facets of digital trade such as data privacy and protection, cross-border data flows, electronic signatures, and electronic authentication (Choukroune and Nedumpara, 2021).

In 2005, Japan was the leading trader of digitally enabled services, followed by India and China. Interestingly, by 2020, India had surpassed both Japan and China to become the leading exporter of digitally enabled services (Figure 15). India's prominent position as a digital service provider underscores the necessity of proliferating RTAs that are conducive to digital trade.

Figure 15: Major Exporters of Digital Services in Asia Pacific, 2005 and 2020
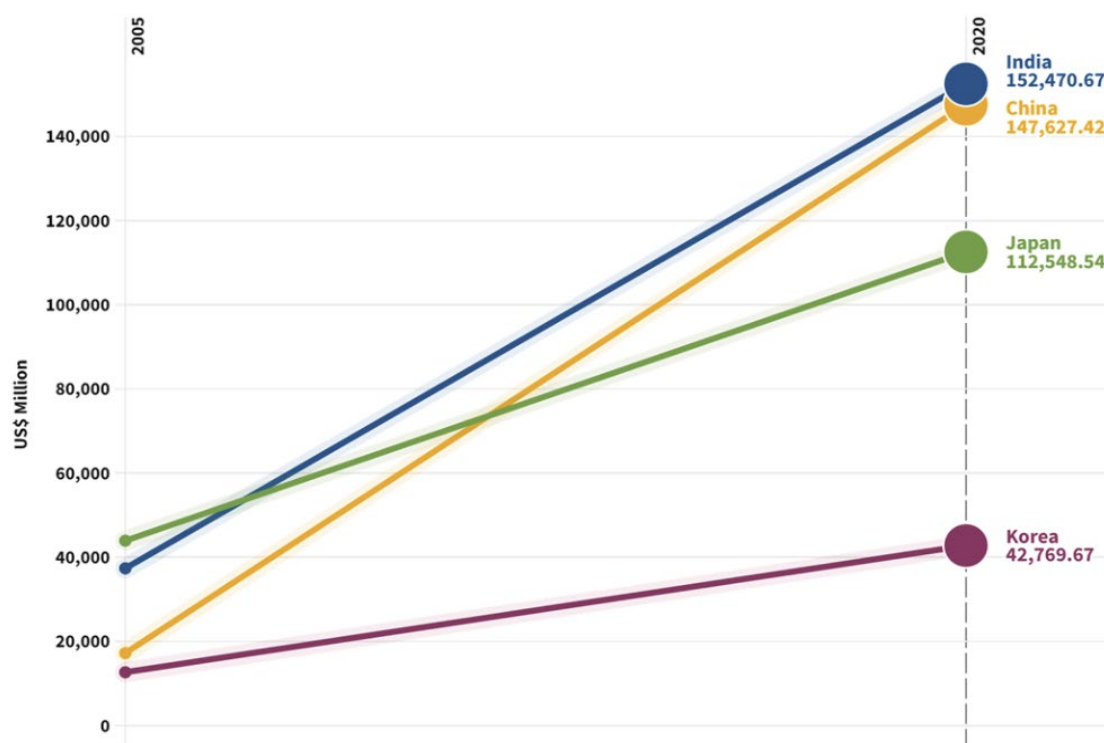
Source: Rahman and Rahman (2022).

One of the most important aspects of trade policy, according to Elms (2021), is comprehensive regulatory and policy administration to encourage digital trade. Chander (2021) demonstrates that while privacy may be costly for businesses to adopt, it is not prohibitively expensive for authorities to implement.

The major recommendations from this section include drafting Regional Trade Agreements (RTAs) to facilitate the export of Digital Products and Services (DPI). These aspects relate to three types of digital commitments:

1. Market Access (MA): Encompasses a broad range of concerns related to valuation, customs duties, natural persons' mobility (as service providers), and data accessibility.

2. Rules and Regulations (R&R): Covers a variety of challenges such as personal data protection, intellectual property rights (IPRs), and consumer protection.

3. Facilitation (F): Includes paperless trade, e-signatures, and digital authentication (Wu, 2017).

It is important for the Asia-Pacific economies to negotiate RTAs with a focus on digitally enabled services, leveraging the opportunities provided by the pandemic to expedite the digital revolution. India's services sector is promising and shows positive outcomes in terms of its involvement in the manufacturing sector's penetration into global value chains. Given this trajectory, it is crucial for Asia-Pacific countries like India to amplify negotiations regarding digitally enabled services in the RTAs. The same applies to other emerging countries in the region. Reforms in digital trade are vital to better connect the region.

Additionally, promoting and facilitating joint workshops and training for ICT capacity building in areas such as software development, e-governance, and e-commerce is imperative. An example of this is the G2G MoU with Singapore, signed in 2018, which promotes the exchange of best practices and capacity building for officials in regulatory institutions. Collaborations include areas such as application programming interfaces (APIs), regulatory sandbox models, and security in payment and digital cash flow.

To improve trade and e-commerce, creating a customised platform to connect SMEs and other companies from India and ASEAN member countries would facilitate digital business networking. This is similar to the B2B MoU between Thailand and India.

Chapter 5

Recommendations

1. Digital Public Infrastructure

The advancement of digital public infrastructure in both India and Southeast Asia presents significant opportunities for enhancing economic and cultural cooperation. However, despite notable progress, various challenges need to be addressed to fully leverage digitalisation for regional integration and development. To overcome these obstacles and capitalise on the potential of digital technologies, several strategic recommendations have been proposed. These recommendations aim to build upon existing initiatives, foster deeper collaboration, and ensure sustainable growth.

Implementing these recommendations requires active involvement and collaboration from various stakeholders, including governments, private sector entities, and civil society organisations. Governments need to create enabling regulatory frameworks, provide necessary infrastructure, and ensure data privacy and security. The private sector plays a critical role in driving innovation, investing in digital solutions, and providing services that facilitate digital transactions and connectivity. Civil society organisations can help bridge gaps in digital literacy and advocate for inclusive digital policies. By working together, these bodies can create a cohesive and dynamic digital ecosystem that supports economic growth and social development. These recommendations are summarised in Figure 16 elaborated on further down.

Figure 16: Eco-system View of Building Out DPI
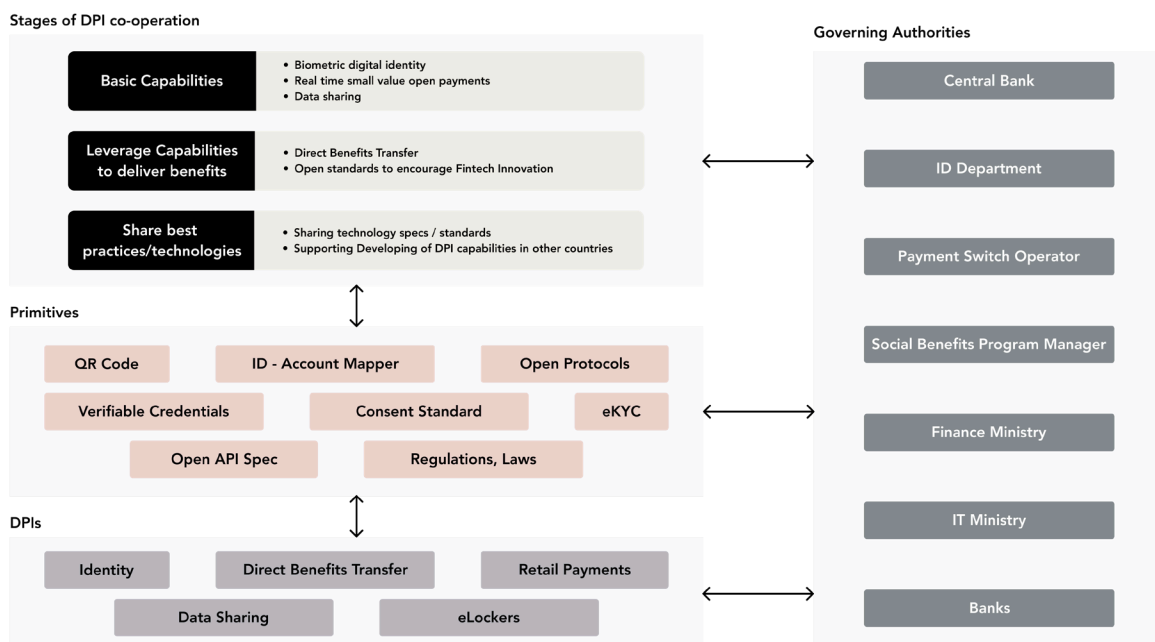
Source: Author's view.

For Central Banks or Financial Regulators

Several pivotal actions are proposed to modernise and regulate the financial landscape effectively:

1. Implementation of eKYC Policy: Stimulate the adoption of digitally signed credentials within specified parameters.

2. Establishment of Interoperable QR Code Standard: Tailor a modern standard for mobile payment systems to streamline transactions across diverse platforms.

3. Transition to Modern Payment Protocol: Enable peer-to-peer and peer-to-merchant transactions, fostering innovation in user experience by fintech companies and ensuring seamless fund flow within the financial system.

4. Open Finance Regulatory Framework: Focus on data sharing, and publish technical specifications to facilitate secure financial data exchange across various sectors.

For Government Departments Utilising Various Forms of Identification

Enhance the reach and functionality of digital IDs:

1. Leverage Private Enrollment Partners: Streamline data fields to expand the coverage of Digital IDs.

2. Augment Digital Public Identities (DPIs): Incorporate eKYC to securely share essential profile data via verifiable credentials or dedicated eKYC APIs.

3. Implement eAuth Mechanisms: Bolster security measures.

4. Integrate eSign Functionality: Enable remote, paperless signing of documents.

5. Adopt Single Sign-On: Allow ID holders to seamlessly access various public and private systems.

For Payment Switch Operators

Enhance the efficiency and versatility of payment systems:

1. Release Interoperable QR Code Standard: Streamline mobile payments across diverse platforms.

2. Transition to Modern, Programmable Payment Protocol: Accommodate various payment types and support functionalities like recurring payments, vouchers, and credit mechanisms.

3. ID to Account Mapper: Facilitate seamless transfer of government benefits to various account types through a four-field registry system.

For Social Benefits Program Managers

Optimise programme efficiency and accessibility:

1. Utilise Face Authentication: Simplify onboarding and registration processes for beneficiaries.

2. Implement ID to Account Mapper: Facilitate seamless transfer of benefits to various account types.

3. Exploit Existing Registries: Enable automated verification of eligibility criteria.

4. Design G2P Ecosystem: Foster a plug-and-play architecture for flexibility and transparency.

For IT Authorities or Digital Economy Ministries

Enhance digital services and interoperability across government departments:

1. Introduce eLockers: Allow departments to convert their certificates into digital credentials.

2. Promote eAuth, eKYC, and eSign Capabilities: Streamline service delivery using existing functional IDs.

3. Publish Open API Policy: Encourage departments to make their APIs available for various services, enhancing integration and utilisation.

4. Transition to Open APIs: Enhance user experience and service delivery by moving from single-window portals.

5. Publish Electronic Standard for Consent to Share Data: Ensure standardised and secure data-sharing practices.

For Finance Ministries

Modernise financial practices and enhance accessibility:

1. Establish Open Banking Framework: Enable secure data sharing and mitigate systemic risks.

2. Promote ID to Account Mapper: Facilitate streamlined disbursal of government benefits, fostering financial inclusivity and efficiency.

For Private and Public Sector Banks

Leverage the open banking framework:

1. Assess Creditworthiness Using Open Banking Data: Analyse past financial history and projected future cash flows to make informed lending decisions.

2. Utilise Open Banking Insights: Improve lending portfolios and promote financial inclusion by gaining valuable insights into customers' financial behaviours and potential repayment capabilities.

2. Trade and Economic Integration Enhancements

To support digital public infrastructure development and economic integration, the ASEAN–India Trade in Goods Agreement (AITIGA) can be upgraded with several key recommendations:

1. Further Tariff Reduction: Continue reducing tariffs to facilitate smoother trade flows between ASEAN and India.

2. Reducing Non-Tariff Measures (NTMs): Enhance transparency provisions, establish contact points, develop trade repositories, use digital technology, and form a joint NTM committee.

3. Digitalisation of Trade Processes: Build on existing progress in electronic single-window systems and cross-border exchange of customs documents. The upgraded AITIGA could facilitate further digitalisation of trade-related procedures.

4. Customs Cooperation Agreements: Implement electronic document exchange, mutual recognition of authorised economic operators, and advanced ruling provisions.

5. Trade in Crises: Address issues such as export restrictions on essential goods during pandemics by incorporating recommendations from the World Customs Organization (WCO).

These enhancements aim to streamline and modernise trade processes, ensuring more efficient and resilient economic cooperation between ASEAN and India.

3. Roadmap

The following roadmap outlines light-touch steps that can integrate seamlessly into any digital transformation blueprint. The primary objective of Digital Public Infrastructure (DPI) is to enable the government to achieve quick wins with minimal investments, ensuring equitable access for all individuals regardless of their backgrounds, and incentivising private market participation to drive innovation and economic growth.

1. Focus on Quick Wins:

Governments should aim for quick wins alongside broader digital transformation strategies. While comprehensive digital transformation involves extensive institutional and policy changes, smaller DPI pilots, such as verifiable credentials, can be executed quickly without new mandates or large

procurement processes. These pilots can demonstrate the success of digital initiatives, garnering support for the larger transformation mission.

2. Prioritise Asynchronous Adoption:

Asynchronous adoption should be prioritised over multi-department coordination. Initial resistance from various government departments can be mitigated by starting DPI implementations with forward-looking departments. These departments can demonstrate the value of DPI, encouraging other departments to join as they see the benefits. For instance, rolling out a government-to-person payment system in the agricultural ministry can showcase cost savings and efficiency, prompting other ministries to adopt the system.

3. Leverage Existing Infrastructure:

Building on existing infrastructure rather than starting from scratch is crucial. DPI interventions are minimalist and aim to enhance current systems rapidly. For example, adding digitally signed QR codes to physical ID cards can enable features like e-authentication and e-KYC, delivering immediate value and increasing adoption rates. This approach avoids long procurement cycles and leverages existing resources effectively, promoting scalable and sustainable infrastructure models.

4. Digital Verification and Interoperability:

To transform existing infrastructure into a robust DPI, light-touch interventions can significantly unlock value for individuals and institutions. Adding a digitally signed QR code to physical ID cards enables them to support electronic authentication, electronic Know Your Customer (e-KYC), and single sign-on capabilities. This allows private and public institutions to verify the legitimacy of the ID with high trust and low cost. It is recommended to allow multiple IDs that can be digitally verified for different types of proof (such as individual ID, business ID, and tax ID) instead of trying to build one ID that holds all the data.

5. Common Specifications for QR Codes:

For individual wallet applications, setting out a common specification for QR codes can make all wallets interoperable. This ensures that digital payments can be made securely from any store of value to any store of value. It is advisable to keep the actual movement of money with the banks, while fintech companies create the user experience layer.

6. Digitally Verifiable Credentials:

By adding a digitally signed QR code to any paper-based certificate, the document becomes a digitally verifiable credential. This enhancement allows private and public institutions to verify the legitimacy of the document with high trust and low cost. Implementing synchronous and asynchronous data sharing mechanisms for public and private data, with regulatory oversight, is recommended.

7. Government-to-Person (G2P) Mapper:

In the context of social benefit schemes, including a G2P mapper helps route money to any ID number. This allows for choice in destination bank accounts and prevents leakages through misrepresentation. Introducing the design of digital signatures and Public Key Infrastructures (PKIs) for future DPI builds is also suggested.

8. Open API Policy:

Including an Open API policy allows any department to leverage third-party interfaces to deliver better user experiences. Publishing a volunteer policy can leverage the capabilities of eager individuals to close capacity gaps.

These steps collectively aim to foster a cohesive and dynamic digital ecosystem that supports economic growth and social development.
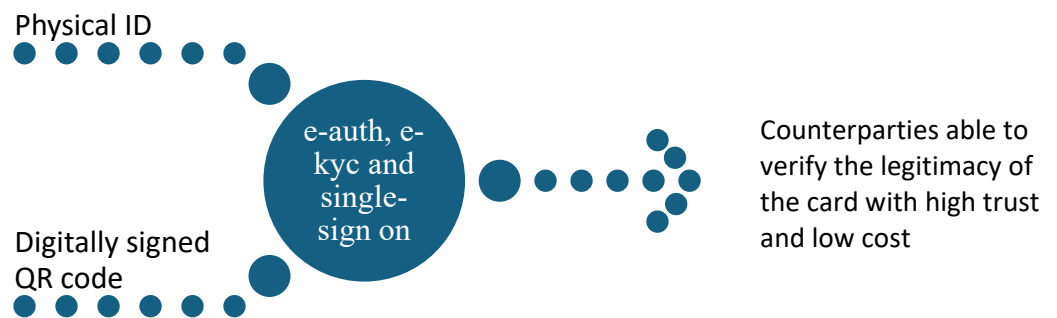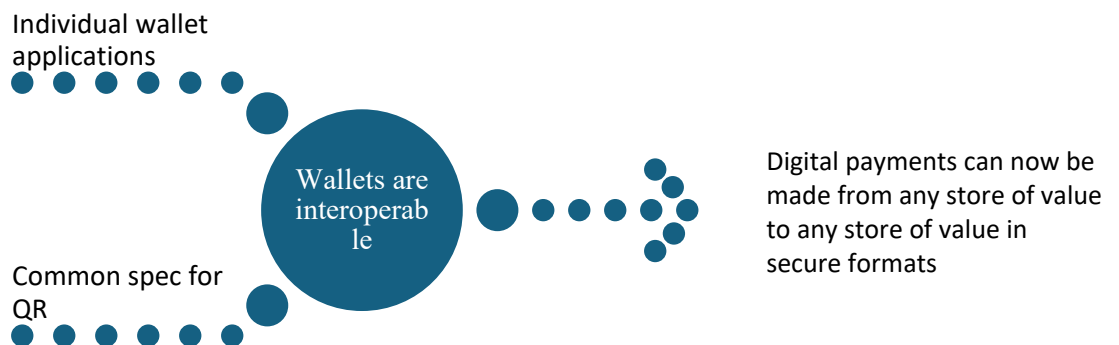
Figure 17: Roadmap for Digital ID

Physical ID

e-auth, e-kyc and single-sign on

Digitally signed QR code

Counterparties able to verify the legitimacy of the card with high trust and low cost

Figure 18: Roadmap for Payments

Individual wallet applications

Wallets are interoperable

Common spec for QR

Digital payments can now be made from any store of value to any store of value in secure formats

Figure 19: Roadmap for Data Sharing

Any paper based certificate

Add digitally signed QR code

Digitally verifiable credential

Counterparty able to verify the legitimacy of the doc with high trust and low cost
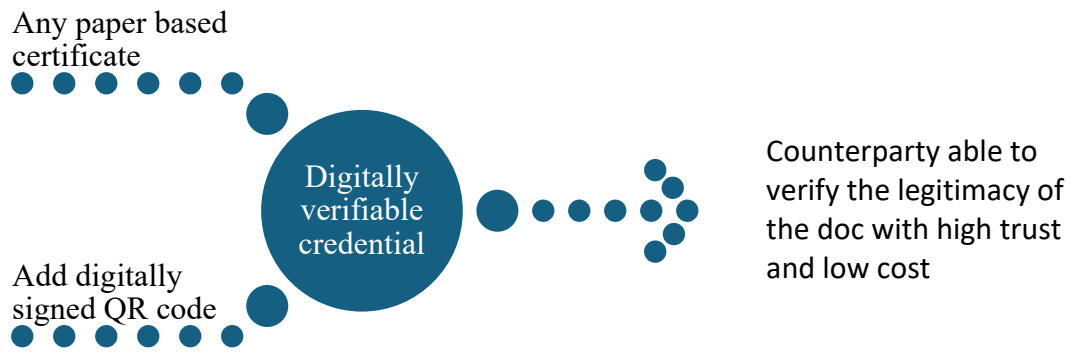
Figure 20: Roadmap for Direct Benefits Transfer

Social benefit scheme

G2P Mapper

Send money to any ID number

Allows for choice in destination bank account and prevents leakages through misrepresentation

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