TECHNOLOGY DEVELOPMENT AND DPI

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TECHNOLOGY DEVELOPMENT AND DPI

TABLE OF CONTENTS

EXECUTIVE
SUMMARY ▶ ▶ ▶

> Digital Public Infrastructures (DPIs) have emerged as the new buzzword in the policy regime, especially after the G20 Summit 2023 where the first multilateral consensus on the DPIs emerged.

Digital Public Infrastructures (DPIs) have emerged as the new buzzword in the policy regime, especially after the G20 Summit 2023 where the first multilateral consensus on the DPIs emerged. Since then, multiple stakeholders have stepped in to explore the potential of the DPIs in contributing to the momentum needed to achieve development goals such as the Sustainable Development Goals.

DPIs offer an immediate and promising opportunity for the countries across globe to build up a better trajectory for development. Better economic resilience, enhanced public service delivery, impactful climate action, and access to better resources are merely obvious benefits of these structures. As the countries develop more such structures, the results can be immensely positive. The countries having experience with DPIs have been able to bend the time-consuming process to achieve extraordinary goals in a much shorter time range.

While the DPIs prima facie paint a sublime picture, there are bottlenecks to overcome for the countries individually, and the global community collectively. Developing a detailed conceptual background, assessing the essentials for sustainable DPIs, determining the enabling mechanism for developing countries, and addressing cybersecurity issues are a few of the important questions which have already started to challenge the policymakers.

While the consensus on the definition of the term DPIs is very recent, and not universal, it is important to address the implications related to the same. DPIs are increasingly becoming the subject of discussions, however, it is equally imperative to consider the opportunities and challenges related to it. Being a recent phenomenon, the DPIs are in a want of diligent approach to be inclusive and sustainable.

In this report, we have attempted to landscape the subject of Digital Public Infrastructures from an analytical lens. We present a comprehensive picture of the discussions across multilateral platforms leading to the concept of Digital Public Infrastructures. Thereafter, we proceed to discuss the available definitions and the nuances related to them complementing it with a survey of DPI experiences from around the world. Our most important effort in this report is the assessment of opportunities and challenges accompanied by recommendations, which we strongly believe can contribute to shaping the discussions on DPIs.

LITERATURE SURVEY ▶ ▶ ▶

> Digital Public Infrastructures have been brought into focus by the recent G20 summit in New Delhi where it found a place in the G20 Financial Inclusion Action Plan.

Within the realm of global diplomacy, the Digital Public Infrastructure has emerged as a potential tool for prosperity, embodying the largest and most influential segment across all economies. They constitute the vast majority of technological developments growing at a very fast pace. The talks on the DPIs are significantly recent, thus the directions of debates need a careful and constructive direction.

Digital Public Infrastructures have been brought into focus by the recent G20 summit in New Delhi where it found a place in the G20 Financial Inclusion Action Plan. The debate around DPIs has evolved around many challenges and opportunities presented by it to the different categories of countries and populations. The humane utility of the infrastructure becomes of centrality here (Svensson, P. 2016). However, there is unanimous consensus on the inevitability of developing infrastructure even when capabilities are not certain.

This work traces the different nuances of DPIs including discussions across different multilateral foras, and the viable models among others to understand the evolution of DPI as a concept and its relevance in the future, provided the recent deliberations on DPIs in G20 and the 77th UNGA Session (UNGA 2023).

Post the G20 summit in 2023, the utility of DPIs has gained a broader playing field, wherein their applications are being seen as a part of holistic development, for example (Kioy, 2023). The United Nations is leading the UN High Impact Initiative to catalyze the actions of DPIs and to enable the capabilities of different nations. It targets 100 nations in terms of financing, safety, and sustainability aspects of DPIs. It ideally aims to identify a strategy in principle to ensure that the DPI growth in the world is inclusive and green.

While the power of physical infrastructure had many countries excluded, the DPI offers a new opportunity to attain growth, including economic, to these countries. Digital ID alone is estimated to generate benefits up to 13% of the GDP, with emerging economies being in the higher gains (D'Monte 2023).

Among the 166 countries having some system of digital payment, those with DPIs had nearly

50%

successful cash transfer programmes during the pandemic.

With many other examples of such estimates, it can be inferred that building DPIs leads to savings in resources and time (Chakravorti, B. 2023).

The push for DPI is also for India and the world to achieve its Sustainable Developmental Goals. As per the UNDP's report on "Accelerating the SDG Through Digital Public Infrastructure", the use of DPI can accelerate global economic growth by 20-33%, reduce carbon emissions by 0.8 to 1% GtCO2e and increase access to justice by 28-42% (UNDP 2023). Among other benefits, the use of DPI can also reduce government expenditure. As per the Indian government report, up to March 2021, about 1.1 per cent of GDP in expenditure was saved due to the digital infrastructure (Alonso et al, 2023). Similar arguments and data can be presented in other parameters as well. Especially in the case of emerging economies like emerging economies, such as India and China, the rising population offers a window to create a large market for innovation (Schroeder, R. 2018). Thus DPIs can be seen as Creative Disruptions with implications for social justice (Muschert et al, 2018) and should be dealt with in policy accordingly (Chase P. & Berzina K., 2018).

Having established the utility and importance of DPIs (Agrawal, N, 2018), the pressing question remains regarding the standards of DPIs and their regulation. Some of the countries which have taken the lead in developing the DPIs are Singapore, India, Estonia etc, and although they have faced different sets of challenges, these experiments have largely been successful from the point of view of infrastructure.

E-Estonia was launched in the early 2000s and it offers digital identity, e-residency, secure data exchange, and digital signatures for citizens and businesses. It also enables digital political participation to the citizens. Singapore's DPI takes a step further and enables seamless and secure access to government and private services and is more significant from the "Ease of Urban Living" perspective. IndiaStack was launched in 2009 to provide a unified platform and includes Biometric Identity, Unified Payments, DigiLocker etc. India's DPI primarily targets public service delivery with a heightened focus on the vulnerable sections. South Korea provides online authentication and Electronic Signatures to citizens and businesses. UAE pass provides a single digital identity for accessing government and private sector services. Australia's myGov tackles Health, and taxation on priority. The United Kingdom's Government Digital Services is also a notable example of the DPI development. With many more governments trying to enable such DPI-based public service delivery, it becomes increasingly important to address the nuances and implications related to the same.

As the DPIs develop, their impact on present and future regulatory frameworks appears interesting. With nearly two-thirds of countries having enabled some or the other technology-related laws, the primary theme in these laws is privacy.

The salience of the Indian Data Protection regime lies in the categorization of Data, apart from most elements from the above mentioned regimes.

One of the most pressing concerns for a very long time is Data Protection. At present, there are no universal standards of data protection, while most of the countries have enacted their legislations to govern the same. The variance in these laws would be a challenge to navigate through as the world becomes increasingly, digitally, and globally integrated. A few of the most notable and significant data protection frameworks are from the European Union, United States, Brazil, India etc. The EU's General Data Protection Regulation (GDPR) was enforced in May 2018 replacing the erstwhile Data Protection Directive. It has a citizen-centric view on data-related rights with rigid content requirements. Another unique feature of this framework is the Data Breach Notifications to the relevant authority. It levies considerably large fines on the violations. The GDPR is widely accepted as the benchmark for data governance, and is reflected in laws the world over (Samson, R. P. M. P. 2022). OECD has also introduced multiple initiatives on data protection.

The United States framework governs Data Protection through multiple states and sectoral laws, whereas Brazil has constitutionally recognized the Right to Privacy which consequently led to the regulation of data usage, data-related rights, and obligations of the entities handling data. The salience of the Indian Data Protection regime lies in the categorization of Data, apart from most elements from the abovementioned regimes.

A structural issue which needs to be addressed is the current experimental approach to developing data standards and stacks that are occurring in the absence of a universally (or even plurilateral) agreed-upon digital governance framework. Another is the ad hoc weaponization of the SWIFT electronic payments system through sanctions on, to date, Iran, North Korea, Russia and Venezuela without either an overarching framework for which global public goods are part of a sanctions regime in the digital era and which are not or a dispassionate understanding of the longer-term consequences (ITU, 2019).

On the eve of the COVID-19 pandemic, close to

87%

of individuals in developed countries used the Internet, compared with only 19 per cent in the least developed countries.

Accessibility to digital technologies, reliable Internet, and coherent digital governance policies proved to be a defining feature of the COVID-19 pandemic survival and recovery. What was unveiled during the COVID-19 pandemic was the irrefutable need for comprehensive, equitable, universal digital access, connectivity, as well as stable governance to bring the remaining 2.9 billion people online (Fattedad C.).

While global digital governance is aspirational, historical experiences warn us against regional biases. The regulations regimes for a very long time have been West-centric and despite several attempts, this feature continues to persist, increasing the divide between Global North and South. The demography as well as the Economy is very different today. Most of the emerging economies are situated in the Global South with the largest populations. This warrants more efforts to include the Global South in the process of formulation of such a framework. Multi-stakeholder engagement is another essential, as developing a structure that fuels the economy and enables social justice is beyond the capability of any one stakeholder. With a holistic approach, more careful consideration needs to be given to practical and enforceable instruments to ensure compliance and to avoid producing a mammoth of "voluntary" instruments.
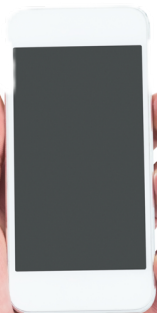
> Considering the nature of technological developments, which are inherently fast-paced, the relevance of any DPI would rest on the farsightedness of the policy shapers.

Along with regulation, the definition part for DPI also needs deliberation. So far, the limited number of leaders which are operating in the field are using their terminology. While it does not pose any significant challenge in the domestic domain, integration of these systems would become a difficult feat to achieve. The DPIs are a new phenomenon, there is no certain definition for them. From the basic understanding, we can infer that it is the link between the physical and digital world, which does not provide essential information. The nature of these structures is such that it will affect a large number of populations across the world, thus the nomenclature must be definite from the very start. For example, the "Public" nature of these structures would vary from country to country, depending on the extent of state control. However, there must be some basic elements defined to render a digital structure as "public" adhering to certain norms and standards. Considering the scale of impact in future, it can be tailored along the concept of the Universal Declaration of Human Rights, as a set of rights available to all citizens.

Considering the nature of technological developments, which are inherently fast-paced, the relevance of any DPI would rest on the farsightedness of the policy shapers. At present, the next technology in line is Artificial Intelligence which needs to be augmented constructively to integrate it into the larger Public Service Delivery System.

> At present, countries like India and Singapore are expanding and enabling DPIs into other countries, which opens up a new discussion.

There are many initiatives led by different stakeholders to address various aspects of AI. However such an in-silo approach may prove to be counterproductive in future. A well-deliberated framework which accounts for regional inclusivity and equality should be the proactive approach which would mitigate the disruptions of AI and will prepare the countries better to deal with such disruptions (Fattedad C).

As the 2023 G20 summit concluded the emphasis on the importance of DPI, other multilateral forums will also begin to focus on it. At present, countries like India and Singapore are expanding and enabling DPIs into other countries, which opens up a new discussion. Many small nations cannot develop the DPI on their own and have less strategic leverage to develop trust in larger nations, as the question of Data and DPIs has direct implications on sovereignty and security. It is now imperative to develop the DPIs keeping in mind the strategic importance of these to different nations. The open-source-based DPIs, like IndiaStack, do offer solutions to the capability issue of smaller nations, but they can not resolve the strategic concerns. The collaborations based on trust have already begun, wherein countries like India and Singapore have started offering DPI solutions to other countries.

While the other nations are hesitant to join, it becomes a case to be decided based on the merits of diplomacy, leaving a plethora of the population deprived of Digital Inclusion. There have been suggestions to develop universal DPIs on the theme of Heritage of Mankind (WEF, 2021), with equal opportunity for all to build digital solutions.
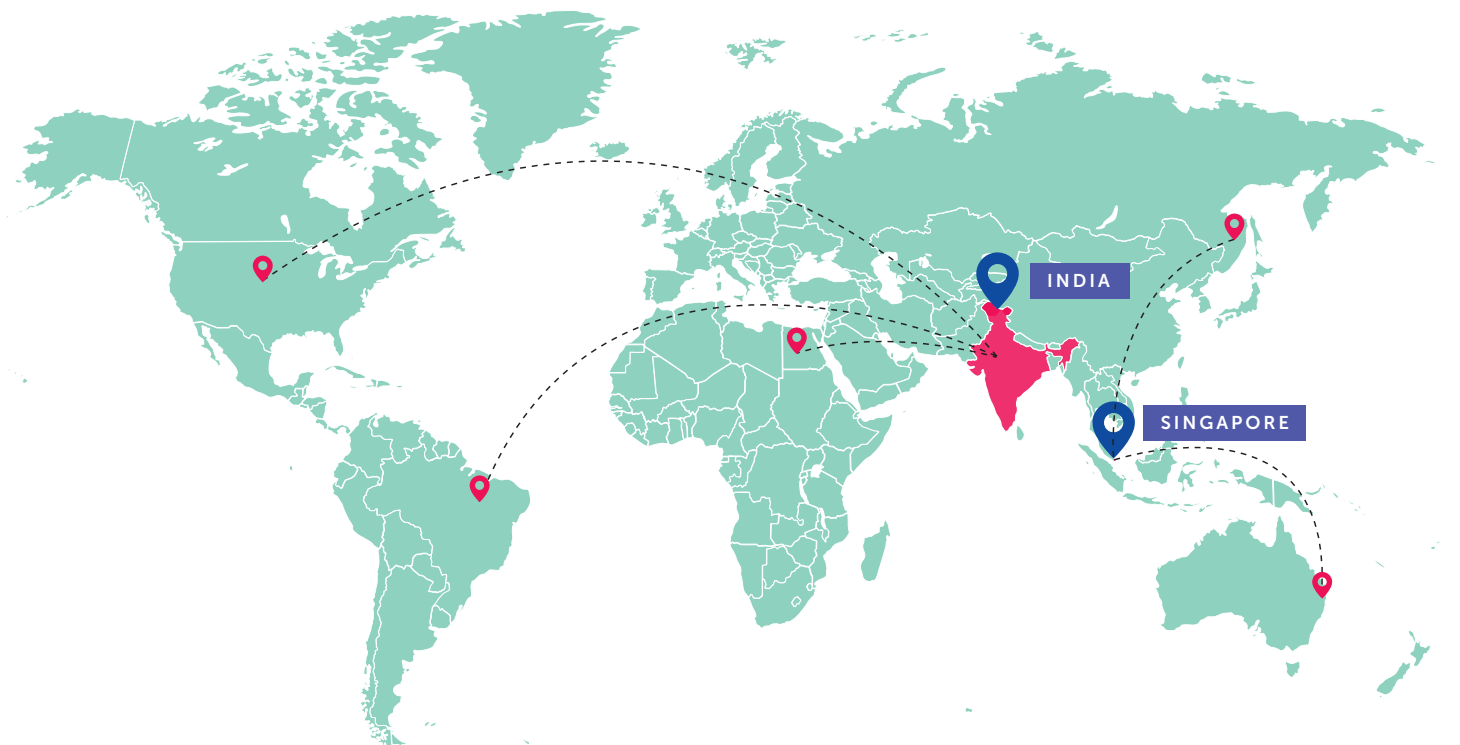
As the governments steer through the challenge of building the DPIs, the private sector is struggling to operate across different DPIs. In an economy which is envisioned to be highly integrated and aligned, a mismatch in DPI would affect the international service provision as the cost of compliance rises for the private sector. The investments need to be increased while the time window to develop these DPIs is unfortunately very small, compared to the physical infrastructure. Additionally, the DPIs by its very nature are the combined domain of both state and market. Thus, the regulatory framework needs to be designed with consideration to the views of both while ensuring competitiveness. At present, the DPI model is one of the most promising to reduce the risks associated with infrastructure development (World Bank).

As we move past the agreement that the norms and principles governing DPIs are essential, we must take note that Digital Governance can be considered an anomaly in the policy domain, where there is a proactiveness among many stakeholders, most notably the Civil Society. There have been multiple suggestions from academia and civil society organizations regarding what should be included in these norms. Among these elements, most recurring are- Technical safeguards such as employing decentralized data storage, Policies and regulations including laws protecting data and implementing cybersecurity standards, participation and agency, Oversight and accountability mechanisms (Alonso et al, 2023). Another lesson which can be taken from the Indian Model. In a nutshell, India's success rests on its foundational building blocks approach, which has been guided by four basic principles, i) providing digital infrastructures as a public good, ii) encouraging private innovation by providing open access to these infrastructures, iii) creating a level-playing field through a robust regulatory framework, and iv) empowering individuals through a data-sharing framework that requires their consent. Another set of elements from Bhaskor Chakravorty 2023 is Enabling Sustainable Development Goals, Inclusive, Citizen-centric, Trustworthy, Supportive of innovation, Interoperable, Resilient, and Politically viable. Post the Ukraine- Russian war, the reusability of DPI has also entered the mainstream as the DIIA of Ukraine which was originally built as a healthcare platform during COVID-19, was repurposed as a job listing platform (Bhaskor Chakravorty 2023).

Keeping in mind the skill disparity across the world, we must also acknowledge that to promote digital transformation, equal emphasis needs to be placed on digital skills development as to infrastructure development. Integral to investment in digital skills development is the subsequent management and evaluation of digital training programmes Asia and Africa are especially vulnerable to this skill gap (Chetty et al, 2018).

It is imperative to touch upon the political imperatives of the DPI as the non-state actors and state-sponsored atrocities are a reality. The extent of control over DPI and the surveillance which may follow is a material concern. The governments across the world have shown signs of ideology-based extremities and thus the access to Common Heritage DPI must be conditional to a certain extent. Another pertinent issue is regarding the adjudication of disputes. The non-state actors are a potent concern for a country like India as the security of the nation depends on it. It may also lead to Arm-twisting Diplomacy and coercive policies by some countries, compromising their sovereignty. Thus, the DPIs have to be "Sovereign by design" as discussed during the Carnegie Global Tech Summit.

The proportional governance principle and the reasonability tests need to be inculcated in the data protection regimes to prevent state and non-state actors from using the data in any form other than the intended consent.

Finally, we must introspect on the role of multilateral institutions in building an equitable data governance regime and a resilient DPI structure. WHO has already adopted 5 Data Principles (Pisa M. & Nwankwo U., 2021). As various platforms have different priorities and agendas, the DPIs overlap with all of those as their applications are eclectic. Multilateral institutions such as the United Nations, G20 etc have their strengths and weaknesses. Some of them need reforms. According to Kassait, regional progress is the way to move forward towards a universal framework as it replicates a bottoms-up approach and would be more inclusive and representative of collective concerns.

> The proportional governance principle and the reasonability tests need to be inculcated in the data protection regimes to prevent state and non-state actors from using the data in any form other than the intended consent.

DPI-THE FULCRUM OF FUTURE

> The DPIs are considered to be a collection of digitalized infrastructure built as open-source technologies (in most cases) to cater to the public interest.

Technological developments have always been considered to be a catalyst in advancing human civilization. From the invention of the wheel to the steam engine and now computer-related technologies, innovations have been harnessed to play a substantial role in attaining growth. With socio-political evolution, technologies have emerged as an area of interest for the government to deliver the state goals, and to secure the well-being of citizens. In present times as democracy rises to become an almost universal form of government, the governments have also elevated the utility of innovation in governance.
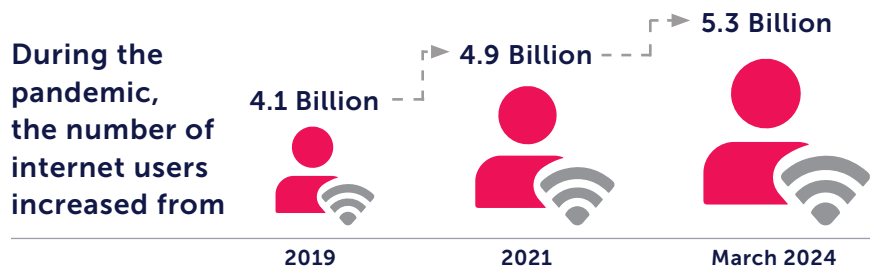
The developments in and around technologies and their integration into governance have culminated in a new phenomenon called the Digital Public Infrastructures (DPIs). The immense promise it has shown to hold for making the lives of humans easier makes it a priority policy area for most of the state actors today. The examples of the success of DPIs in delivering governance goals with cost-effectiveness have led to a sense of importance in building the DPI structures. An urgency can also be observed in these efforts as the technology develops fast, thus policy-makers across the world are presented with a rather small window, in terms of both time and resources, to gain an early start. The significance assigned to the DPIs has reached a point where institutions at the multilateral level have taken cognizance of the same and have begun deliberating on eclectic aspects of the DPIs. For many nations, it is a unique opportunity to recover from historical inequality and build a better future for their citizens, while for others it is a chance to hone the resources at the optimum level. In conclusion, the nations have understood and internalized the potential of digitalization in governance.

To set the context, we must have a basic understanding of the meaning of DPIs first. The DPIs are considered to be a collection of digitalized infrastructure built as open-source technologies (in most cases) to cater to the public interest. As a recent concept still under evolution, it has neither any exhaustive list of elements at present, nor is there an element of universality in the definitions provided so far (UNDP 2022).
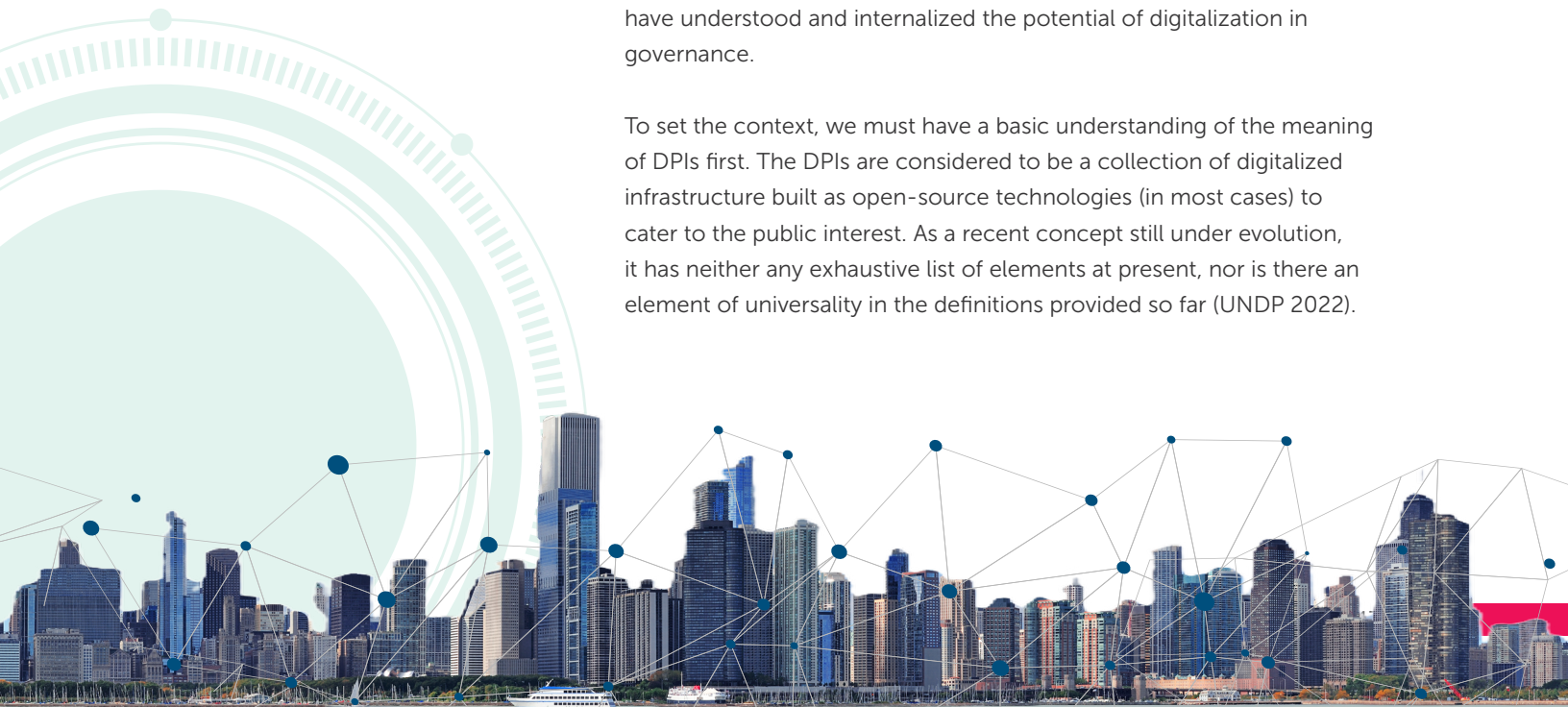
The first decade of the 21st century was marked by phenomenal growth and expansion of Information and Communication Technologies. As greater Digitalization occurred, at some point its utility in Public Services became obvious. Thus, various countries started their DPI journey more than a decade ago, as an idea grounded in digitalization and innovation to attain greater inclusion. (Sharma, R. S., 2023) Gradually, as these efforts began to show positive results, more applications were found to ease the governance in different domains. Through innovation, these countries were able to build different "layers" across the fields of public services. The factors leading to the political will behind these endeavours remain varied from country to country and subject to tentative domestic policy priorities. The framework had started to take shape yet the conceptual clarity on the subject did not emerge until the last few years.

The potential of these systems became much more obvious to the policymakers during the Covid-19 pandemic. The countries with a robust DPI system in place performed better than their counterparts in mitigating the crisis and building back better (UNDP, 2022). The modular designs of these systems allowed countries to roll out a variety of initiatives to manage the unpredictable times. The DPI systems aided the government efforts in managing and mitigating the crisis at hand and the public service delivery was reimagined, as the inclusion at such a large scale became possible as well as beneficial (Sharan, A., 2023).

During the pandemic, the number of internet users increased from

4.1 Billion	4.9 Billion	5.3 Billion
2019	2021	March 2024

The prospects of launching large-scale projects like DPIs started to seem much more feasible.

The hope and optimism associated with the DPIs come from the success it has seen in the countries which took the initiative. It is now a general understanding that the implications of a DPI system are eclectic and promising and there are many countries with substantial data to substantiate it. One of the most successful stories comes from India's DPI, which has become a case study to evidence the more tangible outcomes.

India hosts the largest population in the world and its identity stack covers 99 per cent of the adult population (Sharan, A. 2023, November 17).

During the Covid Pandemic, the CoWIN portal enabled the immunization of nearly

90%
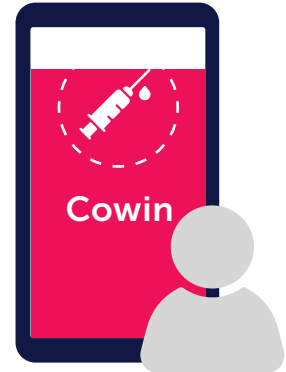
of the country's population.

The UPI platforms processed 13 trillion transactions in 2022 (UNDP, 2022). In the year 2021, the transactions on UPI resulted in savings of more than 12 Billion Dollars, and leading to financial inclusion at an impressive growth rate of 5 per cent (Neufeld, K, 2022).

Moreover, the success of India, although remarkable, is not the only example inspiring the policy will for the DPIs. Countries with different backgrounds, contexts, and geographies have been able to build successful DPI systems, which creates the hopefulness for its universal application regardless of geographical location and developmental status. To illustrate a few examples, Estonian Citizens save 2 per cent of the GDP owing to eEstonia whereas Brazil's Payment system Pix is used by more than 65 per cent of the adult population, proving the popularity and will of the public to adapt (Matthan, R. 2023). These estimations are particularly bright for the developing economies, as they show augmentation of the GDP by 20 to 30 per cent (UNDP, 2022). The estimates are not restricted to cost-effectiveness alone anymore, as the discussions have evolved to assess the value generated by the augmentation of DPIs in different sectors, which appears promising to all the stakeholders (G20 Press Release).

One of the most attractive thoughts on DPI is the seamless transition it promises. Essentially, what has been clear from the ongoing and completed projects across jurisdictions is the notion that DPIs can offer foundational and cross-cutting solutions to modern problems related to public service delivery and allow sectoral application based on tailoring solutions to problems across sectors. While the Infrastructure is generally seen as a matter of public ownership, the DPIs have this condition diluted with a much larger scope for stakeholder involvement in these, leading to a more inclusive process (Varghese. 2023). The possibilities of developing tailor-made models for investment, operations, and funding hold an opportunity for growth driven by local and resilient innovation.
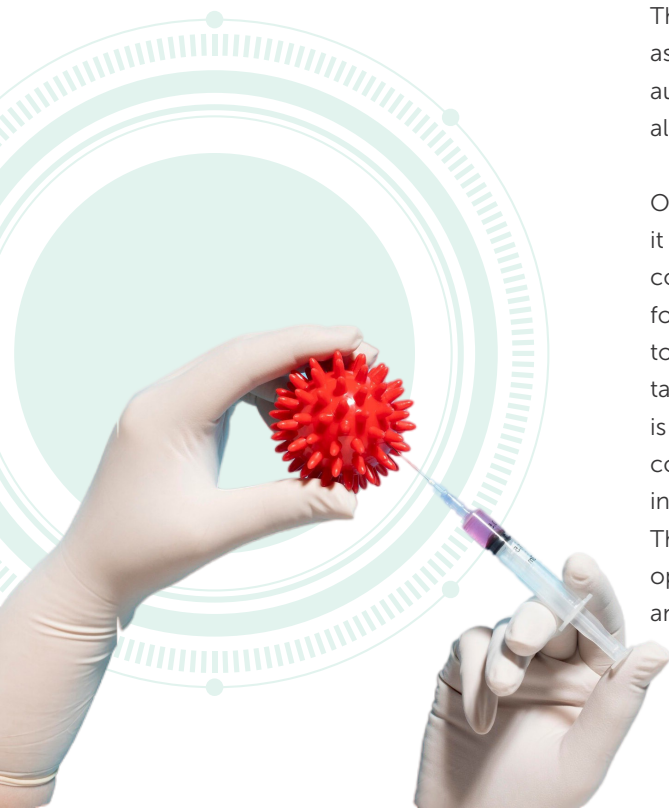
In 1975, intangible assets represented just one-sixth of the market value of companies in the S&P 500 Index, with tangible assets comprising the other five-sixths. By 2020, the ratios were more than reversed, with intangibles accounting for 90 per cent of market value .

As the countries navigate through their plans to build DPIs, the deliberations around the DPIs are no longer connected only to the economic utility and prospects alone and have matured to become a nuanced issue in itself. The discussions on DPIs now are expanding in the direction of becoming an equity enabler as the global south realizes the opportunity it holds to eliminate developmental disparities. This also brings forth the concerns that the Global South has always voiced that the skewed and west-centric nature of the multilateral institutions hamper equity in development and some nations including India and Brazil, have been very vocal regarding this imbalance. This debate on "Historical Disadvantages" has continued to the point of losing its relevance according to some (PYI, 2022), while others still consider it not only salvageable but also worth rejuvenating (Better World Campaign, 2022). It is noteworthy in this context that many of the nations spearheading the innovation at present, like India and Brazil, are emerging as leaders in the DPIs (UNDP, 2023). This paints a unique picture showing an anomaly in the otherwise balance of leverage tilted in the favour of developed countries. Considering the West-centric Industrial Revolution and the consequent West-centric growth witnessed in the past, this phenomenon is creating an opportunity to generate a counterbalance in favour of the global South. The potential of green technologies via DPI offers even more attractive prospects to the developing and least developed world to attain economic growth sustainably.

One of the prominent reasons for the attention towards the DPIs stems from the possibilities of growth to the large spectrum of stakeholders. At present creating the Digital Infrastructure is a state-led endeavor, with some role for other stakeholders such as the private sector. However, the progression of this revolution has to come from multiple stakeholders, including the private players. As governments attempt to prioritize domestic policy goals while creating the DPI framework, they are taking note of the currently globalized world and the implications it will have on public infrastructure. From the past experiences, especially related to the physical infrastructure, it is clear that the public-private partnership reaps better results than the purely public control (World Bank, 2022).

In 1975, intangible assets represented just one-sixth of the market value of companies in the S&P 500 Index, with tangible assets comprising the other five-sixths. By 2020, the ratios were more than reversed, with intangibles accounting for 90 per cent of market value (Tomo O. 2022). Although consistent data do not exist to make global comparisons, investment in intangibles overtook investment in tangibles in the mid-2000s in the European Union and the United States. It is evident that data and digital technologies are ubiquitous and economic and social drivers around the world (Samson, R. P. M. P.,

2022). Steering the bounds of the private sector and ensuring accessibility of technology is a policy question that the governments need to address while envisioning the DPI for their countries, the inaction of which may lead to counterproductive outcomes.

The associated stakes of security, sovereignty and growth have caused a wave of actions but have also caused policy paralysis for many of the nations as they have the capability impediments to develop a DPI on their own, and the trust deficit to outsource it to another country. Thus, the ongoing deliberations need to be shaped in a manner of inclusiveness and consultation to produce equal and equitable outcomes. While moving forward with the DPI deliberations, it is important to create a consensus-based framework moving forward to initiate a sustainable and inclusive process.

In this report, we will analyze the nuances of DPI in greater detail, substantiated with best and sustainable practices, keeping in mind the broad spectrum of stakeholders. We will be presenting arguments along with examples, case studies and comparisons for ease of understanding. This report aims to provide a comprehensive and in-principal way forward to the stakeholders on the past trends, present developments, and future alternatives in navigating through the DPIs while adhering to sustainability and inclusivity at a fundamental level.

DPI- DEVELOPMENTS IN DIFFERENT FORUM

One of the methods by which one can gauge the general understanding and consensus over such issues of universal importance is by tracing the relevant discussions on the multilateral forums.

The domain of technology is by nature rapid in its evolution. Thus, tracing the developments within this domain has few challenges. The absence of uniformity in terminology also poses significant difficulty in drawing comparisons. One of the methods by which one can gauge the general understanding and consensus over such issues of universal importance is by tracing the relevant discussions on the multilateral forums. These forums not only reflect the general understanding of the subject matter but often also include the individual distinctions of the region or nation-specific frameworks.

A subject matter such as Digital Public Infrastructure has to be perceived from this lens to understand the transition in deliberations, as technology and digitalization were streamlined over the years. The trends are also not found to be similar in many of these fora. The reason for such differences could be the different priorities and preoccupations of these multilateral institutions. However, with time most of the multilateral forums have internalized the necessity of developing and harnessing the DPIs for its members to remain on a path of growth and progress.

Since the DPI as a concept has been conceptualized gradually in deliberations, we have started by analyzing the discussions related to technologies on these forums, and have traced the gradual progression towards digitization and DPIs.

A G20

Multilateral fora have played an integral role in shaping the course of global affairs, providing nations with essential platforms for collaborative deliberation on matters of international significance. These forums serve as vital arenas where diverse countries converge to discuss and formulate collective responses to pressing global challenges. By fostering dialogue and consensus-building, multilateral fora contribute to the establishment of a shared global agenda that guides nations toward common objectives. In the complex landscape of international relations, the importance of multilateralism becomes particularly pronounced as it transcends the divergent national contexts of participating countries. While the domestic priorities and policies of nations may vary significantly, the shared agenda set at multilateral gatherings acts as a unifying force. It offers a framework that aligns disparate interests, enabling countries to navigate.

In this context, digitalization has emerged as a key priority at the global level, especially in the last decade or so. Among a range of elements that it encompasses, digital public infrastructure has stood out in terms of its impact and relevance. The previous section gives an overview of the existing literature on DPI. In this section, we explore discussions on DPI across various forums.

Recently, under the Indian presidency, an unprecedented focus was granted to Digital Public Infrastructures, which brought DPIs into mainstream conversations as a priority subject. This development is significant because it paves the way for digital inclusion for all. When India accepted the presidency of this group in its 75th year of independence, the expectations were very high in terms of policy developments provided by the previous leadership of India on environmental and climate-related issues.

Since 1999, the G20 has addressed contemporary issues as per the developments and events. The conversations around Digital developments and technological solutions as well were addressed from time to time by the forum.

Tracing the Digital Deliberations in the G20

The very first time the word "Technology" appeared in the G20 conversations was in the year 2003, while the very next year in 2004 technological advancements were acknowledged as crucial for medium enterprises in the context of FDI. Extending the discourse to the next level, in the year 2005, a full-fledged document was submitted titled "Agreed actions to implement the G-20 Accord for Sustained Growth", which endorsed technical education and innovation.

Building up the discussion around technology and its utility in several green initiatives, in 2006, the call for augmenting technologies to attain energy efficiency was formalized, which was also re-endorsed in the year 2007. As the developments and applications of technology became more widespread, the discussions on the G20 forums also evolved to reflect the same.

The year 2008 had most of the international forums preoccupied with the ongoing economic slowdown which needed immediate attention. Thus, the talk regarding Technologies and Digitalization was deprioritized briefly. In the year 2009, a Progress Report on The Economic and Financial Actions of London, Washington and Pittsburgh were submitted which discussed the actions taken to build technological capacities. By the year 2011, the discussions on G20 had expanded to address concerns related to the market risks posed by the rapid technology developments although the discussions were somewhat limited to protecting the market.

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The year 2008 had most of the international forums preoccupied with the ongoing economic slowdown which needed immediate attention. Thus, the talk regarding Technologies and Digitalization was deprioritized briefly. In the year 2009, a Progress Report on The Economic and Financial Actions of London, Washington and Pittsburgh was submitted which discussed the actions taken to build technological capacities. By the year 2011, the discussions on G20 had expanded to address concerns related to the market risks posed by the rapid technology developments although the discussions were somewhat limited to protecting the market.

The G20 Finance Ministers and Central Bank Governors Meeting endorsed the call for the Global Partnership for Financial Inclusion (GPFI) to produce a framework for implementing the G20 SME Finance Action Plan, explore developing a set of high-level principles on digital financial inclusion and improve data collection and indicators.

Gradually the multidimensionality of the technology started to come to the forefront and the policy issues arising from these also became more pressing. Such a trend is reflected in G20 discussions when in 2013 we see two major shifts in the scope of the discussions. First, the technology skill set in the workforce was seen as an essential component for the growth economic sector (Specifically, the private Sector), the absence of which would pose constraints. Second, the existence of the digital economy was formally acknowledged when in the G20 Meeting of Finance Ministers and Central Bank Governors, it was agreed that "The spread of the digital economy also poses challenges for international taxation." Here, for the first time, we see the separation between the general class of technology and its subset of digital technology. The 2014 summit took a step further by addressing the existence of digital entities such as firms in the backdrop of a globalized economy.

The year 2016 marked a crucial progression point as the talks of the digital economy were added as a priority agenda and were discussed in detail with larger stakeholder inclusion. The G20 Finance Ministers and Central Bank Governors Meeting endorsed the call for the Global Partnership for Financial Inclusion (GPFI) to produce a framework for implementing the G20 SME Finance Action Plan, explore developing a set of high-level principles on digital financial inclusion and improve data collection and indicators. The countries were urged in the outcome of the same group to consider digital financial inclusion more proactively, and for major stakeholders to collaborate to facilitate the said goal. In addition, a report was received titled G20 High-level Principles for Digital Financial Inclusion. The distinction in this meeting also lies in the mechanism of feedback it set to track the translation of agreed-upon principles into policy decisions.

From the 2016 meeting, digitalization became a priority agenda, although the discussions were mostly limited to the context of economic aspects. In 2017, taking forward the discussions of 2016, the G20 Finance Ministers and Central Bank Governors Meeting agreed to ensure risk management and optimal utilization of the opportunities that digital innovation offers while also monitoring digital finance-related developments closely. It made a direct call for Digital Financial Inclusion via G20 High-Level Digital Financial Inclusion Principles. It also acknowledged the nuances of Digital taxation, the importance of access to digital products and digital financial literacy. A specific progress in the field of taxation occurred.

A report to the G20 Deputy Finance Ministers and Deputy Central Bank Governors on MDB Internal Incentives for Crowding in Private Investment in Infrastructure was also submitted, which underlined the need for resilience and better private sector participation in

infrastructure development. Another important outcome was a report submitted by the IMF which addressed benefits arising from technology and investment.

Building on the previous two years, in 2018 the Communique of G20 Finance Ministers and Central Bank Governors called for a consensus-based solution to address the impacts of the digitalization of the economy on the international tax system by 2020, with an update in 2019. An important step in this summit was the endorsement of the G20 Financial Inclusion Policy Guide on Digitization and Informality, which provides voluntary policy recommendations to facilitate digital financial services, taking into account country contexts.

This meeting, which relates to digitalization in multiple ways, is remarkable in terms of both quantity and quality as it depicts the level of urgency the G20 members had attributed to the issue. In support of the above-stated, relevant reports which were submitted are-

1. "Maintaining Competitive Conditions in the Era of Digitalization, OECD".
2. G20 Policy Guide. Digitization and Informality: Harnessing Digital Financial Inclusion for Individuals and MSMEs in the Informal Economy, GPFI
3. G20 Digital Identity Onboarding, WBG
4. Achieving Development and Acceptance of an Open and Inclusive Digital Payments Infrastructure, BTCA
5. Use of Alternative Data to Enhance Credit Reporting to Enable Access to Digital Financial Services by Individuals and SMEs operating in the Informal Economy, ICCR
6. Data Protection and Privacy for Alternative Data, WBG
7. G20/OECD Policy Guidance — Financial Consumer Protection Approaches in the Digital Age, OECD
8. G20/OECD INFE Policy Guidance — Digitalization and Financial Literacy, OECD

In the Finance ministers and central bank governors meeting in the same year, the group representatives maintained the feedback loop created in the year 2017 by calling OECD to deliver updates in 2019 regarding the tax challenges of the digitalization of the economy. Additionally, the GFPI was instructed to produce a policy guide for member and non-member countries for larger financial inclusion. Taking a positive step, the meeting also positively upheld the concept of sustainable finance. The following relevant reports were received, among many others-

1. Achieving Inclusive Growth in the Face of Digital Transformation and the Future of Work, OECD.
2. Secretary-General Report to Finance Ministers, OECD, Buenos Aires, Argentina, March 2018.
3. Interim Report of the G20/OECD Inclusive Framework on BEPS on the Tax Challenges arising from Digitalisation, Task Force on the Digital Economy, OECD.

The meeting also had some interesting outcomes in terms of declarations. The meeting of Finance ministers and central bank governors acknowledged the catalytic nature of the technology in shaping the global economy, along with an affirmation of the importance of infrastructure for long-term sustainable and inclusive growth with access to a new economy, both physical and digital. This development linking infrastructure and digitalization would prove to be one of the founding steps of the Digital Public Infrastructure debate on the forum.

The year 2019 in the G20 group did discuss digitalization and technology. However, the discussions were mostly within the ambit of specific domains of application, such as taxation and health. There was a continuance of the previous spirit of sustainable and inclusive growth, and the importance of technological innovation. On the aspects of collating the fundamentals of digital infrastructure, this year did not mark any specific novation, maybe due to the rising pandemic.

Despite being a time preoccupied with the COVID-19 pandemic, the year 2020 in the G20 grouping marked some significant developments in the matters of DPI. While the immediate aim of most arguments was a recovery from the pandemic, the solutions offered would pave the way for the DPI's momentum. In the virtual meeting of the G20 finance ministers and central bank governors, the importance of infrastructure for growth and prosperity was put at the central stage. Among the outcomes, the G20 Riyadh InfraTech Agenda was notable for the use of technology in infrastructure.

> The meeting of Finance ministers and central bank governors acknowledged the catalytic nature of the technology in shaping the global economy, along with an affirmation of the importance of infrastructure for long-term sustainable and inclusive growth with access to a new economy, both physical and digital.

The members also re-endorsed the G20 High-level Policy Guidelines on Digital Financial Inclusion for Youth, Women, and SMEs prepared by the Global Partnership for Financial Inclusion (GPFI). Under the heading "Lessons for the Future", the communique listed Infratech Agenda, StockTake of InfraTech Use Cases, and InfraTech Toolkit (Risk mitigation and reduction). These elements can be said to be elements of a Proto-DPI discussion.

The important reports and documents received this year were

1. FSB's Report on BigTech Firms in Finance in Emerging Markets and Developing Economies – October 2020.
2. FSB's Report on the Use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions
3. Information Note on the G20 TechSprint Initiative, the Saudi G20 Presidency.

The year 2021 had a challenge of the recurring COVID-19 and to address the healthcare issues. This makes the year 2021 important for the discussions of DPI as the best practices in healthcare involving Digital Infrastructure were already known to the world. Thus, this year shaped the direction of the DPI debate towards a slightly more hyphenated view of technology and DPI.

Although the technology transfer (for vaccination drives) was the recurring debate around the time of the G20 summits, the core focus was maintained to be on the Globalization and Digitalization of the economy and its challenges relating to Inclusion. Green Investments, sustainable infrastructure and innovative technologies were often used as a common thread to bind the discussion, making these important concepts.

The salience of this year's G20 agenda, however, remained the explicit affirmation and agreement of the importance of Digital Infrastructure, which was comparatively less prominent or even absent at times in the earlier discussions. From here, the DPIs as a concept started taking shape and dimension. Another important outcome was the G20 Guidelines for Financing and Fostering High-Quality Broadband Connectivity for a Digital World. The focus and importance of the inclusion were given an additional and defined dimension of Digital Financial Inclusion.

Green Investments, sustainable infrastructure and innovative technologies were often used as a common thread to bind the discussion, making these important concepts.

The members also endorsed an important instrument namely the G20 Menu of Policy Options – Digital Transformation and Productivity Recovery in July 2021. It enlisted focus areas across four main pillars: (i) resilience and maintenance; (ii) digital infrastructure; (iii) sustainable infrastructure; and (iv) inclusive infrastructure. By endorsing this instrument, the members expressly and impliedly formed a consensus over the importance of Infrastructure, including digital infrastructure, as a catalyst in resilience. To affect this, the members also steered efforts towards formulating a set of non-binding and voluntary guidelines – the "G20 Guidelines for Financing and Fostering High-Level Broadband Connectivity for a Digital World".

Continuing its earlier support to the Forum, the GPFI developed the Menu of Policy Options for Digital Financial Literacy and Financial Consumers and MSMEs Protection: Enhancing Digital Financial Inclusion Beyond the COVID-19 Crisis. The objective of this menu was to provide governments with guidance for inclusive financial policies, with an account for digitalization and innovation.

Although the focal point remained the environment, the year 2022 can be assumed to be a prequel to the DPI agenda, a culmination of developments happening around the world in the context of the post-pandemic resilience stemming from a robust digital infrastructure. This year the forum had a multidimensional view of the DPI as a subject matter and it did attempt to address most of those in a productive manner. Under the larger climate-centric theme, the Indonesian presidency was successful in carrying all the previous elements of the DPI debate forward in a reoriented manner.

In its G20 Sustainable Finance Working Group Input Paper, the group agreed to the vulnerability of SMEs in shifting to new technologies and suggested measures for seamless transitions. In the 2022 G20 SUSTAINABLE FINANCE REPORT, digital solutions for sustainable infrastructure were one of the most prioritized items, along with other literature on matters such as Clean Technologies and innovation, Inclusive Transition, Information Governance etc.

In the Leaders' declaration, One Health Concept, Digital and non-digital solutions in healthcare, and enabling the workforce to learn digital skills and digital literacy were among the themes. Additionally, the G20 Chair's Summary of Fourth G20 Finance Ministers and Central Bank Governors Meeting remains important as it reiterates the need for the inculcation of green technologies and the urgency of bridging the Digital Divide. A relevant report which was the outcome of this meeting was the G20 Compendium of Case Studies on Digital Infrastructure Finance: Issues, Practices and Innovations.

Specific to DPI, the Bali summit committed to enhancing digital infrastructure and correspondent investment in InfraTech, to develop cost-efficient Digital Infrastructure, foster Financial Inclusion, and collaborate with the Private Sector in sustainable finance by means including digital market and Digital Infrastructure.

These developments fructified in 2023 under the leadership and presidency of India in 2023 and caused the DPI to be included in the G20 Financial Inclusion Action Plan.

The discussions on DPI for India are not new. The blueprint to create such a juggernaut was detailed and initiated nearly a decade ago in India. The resilience of India's DPI surfaced during the pandemic world where the CoWin Platform became the centre of discussion in many policy circles. The mammoth structure that India built and operates currently, functions as multiple public service delivery platforms for the largest population in the world. Thus, the timing, due diligence and foresight have put India ahead in the race making it a leader in the domain of DPI.

While we traced the discussions on Technology and Digital Infrastructure through the years in G20, it is clear that before 2023, the DPI existed as an intersection of concepts; and that too not till a few recent years ago. It was largely seen as a subsection to some other discussion which makes India's initiative to hyphenize it significant. The discussions on DPIs were conducted majorly on two tracks of the G20, the Digital Economy Working Group under the Sherpa Track and the Global Partnership for Financial Inclusion under the Finance Track. Both these tracks conducted meetings and deliberations throughout the year and concluded with suggested principles on the DPI framework.

ment and DPI
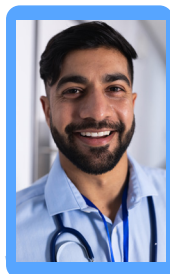
Although attaining inclusion using technology is an idea that has existed for a considerable time, the novelty of the 2023 G20 meeting lies in the tangible multilateral agreement of these nations on the convergence of technology, communities, and governance to build DPIs. This unanimous agreement was the result of rigorous discussions on the Digital Economy Working Group and is the first of its kind formed as a part of the G20 New Delhi Declaration. Parallelly, the Finance track expressed consensus over three deliverables for DPIs namely A framework guiding the DPI developments, fund mobilization specifically targeting Low-and Middle-Income countries in DPI development, and a Global Repository for DPI practices.

Among these outcomes, the GDPIR has already been launched and is functional. At present, it elaborates on the experiences and expertise of member and guest countries. It is expected to function as a resource hub for DPI-related knowledge and practices. It offers a consolidated experience guide across the vertices of design, execution, governance, etc relating to the DPIs from 54 DPIs functional across 16 countries.

The Social Impact Fund has the initial pledge commitment from India for

$25 MILLION

and is envisioned as a multi-stakeholder initiative to assist the global south with both technical and non-technical guidance.

It can evolve into a platform for the stakeholders to contribute in terms of resources and insights to the DPI deployments.

B BRICS

The BRICS is a platform of emerging economies, the issue of utilizing science and technology to an optimum level. (BRICS, 2022) While economic growth is an utmost priority, the time window for leveraging the technology is extremely short. Thus, to attain sustainable economic growth, these nations need to analyze the specific challenges and opportunities associated with the digitalization and the development of the Digital Public Infrastructure (BRICS, 2022). Development of DPI can provide a chafe to these economies to reshape the multilateral institutions in a new and more inclusive manner (Cassiolato & Lastres, Tseng, 2020). The cooperation shown in the environmental discussions by the developing countries does present an optimistic prospect of cooperating in digitalization (BRICS 2020).

Due to the timing of its inception, the BRICS nations were initially preoccupied with harnessing clean energy-related technologies. These nations, remarkably, have made significant leaps within their respective national frameworks in the arena of Digital Public Infrastructure. However, the collaboration on the platform as a group has yet to reach its potential. The pre-existing models of these nations have created a robust framework of knowledge sharing and cooperation which can serve as a fundamental blueprint to move ahead in the digitization process. Thus, the collaboration on BRICS presents an opportunity for the whole Global South to take the lead on digital inclusion. The discussions on the BRICS platform are significant to analyze to develop an understanding of the take of these nations and their priorities.

In the year 2014, the BRICS countries formally agreed on developing a people-centric and public good-driven science, technology and innovation, supporting equitable growth and sustainable development. These countries also signed a memorandum of understanding on Science and Technology. Following that year, in 2015, the BRICS agreed to establish joint mechanisms to support r esearch-cum-infrastructure projects and joint technology initiatives, while acknowledging the central role played by Science, Technology and Innovation. This MoU established a strategic framework for cooperation among BRICS member countries.

In the year 2017 the BRICS Action Plan for Innovation Cooperation 2017-2020 was adopted under which a sustainable and innovation-driven development was envisioned with one of the deliverables being the "creation of networks of innovation." An iBRICS network was also established towards the same goal (STIEP WG. (2019).

In the year 2019, BRICS nations moulded their focus towards a nuanced perspective on digital transformation and applications of technology. A Work Plan was presented aimed at enhancing participation and cooperation in the areas of manufacturing, services, and the digital economy (BRICS 2019). In the Campians Declaration, the member nations reiterated their commitment to collaboration in the research.
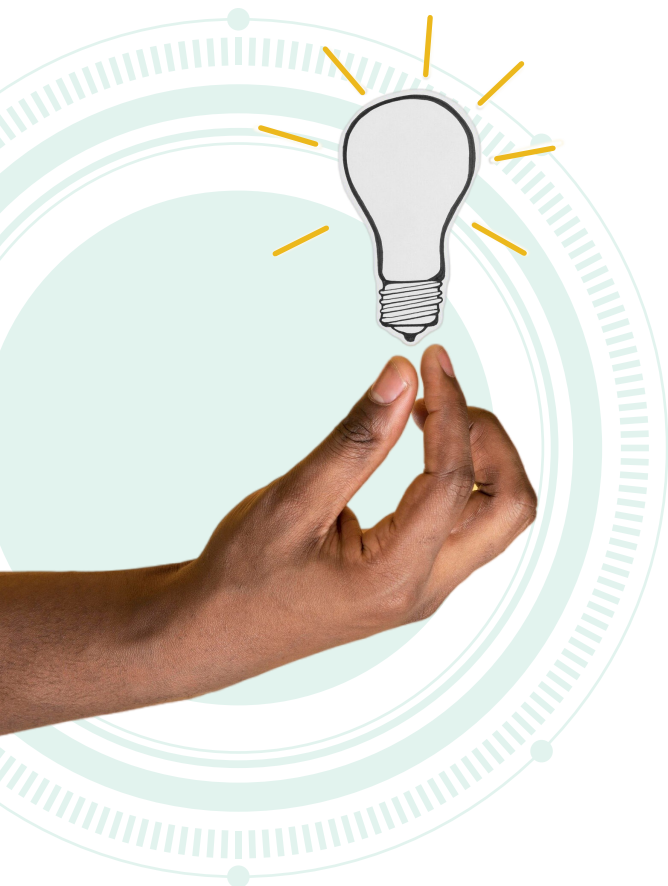
Additionally, the G20 Chair's Summary of Fourth G20 Finance Ministers and Central Bank Governors Meeting remains important as it reiterates the need for the inculcation of green technologies and the urgency of bridging the Digital Divide.

In the 2020 Summit the BRICS Science, Technology, and Declaration was presented, along with a section on the Digital Economy. This section was envisioned as a tool for modernization and transformation towards the 2030 agenda of Sustainable Development Goals. It acknowledged the need for digitalization in attaining growth, and the need to bridge the digital divide, given the population of BRICS nations. (BRICS 2020)

While the other multilateral forums addressed Post pandemic recovery and economic recovery, the BRICS summit of 2021 had the unique feature of recognizing the case studies of Digital Public Goods (In India) and building momentum for the digital infrastructure. It comprehensively addressed the digitalization of public services, the associated opportunities and challenges with specific context for BRICS nations. It addressed the issues of the Digital Divide, the utility of Digital Public Goods in achieving the SDG goals, and the challenges for developing economies, among others. India's presidency at BRICS this year can be considered as a precursor to the 2023 G20 Summit which laid the foundation of the international deliberations on the DPI.

The 2022 Beijing Summit, although did address digitalization as an issue, focused mostly on the economic aspect of it in the context of post-pandemic recovery. The BRICS Declaration did acknowledge the progress made by the Integrated Digital Platform on Infrastructure. The most notable feature of this summit was the progress made towards Digital Sovereignty via common currency (Belli, L. 2019).

The 2023 Presidency brought the focus back to digitalization along with a view towards challenges in trade and investment in the digital era. It expressed support for digital transformation via education policies and resources and reiterated the need for cooperation among BRICS nations in this area.

C **UN**

The United Nations holds great credibility in terms of the issues which it addresses in terms of importance. Being the largest multilateral institution, its significance in shaping the deliberations around the world is immense. The elaborate design of this institution makes it a mammoth task to trace the development of issues, especially a fast-developing subject matter such as technology.

While digitalization, its challenges, and the need to educate people was mentioned as far back as 1999, There are a plethora of materials available, although focused on varied issues, which address the

The search on the UN Library gives 92 results in total for the search for 'Digital Public Infrastructure', the oldest relevant document which refers to data infrastructure was published in the year 1994.

technology-related patterns, eg. the changing nature of jobs due to digitization. While a substantial part of this analysis comes from the "UN Chronicles" which does not form a part of the official UN perspective. However, it does assist in understanding the perspectives on subject matters which the institution considers important.

Of the total 791 results presented, the initial years have the reference to technology in obiter, while the central focus is often a different subject matter. It is noteworthy that at that time, the UN records used the term Information and Communication Technology, as the larger population had yet not gained access to the internet in most parts of the world (UN 2011). Interestingly, it also has documents as far back as 2011 referring to and addressing the issue of the digital divide, with some of these pieces referring to specific domains of digital applications, such as healthcare, Regional Challenges in digitization, social media, inclusivity, cybercrime, Big Data, SDGs, among others. The search on the UN Library gives 92 results in total for the search for "Digital Public Infrastructure", the oldest relevant document which refers to data infrastructure was published in the year 1994. We can conclude that the UN discussion on digital applications goes at least as far as 1994 when it discussed some papers based on the potential of technologies (Tosta, N., 1994). The trend after that is mostly inconsistent till the last 5 years, when the material relating to digitization started to increase consistently with the year 2023 having the most number of relevant documents. This trend is largely consistent with most other multilateral forums, where the discussions on this subject matter have gained momentum mostly in the last 5 years.

The 1994 document titled New Trends in Technology, and Their Application was followed by many different organs of the UN, most notably the UNCTAD. In its newsletter titled "Trade Facilitation and Multimodal Transport Newsletter" (UNCTAD, 1999), acknowledged the developments and differences created due to the usage of the Internet, and the potential leverage the SMEs can get. Later in the year 2000, a document titled "Internet Infrastructure Development In Transition Economies" with the idea of the necessity for emerging economies to be equipped digitally (UN 2000).

In 2003, a draft resolution was submitted to the UN General Assembly with a call for a global culture of cybersecurity and protection of critical information infrastructures (UNGA Resolution A/C.2/58/L.19- 2003). It explicitly expressed the need to close the digital divide and universal access to technology. In the year 2005, "Capacity-building: spatial data infrastructure readiness index" discussed the multidimensional effects of the digital divide (Cuba. 2005). In 2006, the UN General Assembly once again referred to the issue of "closing the digital divide" in its document titled "Information in the service of Humanity". (UNGA Session 58 and 60)

In 2008, a Report of the Secretary-General titled 'Development-oriented policies for a socio-economic inclusive information society, including access, infrastructure and enabling environment' addressed the issue of the quality aspect of the digital divide.

UNCTAD in its 2007 newsletter acknowledged the disruptions and developments in the field of ICT and their applications such as electronic Single Window. The same year, it also published the Division for Services Infrastructure for Development and Trade Efficiency Activity Report. This report addressed multiple dimensions related to digitization such as bridging the digital divide, relevance of digitization for developing countries, National Regulatory Frameworks, etc. It also marked out specific and potential sectors for digital impact focus. (UNCTAD 2008)

In 2008, a Report of the Secretary-General titled "Development-oriented policies for a socio-economic inclusive information society, including access, infrastructure and enabling environment" addressed the issue of the quality aspect of the digital divide. It presented evidence from the OECD countries via teledensity. It brought in the quantity and quality of internet access into the deliberations, and capacity building.

In the same year, a document titled "Highlights of recent trends in global infrastructure", discussed the human and technological capital (Orr, R. J., & Kennedy, J. R. 2008). In the following year, "How to utilize FDI to improve infrastructure" was published which discussed the importance of infrastructure for technological advancement (Kline et al. 2009).

The UNSC also held its first meeting on Artificial Intelligence, while the UNDP in collaboration with the Indian Presidency published a compendium and playbook for Digital Public Infrastructure and Co-led one of the High Impact Initiatives.

Material development on DPI at the UN started around 2018. The Secretary-General convened a High-level Panel on Digital Cooperation to advance proposals to strengthen cooperation among relevant stakeholders. This panel presented its final report, titled "The Age of Digital Interdependence", along with five recommendations. The secretary-general also issued a report named "The Roadmap for Digital Cooperation" (Gates, M., & Ma, J. 2020) which committed to connecting all people to the Internet.

In the year 2020, UNDESA conducted an e-government survey that presented a perspective on resilience and digitization, with a panorama of best practices and challenges. In the same year, "People's money: harnessing digitalization to finance a sustainable Future" marked a watershed moment as it acknowledged the Digital Infrastructure and its impact on the economy with supporting data, while "Connecting humanity: assessing Investment needs of connecting humanity to the internet by 2030" discussed the importance of innovation in new technologies (UNDESA 2022)(ITU. 2020).

UN-DESA in 2021 released the "World Social Report- Reconsidering Rural Development" elaborated on the utility of technology in reducing inequality. The Secretary-General also stated that Digital Infrastructure is a potential tool to resolve global issues. The most significant development occurred in the 77th UNGA Session where the theme was- "A watershed moment: transformative solutions to interlocking challenges," with a vision of safe and trusted DPIs. Additionally, the UNDP Strategic Plan 2022-2025 is remarkable for identifying digitalization as one of the three key enablers to amplify development outcomes. Apart from the above documents, the specialized agencies of the UN as well have made multiple references to digitization and Digital Public Infrastructure concerning their respective domains.

In 2023, The resilience which can be built via Digital Public Infrastructure in addressing the crisis and in increasing interconnectedness. The UNSC also held its first meeting on Artificial Intelligence, while the UNDP in collaboration with the Indian Presidency published a compendium and playbook for Digital Public Infrastructure and Co-led one of the High Impact Initiatives. (UNDP 2023)
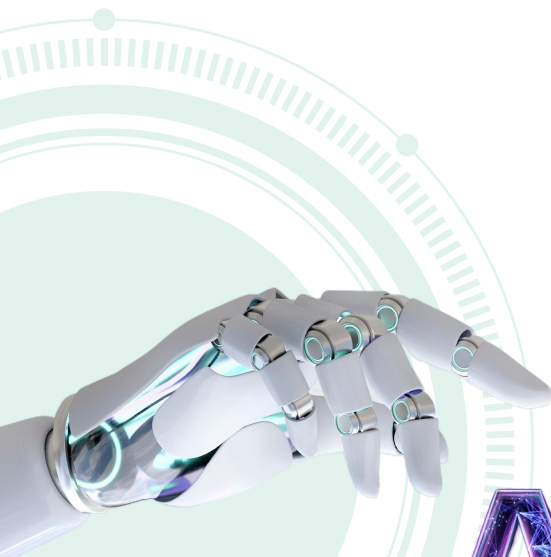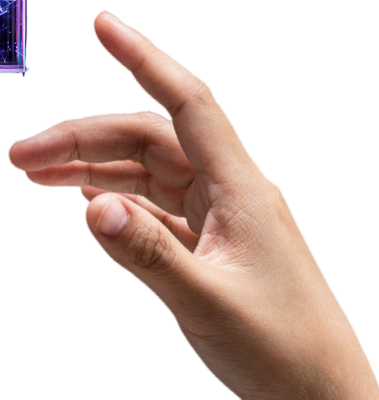
Through the discussions, although the priority in the G7 discussions seems to be inclined towards Strategic usage of technology. Even within the discussions of technology and digital transformation, Cybersecurity has been a recurring theme. Yet, there is no doubt that G7 is one of the multilateral forums to initiate discussions on technology very early on and more importantly, it continuously evolved the dialogue with emerging technology. (Muhanna 2021)

Though the initial discussions on technology and its applications are confined to energy efficiency, (Heiligendamm, 2007) it quickly evolved into broader discussions on the aspects of financial inclusion, Digital divide etc. The First instance of dialogue on cybersecurity within the G7 discussions appears at the year 2006 St Petersberg Summit. Later, a more elaborate theme on this topic was created in the year 2016 under the Japan Presidency.

In 2006, the Forum included innovation in technology in its segment on Education. The year 2007 marked a broadening in the scope of the discussions where investment, innovation and energy efficiency were combined into the same fold of discussion. The BRICS countries also issued a joint declaration with the forum on this matter (Heiligendamm, 2007). In 2008, the focus was on Energy efficiency and demonstrating the same trend, the G8 declaration also reflected the themes of Intellectual Property Rights Protection, energy efficiency, and poverty alleviation. The focus on Clean Energy remained dominant in the discussions of 2009 as well within the G8. The following year, there were no significant discussions on Technology and its nuances.

In the year 2011, as the Arab Spring happened, the G8 Forum was quick to acknowledge the need to provide access to infrastructure related to energy, Information and Communication Technologies. The salience of this development lies in connecting the technology and infrastructure. The following year had a focus on clean technologies.

The year 2013 saw significant developments which laid the foundation for coming discussions on the forum. This year, a lot of focus was placed on the data and access issue. It stated that Open Data sits at the heart of this global movement. Acknowledging the importance, the forum also presented an Open Data Charter. It went on to state that the world is witnessing the growth of a global movement facilitated by technology and social media and fueled by information – one that contains enormous potential to create more accountable, efficient, responsive, and effective governments and businesses, and to spur economic growth." The Open Data Charter collated the Best Practices and Collective Actions. The year 2014 summit had a background of Russian aggression, thus the focus on other areas was lesser comparatively. However, the summit did touch upon the commitment to work on an expanded Information Technology Agreement.

The year 2015 saw significant developments in the deliberations in depth and width. The G7 forum acknowledged the need to promote education and innovation, IPR Protection, Support to SMEs, investment in infrastructures etc. It also committed to negotiate the Information Technology Agreement.

The year 2016 marked a watershed moment where digital connectivity and inclusion came at the centre stage. The G7 forum adopted the Charter for Digitally Connected World. The term infrastructure was used in the context of the digital transformation of life across the world. It acknowledged the initiatives to promote a digitally connected world. It endorsed a single market strategy by the EU, the Global Connect Initiative by the US, Partnership for Quality Infrastructure by Japan among others. Along with these, it also expressed consent over the shareability of benefits of these developments. Acknowledging the emergence of the digital economy and its vulnerability in cyberspace, the group adopted G7 Principles and Actions on Cyber intending to promote security and stability. The Leaders' Declaration also mentioned a section on cybersecurity affirming its importance. Additionally, it also called upon all the countries to join the Budapest Convention on Cybercrime to facilitate cooperation. The G7 Fundamental Elements of Cybersecurity for the Financial Sector was published by the Finance Minister Group as a guideline for effective practices.

The direction and momentum of the 2016 development was sustained in the year 2017 as well. The forum in its publications acknowledged the digital literacy and job security aspects arising due to the technology adoption, and introduced an action plan which was inclusive of the 2016 principles. The Taormina people-centred Action Plan on Innovation, Skills, and Labour in its Pillar I Innovation in Production, and Pillar II Knowledge-Based Capital and Enabling Infrastructure marked inclusiveness, openness and security as the priority areas. In the 2017 Summit, the Declaration on Responsible State Behaviour in Cyberspace was endorsed, reiterating the agreement of the 2016 summit on the subject.

The discussions this year were more specific in their scope as they dealt with the issue of Artificial Intelligence. It envisioned AI as a catalyst for economic growth, equality and inclusion. The Montreal Ministerial Statement on AI also marked human-centric AI as the Charlevoix vision for the future of AI.

In the year 2018, the summit Published a Public engagement paper on the Jobs of the future, marking the discussion on disruptions caused by technologies. The discussions this year were more specific in their scope as they dealt with the issue of Artificial Intelligence. It envisioned AI as a catalyst for economic growth, equality and inclusion. The Montreal Ministerial Statement on AI also marked human-centric AI as the Charlevoix vision for the future of AI.

divide, specifically in Africa. Further, it noted the recommendations from the EU-African Union Digital Economy Task Force, the Digital Economy Moonshot and the Smart Africa Initiative. The 2019 Summit marked a shift in the approach of the forum towards the subject, as the focus was readjusted to Digital Transformation. The Biarritz Summit produced a strategy for Open, Free and Secure Digital Transformation.

The year 2020 Summit was under the shadow of the COVID-19 pandemic; thus, all the other agendas were set back and healthcare and mitigation took priority. Similarly, the 2021 Summit was focused on the Pandemic aftereffects and the recovery efforts. However, during the pandemic, most of the stakeholders realized the necessity of robust digital infrastructure in dealing with challenges of magnitude. Thus, in the 2021 Summit, the Carbis Bay Communique acknowledged the potential of technological transformation for the common good, the spirit of which was also reflected in the joint statement of that year.

The following year had a background of the ongoing Russia-Ukraine Conflict, and the G7 as a forum was occupied with the issue. However, the documents and statements did manage to reflect the elements of developments on the digital transformation front. The goals for a just and equitable society by enabling the digital transformation, infrastructure investments including in digital progress, and shaping the digital transformation by updating regulatory frameworks were stated clearly.

The year 2023 had overall been a successful year in terms of deliberations on the Digital Infrastructures on the multilateral platforms. The G7 also followed the same path and renewed its commitment to advancing international discussions on inclusive AI governance and interoperability. The forum agreed on developing value-based, safe, secure and trustworthy AI, and adopted the Hiroshima AI Process as the first successful international framework on guiding principles and code of conduct concerning the AI. It further committed to working towards Data Free Flow with Trust.
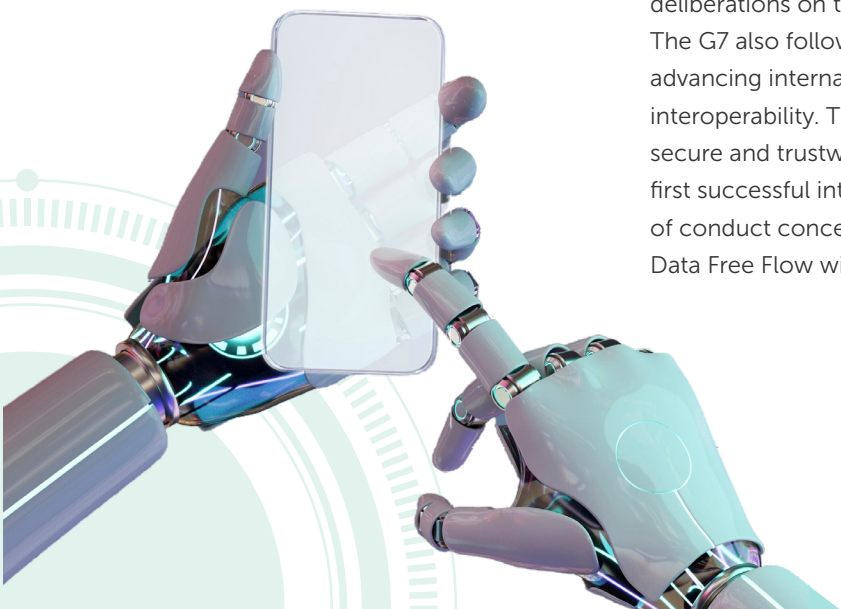
While there are other platforms where the DPI-related discussions have taken place, these forums have witnessed better momentum and consistency. The spectrum of these nations in terms of membership also makes their grouping unique. Analyzing their role, efforts, and views on the DPIs can give us better insights from different perspectives.

These initiatives and the trajectory of the DPI-related discussions hint at the larger role which G20 has taken up. The initiatives pave the way to elevate these discussions at a global level, which is optimistic provided the inclusive approach taken by G20 so far. This notion gets more weight in the context of the mission of the African Union in the G20. It is significant as a considerable portion of efforts related to the DPI developments are already focused on the African countries (World Bank, 2024), and with the African Union joining G20, the DPI deliberations on the G20 platform have a better opportunity to reflect insights from across the world.

The analysis indicates that the BRICS nations are eager to address and harness the potential of technology into development. The trajectory of discussion on technologies on BRICS platforms shows a swiftness in recognizing the emerging patterns of growth in the member countries and the tools used to arrive at the same. Perhaps due to having less number of participants, the ability of BRICS to bring up discourses on DPIs is immense, as the

> While the UN is the largest multilateral forum with unparalleled power in shaping the issues, it has been less effective beyond value-loading as the regional and technical considerations are to be assessed.

member nations are emerging economies with significant footprints in populations, trade, GDP and geography. In fact on most other platforms where these nations are members, their position is often seen as the leader of the global south. The major challenge in front of the BRICS nations is transcending beyond the member countries and recognising the environment and factors relevant from another group of countries as well. Incorporating this can make the BRICS a platform capable of channelling their priorities in alignment with emerging trends.

While the UN is the largest multilateral forum with an unparalleled power in shaping the issues, it has been less effective beyond value-loading as the regional and technical considerations are to be assessed. It does hold significance in bringing issues to the attention, the trust in the UN has been fluctuating if we consider the perspective of the Global South. Moreover, the involvement of near-universal countries and institutions could also be the reason for hindering consensus on matters, as regional platforms have been shown to perform better in terms of building effective consensus.

The UN has made several efforts to inculcate and assist the DPI debate, such as establishing the Office of Secretary

General's Envoy on technology, the consolidation of efforts is yet to see a more creative and concrete direction beyond tracking the developments and knowledge sharing. Perhaps the UN would be more suitable to lead the DPI discussions once regional consensus takes shape and the relevant fundamental values become clearer.

The G7 countries have depicted a proactive approach and have been in sync with the developments. However, the membership of this grouping is mostly developed economies with ample resources and expertise to invest and build the DPIs, yet the very nature of DPIs requires these countries to align their efforts with the other streams of discussions on this matter as siloed efforts could lead to a less efficient DPI structure.

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DEFINITION OF DIGITAL PUBLIC INFRASTRUCTURE

> Additionally, there are best practices known to the world, which come from countries with varied regions, histories, and capabilities.

Since most of the multilateral forums and groups have openly started endorsing the developments related to the DPIs, there has been an increase in the demand for information related to the same. As the countries move forward with their plans along with participating in the discussions on this topic within the international forums, the DPIs being an emerging concept has presented a few challenges.

One such pressing issue is the non-availability of common definitions in the context of the DPIs. While the advocacy-related aspects are increasingly attracting more attention, the foundational work is yet to gain the rightful momentum in the deliberations. The technology being a capability-intensive field itself, the stakeholders seem to hesitate in using the vocabulary relating to the issue. This issue was most evident at the G20 Summit 2023, where the member states agreed to the rising importance of DPIs (PTI 2023), and decided to formally define the DPIs since this definition has been missing from the previous discussions.

Agreement on the definition in itself was a landmark moment, and it provided momentum (UNDP 2023) to the arguments for more conceptual work. Provided with the incredibly fast pace of technology, there is a growing demand for more advanced knowledge creation in this regard to avoid duplication of efforts. Additionally, there are best practices known to the world, which come from countries with varied regions, histories, and capabilities. Thus, developing DPIs at a larger scale with in-built interoperability may require finding the common elements before may hinder information dissemination.

Providing the wider applications of DPIs across the vertices of governance and public service delivery, the DPIs present an opportunity for many countries to harness growth. Hence, the time is ripe for the international community to prioritize the quest of defining the DPI to enable faster adoption and development with informed policy decisions.

To start with slight contextual groundwork, it is important to understand the general meaning of the DPIs. Infrastructures are the wheels on which a society functions and grows. These are means to an end, as the structures which provide the base for other activities. They constitute a critical component of every economy and enable an overwhelming majority of economic activities.

Thus, a general understanding of Digital infrastructure would mean structures which enable digital activities in a society. They include the hardware required to enable the internet, as well as the software which acts as a platform for digital activities. These platforms are mostly designed to be open-source, meaning they are accessible with a capability condition (For example, accessing the internet with a smartphone).

In many of the nuances, the physical and digital infrastructures adhere to the same rules. Like physical infrastructure, Digital Infrastructures (DIs) also are a means to an end and have both positive and negative externalities. Additionally, DIs are also designed as bulky structures meant to facilitate different aspects of our lives. (CJL 2020) Both can be built under multiple modes of control, ie can be of private or public ownership.

DPIs, consequently, are a subset of DIs, which are necessarily accessible to the public by intention, and not mere accident. These have certain civic values or goals at their core and aim to deliver a component of governance. They act as a tool to ease public service delivery, thus fulfilling a part of the state's responsibilities.

Moving towards more specific aspects of the DPI, we must address the question as to why there has been less deliberation on the definition of DPIs, despite it being a relatively familiar concept. In the last two decades, nations have experienced fast-paced growth in various aspects due to international developments. Since the earlier technological developments had different focal points for a long time (such as Climate Change and defence), many multilateral groupings perhaps were preoccupied with strategic and economic issues which did not leave room to introduce the discussion on civic technology. Moreover, the global south was still finding capabilities and leadership in technology, which further restricted the discussions of technologies to the developed countries.

For this reason, while the concept of digital solutions to address civic problems existed, only a handful of nations could translate these into policy. Further, many other nations did not have the capabilities to build these digital solutions, which in the absence of an enabler ended up as inaction on digitalization, even when they were aware of the potential transformation.

As a handful of countries started working on the DPIs, for a significant time the silo did not break as there were no multilateral discussions of the DPIs for a long time. These countries like India and Singapore worked on innovation and often resorted to trial and error methods since it was a new area for navigation. The infrastructures, by nature, have a considerably long gestational period, which was an additional impediment to the potential of this issue evolving into an agenda to build conceptual conversations on it. While many countries initiated the process of planning the DPIs, the pace of progression was varied due to competing with the domestic policy priorities.

The discussions on DPIs did start around the second half of the past decade, however, the agenda was often mixed with other aspects of digitalization and was less specific to the DPIs. The true potential of DPIs was proven during the pandemic when the world realized the potential of DPIs in delivering substantial outcomes not only in times of crisis but also in peaceful times. Thus, the discussions emerged during the pandemic as all the multilateral forums recognized the need to harness the DPIs as soon as possible. Provided that there were no substantial deliberations on what constitutes DPIs, every country had

> The European Digital Infrastructure Consortium (EDIC) is a legal framework aimed at enabling the members to develop the DPIs on similar principles to achieve the Digital Decade Targets and Objectives

to resort to its own set of guidelines, priorities, and innovations. Thus, to further an informed debate on the core of definitions, we must indulge in the models that the nations have developed for their DPI journey.

Among these models, the Indian example is well known. The DPI of India known as IndiaStack consists of open Application Programming Interfaces and digital public goods. It has the objective to support the pillars of identity, payments, and data. It also is significant for the large population coverage it has attained.

A quick survey would lead us to some other models which have proven to be successful. Notably, the EU was among the first to set up a mechanism to lead its members towards DPIs. The European Digital Infrastructure Consortium (EDIC) is a legal framework aimed at enabling the members to develop the DPIs on similar principles to achieve the Digital Decade Targets and Objectives. EDIC interestingly is a mechanism set in motion on the application of member states.(EDIC) While the mandate of the EDIC is much broader, one of its primary objectives is to enable the conception and implementation of multi-country projects relating to digital infrastructure.

While there are other countries with notable success in DPI, their success is often confined to a specific field, thus a broader theme-wise analysis moving forward should be more apt to understand the landscape. For example, in public service delivery, Togo utilized digital identification to assist informal workers during the pandemic. Similarly, Thailand used PromptPay for direct benefit transfer to vulnerable groups during the pandemic. Nepal created SipShala in partnership with private entities, to provide tailored employment information to migrant returnees. eHealthAfrica in Nigeria facilitated data management for the immunization drive while Pakistan attained significant financial inclusion of women by enabling the DPI platform Raast with the assistance of the World Bank (Bandura, R., McLean, M., & Sultan, S. 2023). Another theme for modelling the DPIs is the onus of DPI development. Here mainly two models emerge, one opts for allowing private players to develop the DPIs and consequently, the DPIs are optimized for profit, while the other, in contrast, prefers heavy state investments and regulations in DPI.

Thus, although many countries have embraced and acknowledged DPIs and their potential to resolve developmental challenges, the Stacks or models are mostly isolated. While these have some elements common by design, there is no formal foundational consensus on the principles. A serious consequence of this is the lack of formal definitions available outlining a set of the essential elements of the DPIs. Provided the age of the concept, probably the stakeholders are worried about it being a

premature discussion, or maybe there has not been enough information with the key policy-makers and stakeholders to arrive at an exhaustive definition yet. Another contributing factor could be the lack of successful experiences in DPIs, which makes the understanding reliant on the information provided by outer entities resulting in limitations on initiating the discussions.

In either scenario, we can easily assess a gap in the capabilities of the stakeholders in some or the other form. Additionally, the deliberations on such matters of universal importance and of universal application can only progress sufficiently on the experience of nations which is at a very nascent stage.

Even while trying to define the DPI inclusively, the descriptions are lucid. One of the few organizations to initiate the discussion on this matter is the G20 group resulting in the first multilaterally agreed-upon definitions. In 2023, the G20 Digital Economy Ministers Meeting outcome document recognizes DPI as "shared digital systems that should be secure and interoperable, and can be built on open standards and specifications to deliver and provide equitable access to public and or private services at societal scale and are governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, and competition and respect human rights and fundamental freedoms." This definition defines the DPIs and their most prevalent elements, and it does reflect a larger scope for crafting further specifications within this definition as technology progresses. This definition is value-centric and appears to be oriented towards setting the dimensions of DPIs, rather than attempting to identify the technical essentials.

GermanStack understands DPI as solutions and systems, which enable the effective provision of essential society-wide functions and services in the public and private sectors. The World Bank's Identification for Development project defines DPI as digital platforms that enable the provision of essential society-wide functions and services. Co-Develop, an organization working toward catalyzing the adoption of DPI globally, defines it as a stack, with individual DPI systems playing specific functions as layers and interfacing with each other (Kapoor, A., & Watson, E. 2023).

Some of the civil society platforms have defined DPIs as the combination of solutions and systems enabling essential public services by using a digital component. (DGPA 2022) This definition includes but is not limited to the identity, payment and data layers. The Bill and Melinda Gates Foundation defines the DPI as a digital network that enables countries to safely and efficiently deliver economic opportunities and social services to all residents. DPI can be compared to roads, which form a physical network that connects people and provides access to a huge range of goods and services.

While the attempts are appreciable, these do not serve as a universal guide towards the DPI and its elements (DPGA 2022). Additionally, these definitions, especially those given by non-state stakeholders are not designed as formal definitions but serve as an indicator of elements for the public. Thus, the priority in these compilations is often the simplicity of the definition for a better understanding.

While we address the issue of the absence of a single definition, let us also briefly understand and state the demand of the present developments. Considering the potential large-scale, and almost universal attempts at adoption of the DPIs, the definition needs to be able to accommodate the speed of technological developments without compromising on any policy priorities and dimensions. This task is difficult to achieve as there are bound to be different priorities for different regions. Thus, the deliberations need to start at the earliest to seize the small

> The electronic payment layer is often designed to enable online platform-based payments, fees and tax deductions among other financial transactions.

window of opportunity to develop an international framework governing the DPIs for the benefit of all.

While the discussions on the DPI grow across platforms and stakeholders, there are a few elements which keep resurfacing in the discussions as the characteristics of the DPI. Mapping the same would allow us to view these elements in their embedded state, while we analyze their importance and role in the discussion. There are also themes across which the discussion on these elements is set.

For instance, one of the themes is based on the application of the DPI based on the "layer" in the respective stack. For now, the most recurring and discussed layers are digital identity systems, electronic payment systems, and data exchange systems. These are not exhaustive, however, these are serving as building blocks on which the governments are designing their public service delivery and for the present developmental challenges, these are sufficient to provide the space to build solutions for both private and state agencies.

To elaborate, the identity layer authenticates an individual as a member of the socio-political community which makes it possible to ascertain the incident of Public Service Delivery by targeting the desired set population (Wilson, K. (2023). Some of the most common forms of public services enabled by the identity layer are credit grants, civil registration, assistance to vulnerable sections etc. The electronic payment layer is often designed to enable online platform-based payments, fees and tax deductions among other financial transactions. Further features can be added to this, such as instant fund transfers, bank account linkages, platform wallets etc. The third layer enables data sharing between individuals and other entities. The data is often processed in some other form to allow the data to be available across aspects of an individual. For example, India spearheaded the linkage of Aadhar, its residential identity to the PAN. These innovations often resort to data sharing and exchange accompanied by standardized methods for data management. While these are the most prevalent layers at present, there can be more layers added and innovated upon.

Most DPIs are built as open-source software and the same is usually taken as a characteristic of the DPIs, and with an enabler for the standards classified as Digital Public Goods. It would be crucial at this stage to distinguish and define the related terms which often keep occurring in the discussions related to the DPIs but are given less attention compared to the DPI. The utility of this exercise lies in bringing clarity relating to the role and functions of each of these components.

A   Digital Public Goods

DPGs are often seen as the elements at the centre of innovations within the DPIs. DPGs are a transition of civic goals from the material to the digital world. They represent the community efforts of the past, present and future. They are seen as a continuous process of inculcating good practices and accommodation of rapid innovations and are often effective tools to create the layers of DPIs.

DPGs as a concept are related but distinct from the DPI. The most relevant utility of the DPGs is their ability to bring a comprehensive set of SDGs within the DPI discussion. The DPGs, while part of the DPI ecosystem, do not restrict the DPIs, but rather exemplify the flexibility of the DPI framework. This characteristic makes the development of hybrid models possible and promising, especially in providing tailored solutions to different facets of an issue (Digital Frontiers Institute. 2023). We can say that Digital Public Goods are the end of the means of DPI.

B   Digital Public Platforms (DPPs)

DPPs are a recurrent misnomer to denote the DPIs. While related, the two concepts have considerable distinction with distinct roles in offering digital-cum-governance solutions. DPPs consist of apps and services built on the DPI ecosystem and thus the DPPs are often the tools created to augment the DPIs to enable digital solutions. These are often also referred to as the "Building Blocks". often these have comparatively lesser licensing requirements compared to the DPGs and DPIs.

C The Public Component in the DPIs

The public component of the DPIs refers to the accessibility aspect of the DPIs as open source and equal access. The DPIs are intentionally inclusive and foundational to cater to the needs of all citizens desiring to avail of the services.

Having delineated the different concepts, now we move forward to assess and evaluate the works in progress towards streamlining the meaning of the DPIs across the world. These initiatives include all the works under progress relating to DPIs, as there might not be a dedicated effort towards developing the definition alone because of the novel nature of this phenomenon.

Being the largest multilateral platform, the UN has taken the cognizance of DPIs and has started the deliberation on the same. The UN views the DPIs as a promising tool to attain the SDGs and thus is considerably invested in streamlining the DPIs as a concept. Its SDG Action Weekend initiative called for building safe and inclusive DPIs. This initiative has the

target of covering 100 countries by 2030. Under the leadership of the International Telecommunication Union and the UNDP, the High Impact Initiative was started to grant momentum to the SDG Digital programme. The UN Tech Envoy launched the Universal Safeguards for Digital Public Infrastructure Initiative.

The G20 New Delhi Leaders' declaration echoed the same spirit and vision expressing its faith in digital solutions for governance and services. The G20 leaders did reiterate the utility of DPIs in bringing the progress on SDGs on track. In these multilateral discussions, there were some valuable inputs from many member countries. For instance, Brazil emphasized the inclusion component, while Egypt prioritized green transitions in its inputs. calling for a better strategy for the DPIs. Finland expressed faith in DPIs as welfare Enablers, and among praiseworthy efforts, India called for technical assistance in building capacity for all to harness the DPIs via One Future Alliance.

The participant institutions also provided some notable inputs. Among those, the pledge to augment capital flow by the Inter-American Development Bank was well received, while the Patrick J. McGovern Foundation proposed an expansion in the existing toolkit to support communities. On the same occasion, the Model Digital ID Framework was launched with the aid of the Norwegian Agency for Development Cooperation, with more than 80 ID governance best practices placed within a single instrument of ChatBot. (UNDP, 2023)

These discussions culminate into a set of five priority areas identified by the UN around safe and inclusive DPI for the 2030 Agenda. These include universal safeguards, innovations for last-mile inclusion, DPI that is affordable and open; DPI that is sustainable and green; and financing DPI for sustainable development. (UN, 2023)

The above discussions set out the priority of countries and indicate the policy accommodation that needs to be made while developing DPIs. As we saw in the earlier chapters, while the discussions on DPI have started to gain momentum recently, the opportunity timeline to develop the framework and the cost of leaving out any significant factor can cause a domino effect on the development of many sections. In determining so, the Indian initiative of the Global Digital Public Infrastructure Repository may prove to be helpful as it can lead us to safer choices.

Moving ahead to address the need for a single definition, since the knowledge gap is considerable at this stage with regards to the DPIs and the capacities are varied for countries, the quest for a single definition appears to be neither possible nor desirable without causing unjust exclusion of certain vulnerable stakeholders from the discussion.(ORF 2023) The necessity to act sooner trumps the necessity of procedural correctness.
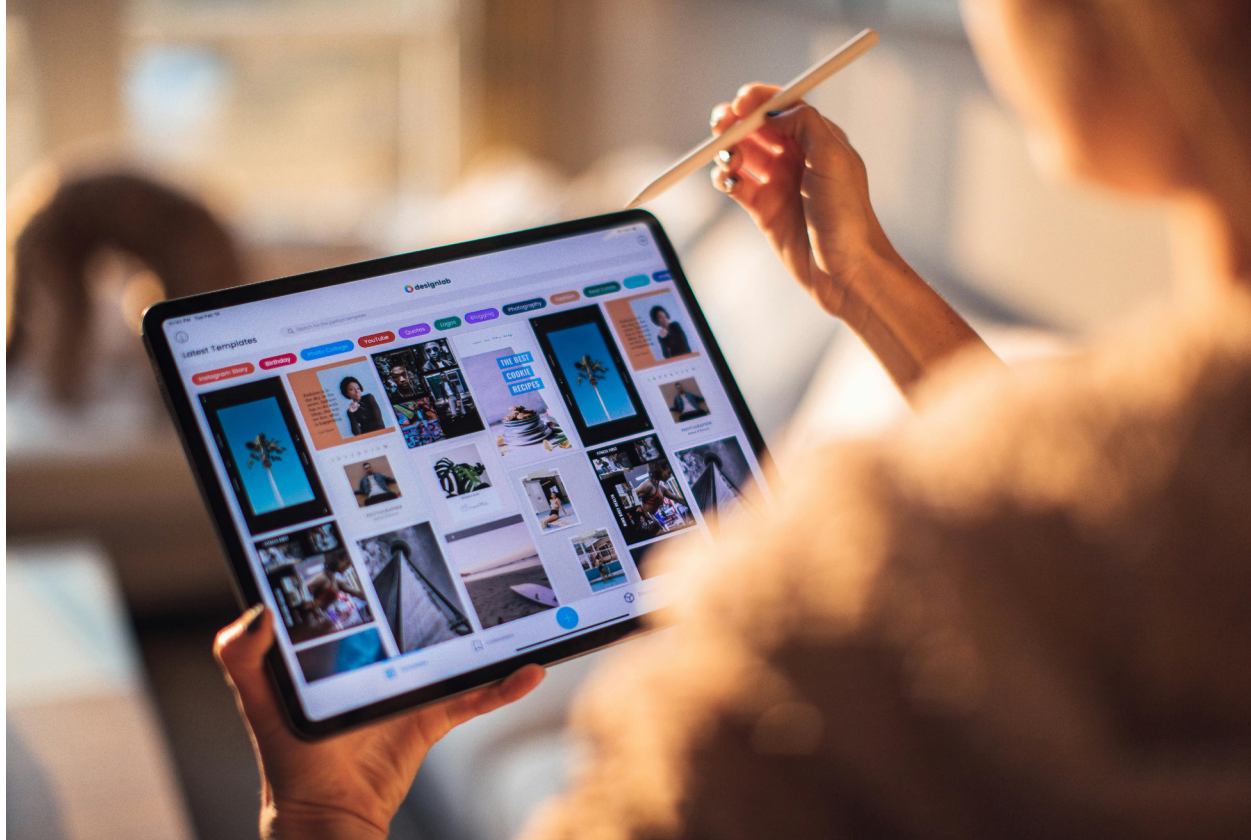
Thus, we suggest the development of a standard framework listing the inputs from various stakeholders and best practices. This would serve as a guide to those willing to develop their DPIs while refining the process of trial and error. We need to carefully evaluate the existing models with a view of replication. It would be immensely helpful to view DPIs as an extension of Sustainable development.

The international community has tackled similar challenges before and at times it has resorted to defining the components in negatives. Similarly, the DPI framework can be modelled on the Human Rights Model where without giving a single definition of Human Rights, the framework was laid down to prohibit certain activities. In the case of State Responsibility as well, the International Law Commission provided draft guidelines to present an inclusive list of acts and how the attributability would be determined.

While we have discussed the context, it is well established that the way forward has to be through the existing best practices. Surveying the same would also help in developing a practical model based on experiences and policy realities to start the work for a single standard framework. As of present, the Indian Case study has been highlighted since the G20 2023 summit, it would be prudent to examine it through the lens of adoptable elements, provided that the scale of implementation, and the layers of DPI in the IndiaStack offer a more comprehensive perspective. (IMF 2021)

> Firstly, the civic design of these frameworks should be decentralized but federated to enable bottom-up problem-solving.

On the matter of data governance, the Indian approach is impressive on preemptive measures such as strong legal sanction for the DPI development, which defined the extent of state power and individual rights. The regulation includes robust digital financial architecture framework's inherent privacy safeguards in the technical design which protects an individual's right to privacy. Further, the approach taken is largely balanced which neither demands excess state intervention nor leaves scope for the unregulated free market.

Furthermore, the Indian model combines the public and private sectors by providing public design but private implementation of the DPIs. This puts the onus of product delivery shifts to the private sector, which has a better experience of the consumer interface. This combined with the verifiable identity layer made public services available to the remotest of the sections. Similarly, the payment system built on similar blocs offers better management for businesses while providing a secure channel for the government for welfare and other payments, which is also a remarkable example of stakeholder inclusion as the regulator and regulated run the system in collaboration.

Thus, we can derive three chief components of a resilient DPI, namely-consent-based Data governance, practical and participatory regulatory framework, and minimal participation conditions. (IMF 2021) Apart from these, there are certain other elements which have consensus in debates and discussions and since they form part of the conversation, addressing those is important.

The DPI has both technical and non-technical components. While innovation can resolve technical issues, the non-technical elements are more important to be kept in mind while drawing a framework for the DPIs. Firstly, the civic design of these frameworks should be decentralized but federated to enable bottom-up problem-solving. Inclusion alone would not offer solutions as the problems of people in a country as diverse as India may not be suitable for a straight-jacket formula. Moreover, the foundational nature should be inculcated in the DPI to foster innovation for developing such solutions.

Although the majority of the countries have enacted data protection laws which is a starting point these laws need to be refined and aligned with the DPI regime of the respective countries.

The open digital ecosystem approach offers valuable insights in this context where a trust-based and citizen-centric model is proposed, which marks Trust, Access, and accountability as the foundation of DPI, with an active effort to bridge the digital divide. (ODE 2022)

To address the negative externalities of DPIs, the framework must offer a mechanism to reflect the value-neutrality of its layers to adhere to the international norms on various matters such as human rights etc. Additionally, the SDGs can be used as a blueprint while developing the DPIs to stay within the bounds of development. In addition, there need to be enough checks and balances to restore any deviation from the objective of DPIs. To illustrate, the Supreme Court of India closely monitored the balance between data usage and the right to privacy.

By its nature, the development of such a framework poses many challenges which need to be scaled to build a consensus around DPI as it is a contested terrain due to diversity in practices. From the literature and discussions, a few key challenges can be identified. Let us understand these challenges and their implications.

The DPIs are an emerging concept and thus the foremost challenge is security. The nation's resources and data need a robust mechanism built in to safeguard the interests of the users. The spectrum of threats is significantly broad, from external sovereign actors to non-state actors (Rathod, S.2023), with concerns regarding digital colonialism (Meier, C. M. 2023, February 7). Along similar lines, the Surveillance capacities of these actors also pose a significant privacy concern. Although the majority of the countries have enacted data protection laws which is a starting point these laws need to be refined and aligned with the DPI regime of the respective countries.

The next challenge is posed in the form of inclusivity. Since DPIs have the component of public inherent in them but are not inherently inclusive, (Behrends, J. et al 2021) The design of DPI needs to be such that it enables inclusion of every citizen. The DPIs require basic capability (Digital Devices) to enable access to DPGs. Thus, the countries must implement a holistic policy which translates to effective outcomes. Interoperability is the next hurdle in harnessing the DPIs, especially in the Global South, where formalism has a larger presence. The organs of governments need to align and equip the existing systems to work on identifying suitable solutions for country-specific problems.

A holistic approach needs to be taken in the context of DPI and almost all its aspects. To substantiate, while developing the DPIs, countries must keep in mind the negative externalities of these structures and

try to integrate mitigation and preparedness in the original framework itself. An effective remediation process would lend better growth and positive direction to the DPI-related efforts and would keep the stakeholders from demotivation. Similarly, the involvement of all the stakeholders possibly needs to be arranged as the investment in DPIs in terms of time and resources increases the risk factor. While the government can be the chief architect, it must incorporate the roles of other stakeholders to decrease the risks and maintain accountability to the public trust. A legal mechanism to enforce accountability would also be a step towards better and more resilient DPI development, as it would serve as a strong feedback mechanism.

We can agree from the discussions so far that there is and for some considerable time, will be a difference in approaches of different countries in developing DPIs. While we agree on a definition, we must ensure that the existing positive features of the DPIs as a system are not lost, and the negative externalities are terminated to the extent possible. We can start by adhering to a set of elements such as foundational, inclusive etc. and ensure that the regulatory framework of countries does not enable the perpetration of injustice of any kind, by the state or non-state actors, and then build a more sublime framework including other factors.

03

PROMINENT DPI APPROACHES:
CASE STUDIES

▶ ▶ ▶ ▶

The EU's domestic policy has a catalytic effect on policy-making around the world , provided the vast single market, high per capita GDP, and the "inelastic regulatory targeting", among other factors.

Around the world, matters of policy and governance inherently vary as polity and history dictate many of the experiences. Apart from the evident differences in the level of development between the countries, the countries stand across a broad spectrum of choices on novel challenges presented to them. Thus, on these matters, collating implementations appears challenging and overlapping. As discussed in the earlier chapters, there is a common consensus on the urgency to develop the DPIs and most of the prominent multilateral forums reflect a common intention towards building on DPIs. The idea of Digital Public Infrastructure is among the areas which are relatively new and less explored, and the available insights on the same differ to a great extent.

To elaborate, the countries are building up on the available information and practices. Moving from the primitives of technology to a "stack" building by arranging the elements in their own preferences of permutations and combinations. The flexibility of the technology offers endless solutions and options thus making the need for a technical blueprint obsolete. Notably, the progress on the DPIs is remarkably rapid and growing in nature. A few countries which have taken the lead in this area, have made leaps in a very short window of time and the others are eager to develop their abilities in DPI. Hence, we can attempt to draw a mind map of these practices to arrive at a set of patterns and commonalities.

THE EUROPEAN UNION

The European Union has depicted one of the earliest interests in developing the DPIs in the region. The developed nature of the economy and policies probably sparked the initiative. We can see an example of a mature and cautious approach in the EU as it provides legal sanctions and regulatory policy for most of the initiatives relating to digitization. The segregation is apparent on the policy front into two categories, DPIs and Data Governance, marking the caution in the approach.

The data governance laws formulated by the EU have given rise to the Brussels Effect , implying wide acceptance of these standards by many other jurisdictions. The EU's domestic policy has a catalytic effect on policy-making around the world , provided the vast single market, high per capita GDP, and the "inelastic regulatory targeting" , among other factors. It can be concluded that the DPI policy adopted by the EU is likely to have a similar impact.

EU Digital COVID Certificate was a response to the ongoing pandemic but it emerged as one of the notable cases of DPI implementations.

At the foundation of the EU approach towards the digital landscape, the elements of ethics and privacy are based on value and human rights. Consequently, the GDPR enshrines a comprehensive approach to protecting the privacy of its citizens regardless of the jurisdiction. The EU has given considerable focus to the competitiveness aspect of digital developments, along with gaining international policy leverage. In addition, the EU has listed out domains of technologies it considers as the components of the DPI design, namely- Internet of Things, 5G, Clouds, Platforms, Artificial Intelligence and Cybersecurity.

In the EU, it seems to be a consensus that the state must lead the infrastructure building, with a specification of public utility added to the DPIs. Considering the stakeholders involved, political consolidation is needed, apart from the need for capital investments in connectivity. It appears that the government's involvement is inevitable to ensure the sustainability of the endeavours. (Michal Boni et al)

The DPI developments in the EU can be analysed at two levels. One at the Collective level of the EU, and second at the country level.

EU Digital COVID Certificate was a response to the ongoing pandemic but it emerged as one of the notable cases of DPI implementations. It was launched in 2021 as an open-source solution to issue and verify the vaccination of citizens, and it continued till 2023, after which it was subsumed within the WHO's Global Digital Health Certification Network.

It has a massive scale of presence in

78COUNTRIES **and is available to nearly**
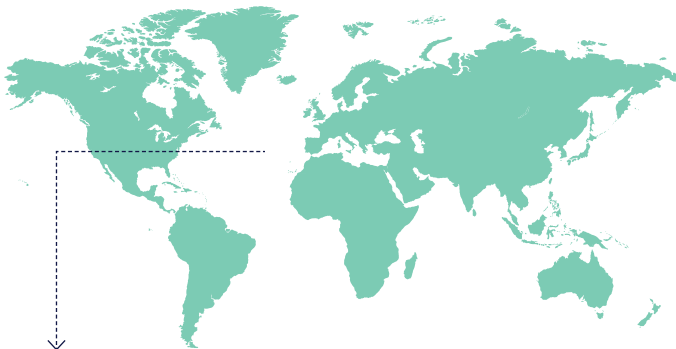
1.8BILLION **individuals worldwide.**

The forum was regulated under multiple legal instruments, primarily Regulation (EU) 2021/953 , Regulation (EU) 2021/954 and Commission Implementing Decision (EU) 2021/2301. The obvious use-case was vaccination, test, and recovery.

The more permanent layer of the DPI led by the EU is the EU Digital Identity Wallet, which has yet not been adopted although other e-identity means have been implemented since 2016. When complete, it aims to cover 100 per cent of the EU citizens. The purpose of creating the EUDI wallet is to enable large-scale trusted digital identity with considerable control by the user. It would facilitate safer online interactions and monitoring of personal data by individuals, giving them more solutions to access public and private services. There is an accountability mechanism as well built under the eIDAS. The potential use cases include E-government services, Banking operations, Digital Signatures etc.

On the domestic level, some of the European Countries have attained significant developments on the DPIs.

Estonia has attained a considerable scale of digitalization and is offering a variety of public and private service delivery. The development was driven by multiple factors depending on the layers and relevant industry players. For instance, digital payment solutions were driven by banks. The e-ID and Digital Signature provide strong authentication and automation. Estonian DPI used the fundamentals of Finland's digitalization and built upon those. The data exchange layer of Estonian data exchange layer is open source, and is used by many other countries as well.
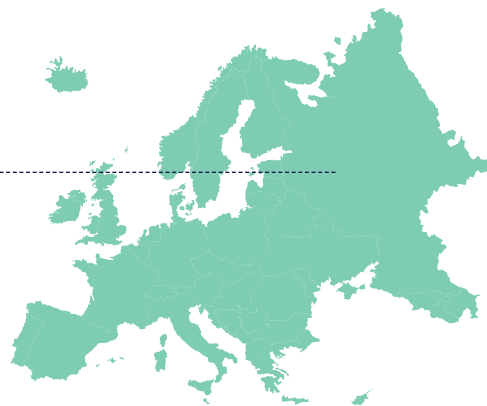
Germany devised openIMIS in 2016 as an open-source solution for healthcare and social security by managing high-volume data flows seamlessly on a single platform. It has been hailed as one of the most robust implementations of Public Goods accessibility.

The adoption has a large scale of

12 COUNTRIES

offers 15 schemes and caters to

10 MILLION beneficiaries

The use cases are Health insurance, voucher schemes, insurance, funds transfer, and social benefits. (IMF 2023)

France has a more developed approach towards the DPI as it has developed multiple layers within its systems. The foremost of these layers is FranceConnect, which attempts to simplify access to access to online governance via authentication and digital identity. Based on OpenID Connect, his layer witnesses 330 000 000 connections per year and 1500 service providers along with a user base of around 30 000 000 individuals.

The legal backing comes from the Prime Minister's Order of 8 November 2018 concerning the teleservice denominated FranceConnect.The accountability is overseen by the DINUM (Interministerial Directorate for Digital). The most prominent use cases are administrative governance, childcare, proxy voting requests etc.

The second layer is named Base Adresse Nationale containing addresses and geolocations of all addresses in France. The user base spawns half a billion API calls per month. It is jointly managed by the French National Institute of Geographic and Forest Information and La Poste. It has the utility of navigation. The third layer is data.gouv.fr which was created to grant public access to public on the data.

It has

10 MILLION **visitors**

200000 **datasets**

1 MILLION **reused data**

The technological architecture consists of CKAN an open data portal platform. It is governed under French laws and has a use case for transparency, research, innovation, and public service improvement.

Italy developed App IO in 2019 for public service with a new approach towards the equation between citizens and government institutions and introduced e-governance to improve the quality of lives of citizens, along with evaluations publicly available. It is increasingly moving towards a cloud-native approach and is incorporating more elements of interoperability. The regulation is under the Art. 64-bis Code of the Digital Administration.

The platform has more than

200 THOUSAND

services available on the app by 2023 and nearly
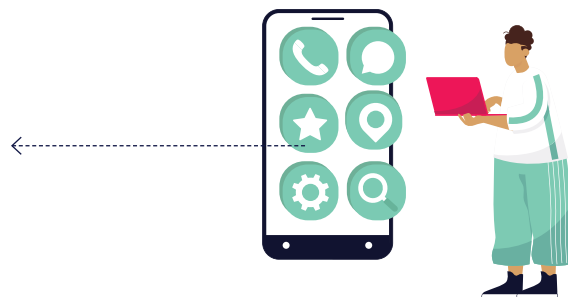
58 MILLION **monthly active citizens on average**

The use cases of this layer are broader and include communication, fund transfers etc. The PagoPA platform is the second layer of the German DPI layer envisioned to simplify public payments to the government in 2014. It introduces the elements of simpler, safer, and more transparent. It enables citizens to choose the method and the recipients of the transactions, in both online and offline manner.

It has more than

19000 **active public entities in 2023, and more than**

37 MILLION **active citizens**
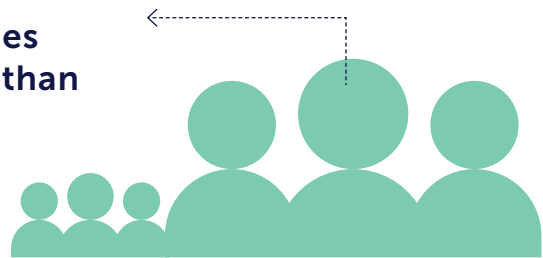
The governance is covered under broader Italian laws and policies.

Georgia is working on a Digital ID application operable from smartphones to provide seamless access to government services, following the EU standards. The focus is on two sections, citizens and MSMEs, for which a digital payment layer is also envisioned.

SINGAPORE

On the DPI front, Singapore opted for a proactive approach and worked on multiple stacks simultaneously. The Singapore government decided to launch its financial data exchange in 2020. Later, the Singpass was launched as a digital ID to provide access to services of public as well as private domain. Additionally, the baking sector developed PayNow to offer instant Digital Payment Solutions under the leadership of banks and NFIs, converging digital ID and mobile connectivity. The beneficiaries can receive instant transfers from the government and other agencies. However, the e-payment as a structure is yet to be consolidated, as the work on interoperability is underway to align the financial tools and intermediaries. Under a public-private partnership, a mechanism has been devised to let individuals use their digital identity to access information on financial statements. It is aligned with a data exchange platform and consented data sharing mechanism.

The first limb of the DPI structure in Singapore was launched in 2017 is the PayNow Platform, which offers instant funds transfer in Singapore Dollars between consumers and businesses with interoperability between different banking and payment intermediaries, through Fast and Secure Transfers (FAST) network using a single identification. It is a repository of proxies based on mobile numbers or other required IDs, and the participants perform transactions using these proxies. In 2021, it was opened for Non-bank Financial Institutions as well. The mandate for the PayNow comes from Singapore Laws while the ownership lies with the Association of Banks in Singapore (ABS). The Banking Computer Services Pte Ltd (BCS) is the operator and oversees the operations and developments.

This system allows sending funds without the details regarding account number etc. by providing a Lookup Request. It has a Message Queue and API interfaces. The prominent use cases are peer-to-peer transfers such as bill payments and fund transfers, consumer-to-business payments, B2B Payments, G2B and G2C Payments. By the end of 2022, PayNow has witnessed a total of 7.6 Million registrations, and 311 Million transactions valued at 123 Billion in Singapore Dollars.

> The mandate for the PayNow comes from Singapore Laws while the ownership lies with the Association of Banks in Singapore (ABS)

The second limb of the Singapore DPI is the Singapore National Digital Identity- Singpass, operating since 2003. The intention behind crafting this layer was to offer an ecosystem for public and private sectors to build services and co-create. The Government Technology Agency has the responsibility of implementing relevant policies and cybersecurity, and the general governance is conducted under the Laws of Singapore, prominently the Personal Data Protection Act. This system eliminates the need for multiple online identities, passwords and physical mediums of transactions. The system is also designed with inbuilt security, confidentiality and integrity for transactions, with convenience. It offers a federated structure for the economy to operate without compromising on privacy. It operates on OpenID Connect and Public Key Infrastructure. The prominent use cases are Myinfo (User data profile), authenticated login, verification, digital signature, and identiface (face recognition).

Singpass has nearly
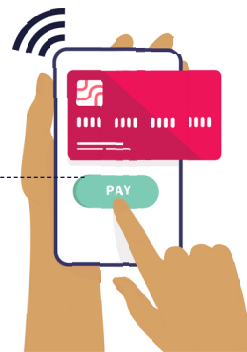
4.5 MILLION

users, and only around

3%

of the population of Singapore is excluded.

Annually, Singpass enables more than

350 MILLION transactions.

AFRICA

In recent times, the continent of Africa has been in focus due to the immense opportunities and potential it offers. Among the efforts to enable developments, the discourse on digitization, especially DPIs, has surfaced as a promising avenue. DPI enshrines the elemental structure to enable larger public service delivery and empowerment of individuals. Thus, building the DPIs can truly be a game-changer for the continent of African economy, governance, and public services. The demography and urbanization in African countries are among the favourable factors for digitalization.

However, Africa as a continent represents a larger developing world and thus has challenges relating to developments, political will, and infrastructure, needing a different and more careful approach towards policy priorities. The average spending on Digital Infrastructure by the African nations is around 1 per cent of the GDP as opposed to the nearly 3 per cent spent by the developed countries. (World Bank, 2021) The investment in DPI in Africa has scarce sources, both from government and private sources.

The window of opportunity for Africa has just opened up and it demands a trust-based approach, which is a challenge due to the dependency on other infrastructures like energy and internet access. Thus, a sound and coherent policy framework (Suitable in a regional context) is for building the DPIs, as in many countries, the data governance and regulations are at a nascent stage comparatively. Hence a collaborative and coherent policy development and deployment is required to scale the DPIs in Africa. Despite the above-stated challenges, in the post-pandemic world, DPIs are growing rapidly which does indicate initiatives in Africa. (Mureithi, C. 2022)

During the pandemic, the necessity of digital inclusion came to the forefront and consequently, many of the initiatives started to come up. Among those, at a regional level, the African Union introduced simplified digital verification of travellers. Later the AU launched the Digital Transformed Strategy 2020-2030 with a vision of development by digitalization built upon digital access and a single unified market by 2030.

This vision is aligned with the estimates of the World Bank which predicts a

2.5% **increase in the GDP by attaining** **10%** **increase in mobile internet access.**
(World Bank 2021)

The Network upgrade from 2G to 3G or 4G is happening at a rapid rate, and now the 4G network is estimated to be at 28 per cent by 2025 from 12 per cent in 2020, even though it remains below the global average of 57 per cent.

The optimistic aspect is that the internet access is increasing at one of the fastest pace. (World Bank 2021) There are other significant trends in this area as well. The Network upgrade from 2G to 3G or 4G is happening at a rapid rate, and now the 4G network is estimated to be at 28 per cent by 2025 from 12 per cent in 2020, even though it remains below the global average of 57 per cent. Also, the further transition to 5G is yet to gain momentum as only 5 African markets offer 5G connectivity. (Jackson, B., 2022)

On the matter of physical infrastructure backing Digital infrastructure, only these nations remain exceptions to the connectivity to the fiber-optic cable network. (ITU 2022) In the efforts to double the internet capacity by 2024 of the continent, the 2Aftrica cable system was launched. The task of taking the benefits of this project to the ground level remains an uphill task. (African Union 2020)

Many of the developing nations are hesitant to develop DPIs in partnerships as there are concerns over data sovereignty. In Africa particularly, these concerns are deeper due to historical experiences. Consequently, data centre localization is increasing in Africa giving rise to data centre, While the regulation governing data and the digital sphere is not structured yet, the consciousness and awareness are rising fast paving the way for legal consolidation very shortly, which in turn would give rise to increased data localization.

The legal backing comes from the Prime Minister's Order of 8 November 2018 concerning the teleservice denominated FranceConnect.

At present, around 2/3rd of the total data centres are located in South Africa alone. The rest of the continent to a similar capacity, around 700 more data centres would be required with 1000MW capacity.

Similar data indicates that the data centre market will grow to

US$ 3 BILLION

by 2025 (Digital Council Africa 2021)
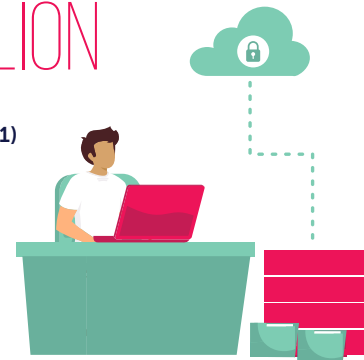
Among the efforts to enable DPIs in Africa, many multilateral forums have come to the forefront in supporting the transition. The World Bank is actively participating in the Digital Economy for Africa Initiative, with DPIs being the critical component of it. The African Union also endorsed this effort and expressed consensus with the World Bank Group's approach towards foundational elements, aligning the two sets of efforts. Collectively, the African Union proposed the African Digital ID Interoperability Framework which was adopted by the African countries of states in the year 2022. the African Committee of Experts on Digital ID (ACED) was constituted to steer the projects, including the one on Digital ID interoperability.

EU has also shown great interest in enabling digitalization in Africa as it launched two initiatives to enhance sustainable connectivity. The first project, the Global Gateway is designed comprehensive strategy to optimize resources for building quality infrastructure with due consideration to the partner country's policy and development priorities. The second initiative, the Team Europe Initiative is a joint approach combining EU strategies under one standard addressing digital connectivity, offering a support package for development. China has also expressed interest in the DPI development of Africa, notably promoting the Digital Silk Road, a component of its Belt and Road Initiative.

On the level of individual countries, we can find numerous examples and efforts to scale the DPIs. Among the prominent initiatives, Togo has built up a digital payment system, originally devised to assist informal workers in the pandemic times.

Nigeria has made considerable progress across the DPI spectrum. Its most renowned success lies in the Digital National Identity Number (DNIN). The framework has its regulatory and implementing mandate in the National Identity Management Commission Act. This project was devised in 2015 to tackle Distaste Recovery in Business continuity via digital identification infrastructure, with a focus on essential services. The segregation of sites based on needs is also remarkable where the services are available continuously in some locations, and can be triggered in other locations when the disaster hits. This model accounts for geographical diversity and local disruptions, along with built-in security and privacy measures, and future updates. The design has the elements of one-time registration and biometric enrolment of residents, unique identity numbers, and multipurpose identity cards among others. This endeavour has at its core the necessity of ensuring clean and correct data, avoiding duplication of efforts, sustainable privacy, dependable data verification, and interoperability, and the government of Nigeria has developed 10 use cases to augment the public service delivery.

Other than Nigeria, **Togo** has also made some progress by developing some layers of DPIs. It has successfully developed a Digital Payment system built on mobile money. It offers T-money and was used to transfer the benefits to the informal workers during the pandemic. The government realigned its infrastructure into Novisi, a digital cash transfer program, to transfer the benefits to the targeted accounts. The beneficiaries' identification was based on the voter IDs, and the combination of machine learning and AI to identify the poorest section.

Lesotho started its work towards National Identity and Civil Registration (NICR) with a vision towards real-time identity verification for the provision of nearly a dozen services of public and private domain. Including the Digital ID has eliminated the logistical burden of the government, and has created more efficient data management.

In Angola, the digital payments system at present is being used primarily to implement the social security programme, Kwenda, with a gradual transition in scale. Similarly, the Tonga Digital Government Support Project envisions development in laws via amendments to adopt digitalization. In Samoa, The Connectivity Project is being conducted to draft a National Digital ID Bill for the entire population.

Ethiopia is devising its Digital ID programme Fayda in partnership with the UN Economic Commission for Africa. Significant progress has been made in creating a legal mandate for DPIs as the Bill has passed multiple stages of the legislative process. This bill notably also enshrines the privacy safeguards for the citizens. The technical progress on the Digital ID is being carried forward with due caution, and with the participation of multilevel stakeholders. The objective of Fayda is primarily social security coverage, healthcare and financial services.

At present more than
35% of the population does not have government identification.

The policies and implementory framework are under consultation and review.

Central African Republic has also started laying the foundation for the digital transformation of the DPI ecosystem. Under the ID4D program, a comprehensive analysis has been conducted to provide legal backing to the digital identification system, as at present the identification relies on birth registration. Efforts are being made to address the judicial and administrative reforms, cost-effective solutions, and policy dialogues with development partners to attain an inclusive structure for the robust identification system.

Rwanda has taken a more proactive approach where it is working on bringing the DPI-related developments via means of legal mandate. The process of strengthening its new Identification laws with the advice of the World Bank and ID4D under the aegis of the Rwanda Digital Acceleration project is underway. The policy priorities are to integrate transparency, accountability and sustainable development for the next-generation identification system.

To develop the digital payment layer of the DPI, the Vision Umurenge Programme launched in 2008 was equipped with a digital payment limb, which gradually attained the coverage of nearly

500 THOUSAND household
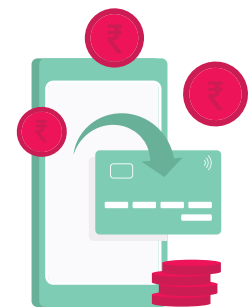
It catalyzed to initiate and accelerate the public service delivery, and the Direct Benefit Transfers. The government also has made some notable commitments in its budget to enhance the foundations of DPI in the country.

Similarly, in **Tunisia**, the leading social assistance program, Amen Social, was updated in the year 2020 to provide an option of Digital transfer to the beneficiaries in a choice-based model.

SOUTH AMERICA

Chile is beginning its digital transformation at the societal level with the establishment of a digital ID. Clave Única is a centralized service that allows people to validate their identity on the web platforms of public agencies to access the government data and procedures available, always using their identification number and a password defined by the same person. Until January 2023 Clave Única has registered 14,573,731 users, which represents 88.5 per cent of the people who can obtain it.

Users with a Clave Única can access 1,730 government services and procedures, which corresponds to

85%
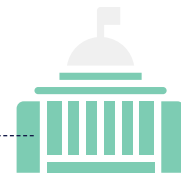
of all central government procedures that require some authentication mechanism to carry them out.

Argentina developed a system of digital payments system in 2011 which over time has evolved to be called Transferencias 3.0 to foster digital payments and financial inclusion. In terms of design, the Transferencias is built on shared infrastructure under the supervision of the Central Bank of Argentina, with a significant role for the private sector. The scheme managers also have a role in setting the Operational and non-regulatory requirements. There is a significant collaborative link between Public and Private players in the system designed, and the engagement of stakeholders is ensured via a forum called "Comisión Interbancaria para los Medios de Pago de la República Argentina" (CIMPRA). The use-cases spawn across Instant Fund transfer across payment instruments, with the features of QR Codes payment links and credentials, with the interoperability element. The system at present carries out more than 40 per cent of retail payments. Its speciality lies in enabling natural as well as legal persons to operate funds using accounts of banks and other payment intermediaries.
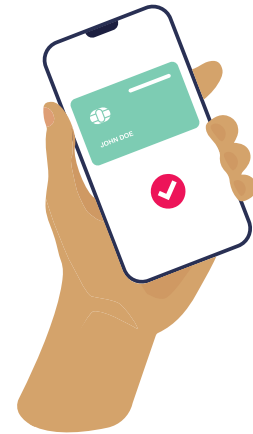
Since its launch, it has processed more than

4 BILLION

transactions with a daily average of

11 MILLION

transactions. (GDPIR 2023)

Peru has been able to expand on DPI in a phased manner, which resulted in the adoption of choice in the social assistance programmes while shifting from cash-based transactions to digital payments with a strong shift towards digital modes of transactions. The approach of the Peruvian government was predominantly collaborative where the Banking and financial institutions were taken on board to develop a robust system for digital payments.(GDPIR 2023)

Brazil is one of the nations leading the DPI development in South America, as it has successfully developed three layers into its DPI. **Gov.br Digital ID** is the national Digital Identity layer of Brazil's DPI, built in 2019, to enable the reliable identification of citizens. Similar to ConectaGOV.BR, the legal mandate for Gov.br comes from the presidential decree and federal law. It offers nearly 4500 digital services from eclectic public agencies over a closed-source platform developed by state-owned entities. It has three categories- Gold, Silver and Bronze to initiate public service delivery. The three categories offer different sets of services depending on the scale of information shared, increasing from Bronze to Gold. The prominent use cases are Income Tax statements, enrolments in educational programmes, social security, digital wallets, vaccination certificates, public service portals etc.

It has a total of

153 MILLION **registered users along with**

250 MILLION **authentications per month**

PIX is the third limb of Brazil's DPI structure launched in 2020 and offers payment-related solutions. The prominent objective of creating this limb was to enable an infrastructure which can support real-time account-to-account payment services, including targeted Direct Benefit Transfers. Law 12.865/2013 provides legal backing to the Brazilian Central Bank (BCB) to formulate policies for restructuring the Payment System to introduce transparency, competition, and inclusion. The BCB is the main public policy formulator and the infrastructure provider to back the related Public Good. The prominent use cases in Pix are C2C transfers, B2B Transfers, purchases, tax collection, bill payments, donations, Direct Benefit Transfers etc. By 2023, a total of 146,861,796 individuals were using PIX, in addition to 14,462,733 legal personalities registered on the same, 161,324,529 users.

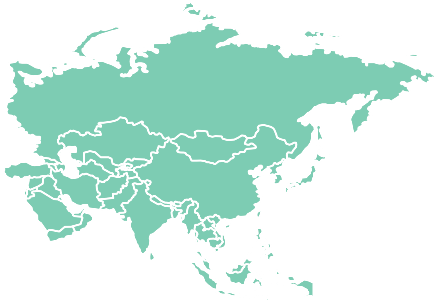**The scale of transactions has reached around**

32 BILLION

by the end of 2023. (GDPIR 2023)

WEST ASIA

Jordan started its work towards crafting a DPI architecture before the pandemic hit in 2019 and has considerably accelerated the progress since. In 2019, to carry forward the social assistance programme Takaful which later evolved into the Unified Cash Transfer Programme. This umbrella scheme initially aimed at 15 per cent of the population, offering them a spectrum of choices like e-wallets. The financial inclusion of women was found to be remarkable post-implementation of Takaful.

Oman is another country in West Asia which has opted for preparedness for the DPI. It has made progress across multiple limbs of the Digital Public Infrastructure notably the Oman Broadband Company, Census Project, G-Cloud, Unified Portal, and the National Data Centre. Understanding the need to access, the Oman government established the Oman Broadband Company in 2020, which was tasked with building the infrastructure to support digital access via laying down the Optic Fibre infrastructure.

Soon after its inception, the company was able to cover nearly

50%

of the housing units by mid-2020 itself.

In parallel efforts, the Oman Census Project was also rolled out in the year 2020 to move away from the traditional census process towards e-census mode. This register operates on the administrative inputs received from multiple limbs of the governments, with near real-time updates. The project has since processed more than 100 million records. In the same series of efforts, G-Cloud was launched as a strategic effort to optimize cloud technology, which had the vision of public service delivery with ease and to eliminate the duality of efforts. It has evolved into several use cases including healthcare, social security etc.

ASIA
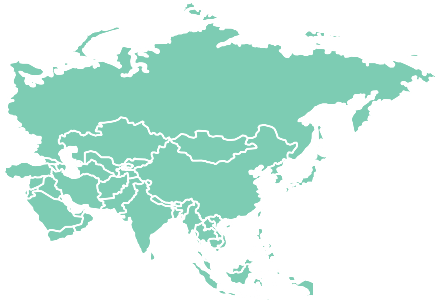
Japan started its DPI journey considerably early and was one of the first countries to raise the issue of digitalization on multilateral forums. Some of the initiatives at present are enforceable while others are launched as guidelines (Such as Government Interoperability Linkage). This combination probably was opted for a seamless transition, and to gradually adapt the digital infrastructure to the use cases. The Japanese approach towards the DPI shows a classification for individuals and businesses in designing the layers of digital infrastructures. For individuals, MynaPortal is the individual identity layer, which enables public service delivery via an individual number card and has a base of nearly 630260000 users since its inception in 2017. The governance aspect of MynaPortal is guided under the Japanese laws. The prominent use cases developed since 2017 are in the domains of insurance, banking services, passport-related administrative procedures etc. For Businesses, GBizID is devised as an authentication service with a login facility and 2-factor authentication to nearly 990 thousand accounts. It has integrated various levels of government into a single system for data and information exchange. Another unique layer in the Japanese DPI is the Trusted Web which is set up to provide a check mechanism against fake and misleading information, and it has an impressive use-case trajectory (13 in 2022, 12 in 2023). (GDPIR 2023)

South Korea initiated its DPI journey by launching the Digital Platform Government Hub to provide secure access to public and private data. Although it is not yet opened to the public, it is being updated for this purpose. The robust legal mandate backing this initiative is impressive. The governance is ensured under multiple yet relevant laws.

Philippines is one of the beneficiaries of the World Bank's FIRST (Fast, Innovative, and Responsive Service Transformation) Social Protection Programme. Under this umbrella project, support is provided to the partner country's social welfare agency in building sustainable social services infrastructure. As a crucial limb of this project, support is being extended to craft the e-PhilID under the Philippine Identification System (PhilSys) aiming for a national-scale adoption to avail social services. Apart from this, the work on the parallel layer of digital payments is also in progress with a vision to promote eKYC via underlying PhySys and implementation of digital payment regulations, choice of payment methods.

> For individuals, MynaPortal is the individual identity layer, which enables public service delivery via an individual number card and has a base of nearly 630260000 users since its inception in 2017.

The legal backing comes from the Prime Minister's Order of 8 November 2018 concerning the teleservice denominated FranceConnect.

Mauritius has started developing its Digital identity layer with single sign-on access to multiple services.

It has a user base

300 THOUSAND

and is growing at

3.33% annual rate.

The platform serves as a dual facilitator for both the government and individuals in tracking and assimilating information and enabling access to services accordingly.

Russia has envisioned two functional DPI layers, namely e-services and the Unified Digital Platform.

The Unified Portal for Government and Municipal Services has a massive user base of

56 MILLION

active users while the total registered number of users exceeds

78 MILLION

and has been in operation since 2011.

The Unified Platform is imagined as a solution to transform the public sector of the Russian Government by enhancing efficiency at all levels of the federation. It has 5 use cases (Science, Transport, Ecology, Sports, and healthcare), while the other 13 use cases are under development. These portals are governed under the Federal Russian Laws.

Indonesia is one of the countries which have the advantage of a pre-existing population register which is also relatively comprehensive as nearly

97% **of the population is included in the said dataset.**

However, there were challenges in identifying vulnerable groups from the given data to provide them with necessary assistance and benefits. Thus, with the support of the Australian government and the World Bank, the Indonesian Government pioneered two initiatives to bridge the gap, one of them being the prospect of using Digital ID for the empowerment of women and PWDs. It has taken inspiration from the Singpass and at present is attempting to innovate on the available models to cater to its policy priorities.

Cambodia has decided to move towards DPI with the Direct Benefit Transfers regulation on the recommendation made by the World Bank, from the regular physical banking transactions.

Thailand has made progress towards the development of DPIs in multiple layers, including the digital payment data exchange and the Digital ID. The Thailand policymakers have decided to move ahead with two types of IDs for the citizens for public sector and the financial sector. The first of these IDs is the National ID based on the civil registries named D.DOPA. The second ID is called NDID and combined with the State Welfare Card provides access to services. The same ID has dual functionality as a wallet as well for transactions related to necessities. The work is underway to develop the use-case of tax filing for the NDID. The data exchange layer for the public sector is functional while the data exchange for the private sector is being worked upon. PromptPay, the digital payment platform enables seamless fund transfer initiated by NDID, Mobile number or QR Code.

Bangladesh has been successful in designing 6 verticals of the DPI architecture namely MyLocker, DOPTOR-Identity Provider, UBID- Business Identity Registry, MyInfo, Muktopaath, National Intelligence for Skills, Education, Employment, and Entrepreneurship. Among these, MyLocker is a cloud-based initiative to eliminate paper bureaucracy. Since its inception in 2021, more than a million certificates have been issued and verified. The operational of responsibility MyLocker is distributed throughout the government organs, while the ownership belongs to Aspire-to-Innovate. Doptor envisions a paperless government by providing integrated e-services. This amenity has been accessed in nearly 9000 offices across the country since 2014. MyInfo was launched in 2020 as a profile aggregator platform with more than 4 million users to primarily provide verification services. Muktopaath is a knowledge-sharing and skill-building platform and along with the National Intelligence for Skills, Education, Employment, and Entrepreneurship creates an ecosystem of learning and knowledge management steered by the public sector.

Among these, AePS (Aadhaar-enabled Payment System) was introduced in 2010 as an interoperable system enabling financial transactions with Aadhaar Authentication, while the Aadhaar Payment Bridge was an upgrade to the AePS where the Government beneficiaries were provided with direct benefit transfer.

India, among all the countries and regional forums working on devising their own approach towards DPI, the approach taken by India has emerged as one of the most admired and noted, especially after the G20 Delhi declaration. The reason for the India approach to be hailed as a blueprint is also the noticeable progress on the development goals achieved since the steps were taken to advance the DPI.
While starting this journey, the focus of the Indian Policymakers was on developing the foundational building blocs for the DPI, which provided the wide spectrum to implement a larger set of digital solutions in a wide range of areas. The Digital Public Infrastructure in India has 3 prominent layers across the domains of identity, payments and data exchange, under which, there are multiple services offered in digital mode.

The identity layer was the foremost project taken up by the Indian government in the year 2009 with a robust legal framework. The Aadhar Project was launched as a 12-digit unique identity number with three limbs namely, Biometric Verification, Demographic details and contact information. Using this identity, many digital services have been offered which provide choice-based solutions to public service-related issues. Among these solutions, eKYC was rolled out in 2013 and it offers e-authentication of customers using Aadhaar details. Similarly, eSign enables Aadhaar holders to sign documents electronically and remotely, while the GSTN was developed to provide the 15-digit identifier to the entities operating under the GST Tax regime.

Simultaneously, the developments on the Payments layer had started with Aadhaar as the introduced foundational block. Among these, AePS (Aadhaar-enabled Payment System) was introduced in 2010 as an interoperable system enabling financial transactions with Aadhaar Authentication, while the Aadhaar Payment Bridge was an upgrade to the AePS where the Government beneficiaries were provided with direct benefit transfer. The Unified Payment Interface system proved to be a game-changer in the digitalization drive as it provided real-time payment transfers to the participants, and along with the Bharat Bill Payment System, it paved the way for a digitalized market from the side of merchants and consumers both.

On Data Layer, the Indian Policymakers developed DigiLocker and the Account Aggregator in the years 2015 and 2021 respectively to provide access to authentic documents and information to the Aadhaar holders and third parties in certain cases.

SCALING-UP FAR AND WIDE: OPPORTUNITIES & CHALLENGES ▶ ▶ ▶

04

> The DPIs are hailed as one of the most potent solutions to global as well as local issues across the world.

The importance of infrastructure of any kind in attaining progress is known and accepted. With time, different variants of infrastructures have been facilitating the mobilization and integration of eclectic resources, such as money, information, labour etc. The present democratic order has its foundation in the innovations facilitated by infrastructure, and it is still sustaining on the "public" nature of the infrastructure. Further, as the world steps into the fourth industrial revolution, the necessity to develop and harness the digital infrastructure has emerged as a precondition to utilize the technological advancements for development.

The Digital Public Infrastructure, a nomenclature catalysed by India, has emerged as an approach towards digitization, rather than a technical term. While the most technical aspects of the DPIs remain the same as the countries start and implement the "stacks", the avenues that DPIs offer keep widening. Similar to the physical infrastructure, the utility of these structures is proving to have reached beyond the essential and original function, allowing governments to develop more and more solutions to public service-related issues. The DPIs are hailed as one of the most potent solutions to global as well as local issues across the world.

While the existing countries leading the DPI practices might have started in silo, with the national development goals and priorities in focus, the success of even relatively smaller digitization efforts in these countries has led to a desire in other countries to replicate this success.
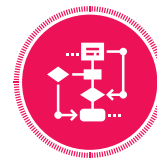
From the country practices, 3 prominent models have emerged, namely
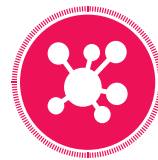
THE WEB3 MODEL   **THE BIG TECH MODEL**   **THE DPI MODEL**

Among these, the DPI Model has been considered to be the most modular and flexible, making it a popular choice among policymakers. (Saran S. 2023)

The prominent features of the building blocks created under the DPI Approach entail cost-effectiveness, interoperability, and modular structures among others, which render consequent infrastructure the capability to function as a set of foundational pillars for devising multiple solutions. The DPI approach also indicates an ecosystem where all the component has the possibility inherent in them to integrate to develop new products and solutions. This allows the creation of open-source solutions at a much larger scale than in the other approaches, leading to enhanced problem-solving capacity.

As a recent phenomenon, various aspects related to the DPIs have yet to find a place in mainstream discussions. However, considering the vast impact and stakeholder pool, it is imperative to proactively discuss the opportunities and challenges related to the DPIs to lead a sustainable policy ahead.

OPPORTUNITIES

DIGITAL PUBLIC INFRASTRUCTURES AS A TOOL

GOVERNMENT
can perform better on civic deliverables

PEOPLE
can access Public services and Enhanced resoureces

BUSINESS
can access better capital and innovation

GLOBAL SOCIETY
can access more relilience on overall development

The DPIs have transformed the markets by offering solutions to expand banking services, payment options, and credit, among many others to the farthest parts of the population spectrums.

So far, the technological developments facilitated by digitalization have proven to be the next aspiration for an all-around and faster development. It offers a fast route for the developing world to attain growth for all, negating the historical under-development. The current experiments have shown the potential of developments in many sectors, prominently the governance component in the public sphere. A few of the promising results observed are enlisted as follows.

A Social Security

One of the earliest attempts by many of the governments aspiring to build DPIs was in the space of creating a Digital Identity to extend and enhance public service delivery. It forms one of the most common layers across the DPIs of various countries and is also the most common building block used. It enables certainty in determining beneficiaries and has now evolved into a tool beyond identity. It has grown to facilitate travel, Direct Benefit Transfers, and Skill Development, among other use cases.

This type of digital identity forms the basis of many digital services by automated identification and classification of the beneficiaries.

B Financial Inclusion

One of the most impacted areas of the DPI has been the financial sector, where unprecedented positive results have been observed. The DPIs have transformed the markets by offering solutions to expand banking services, payment options, and credit, among many others to the farthest parts of the population spectrums. The scale of financial inclusion attained by using DPIs has been remarkable in terms of time and resources.

For example, in India alone, the Aadhar and UPI have witnessed nearly

80%

financial inclusion in 6 years.

In a traditional financial system, the same growth would have taken another 46 years to reflect the same results. (Alliance, D. I. 2023)

By 2020, India had the largest share of Digital payments (46%) in the world. (PIB 2023)
From 2014 to 2021 the growth rate of digital payments was

35% - 57%

which was a result of DPI developments.
(Tombini, A., 2023, October 29)
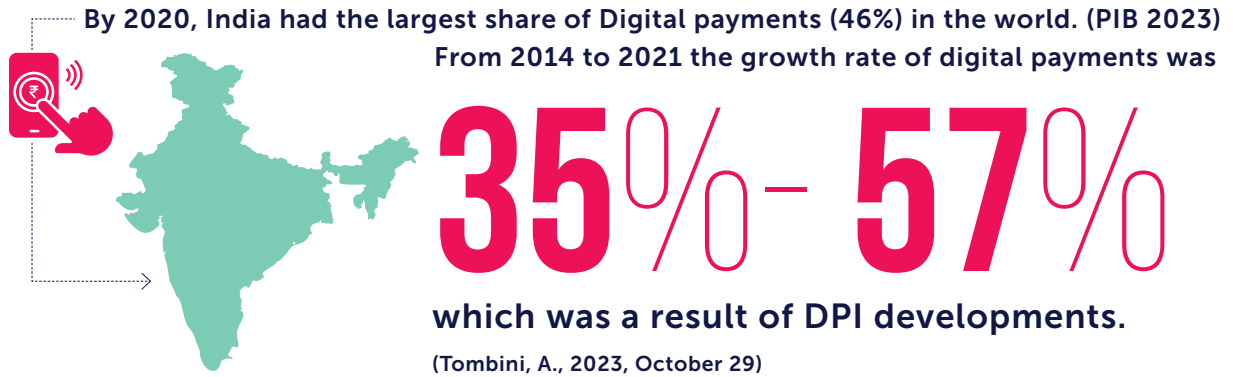
C Healthcare

While the countries were in the process of creating respective DPI Blocs, the unfortunate pandemic hit in the year 2019. The true potential of the DPIs came to the forefront as the governments were able to utilize the blocs of DPIs to extend healthcare services to their populations, vaccinations- in particular. While the initial focus was on tracing the contact cases, maintaining the COVID vaccination records, and facilitating the administration of vaccines to the population, the use-case quickly evolved to deliver more functions such as medical record maintenance, non-covid vaccine administration, relieving the pressure from the healthcare systems.

Data from China alone indicates that patients can save up to

18%

on healthcare-related expenditures by augmentation of DPIs. (Han, H et al 2023)

Other successful examples of developing use cases under health may be found in France, where based on DPI, a Health Data Club has been designed to aggregate the data from various agencies having access to the medical data or information of an individual.

D Gender Equality

While the approach taken while building physical infrastructure, unfortunately, did not account for the specific needs of women, (Gill A., 2023) the DPIs being a flexible model may have great applications in promoting gender equality in multiple aspects of women's lives, by an in-built gendered intention. In countries such as Pakistan, the DPI has been successful in offering solutions for women from rural communities to be integrated into the financial fold allowing them access to credit.

> To substantiate, PayNow, Singapore's Digital Payment System, has provided substantial, verifiable, and reliable data on the wages received by women.(UNDP 2023)

In India, nearly

70 MILLION

women are active users of UPI indicating the usefulness of the technology.

The DPIs can also offer more unconventional tools to fight gender inequality as it has the component of innovation inherent in their structure. To substantiate, PayNow, Singapore's Digital Payment System, has provided substantial, verifiable, and reliable data on the wages received by women.(UNDP 2023)

E Improved Climate Action

As the window on taking action on Climate Change closes in, efforts are being made on a mission mode to prevent, mitigate, and adapt. While the liaison of technology and climate actions is not very recent, DPIs have emerged as a potential tool to aid the efforts. As nearly 45 % of the world remains without reliable power sources, (energy for growth hub. 2023) the DPIs are emerging as a solution to aggregate and provide access to the relevant data, depicting the greater scope of building solutions to climate-related issues. Another example could be the National Carbon Registry as a means to report and verify the national and international relevant information on carbon trading. (UNDP 2022)

In another impressive example of mitigation, the early warning system developed by Mozambique has led to more than

80%

reduction in the number of lives affected by floods. (Alliance, D. I. 2023)

(F) Economic Growth and Innovation

As the population of the world increases, most concentration of the young population has shifted to the Global South which has enormous informal markets. The population engaged in these markets is outside the purview of social security and occupational opportunities for skill development. The DPIs are increasingly being used to offer distance skill enhancement opportunities in over 90% of the countries in some or the other form.

However, there is a scope for augmenting these efforts, and the estimates suggest they add up to
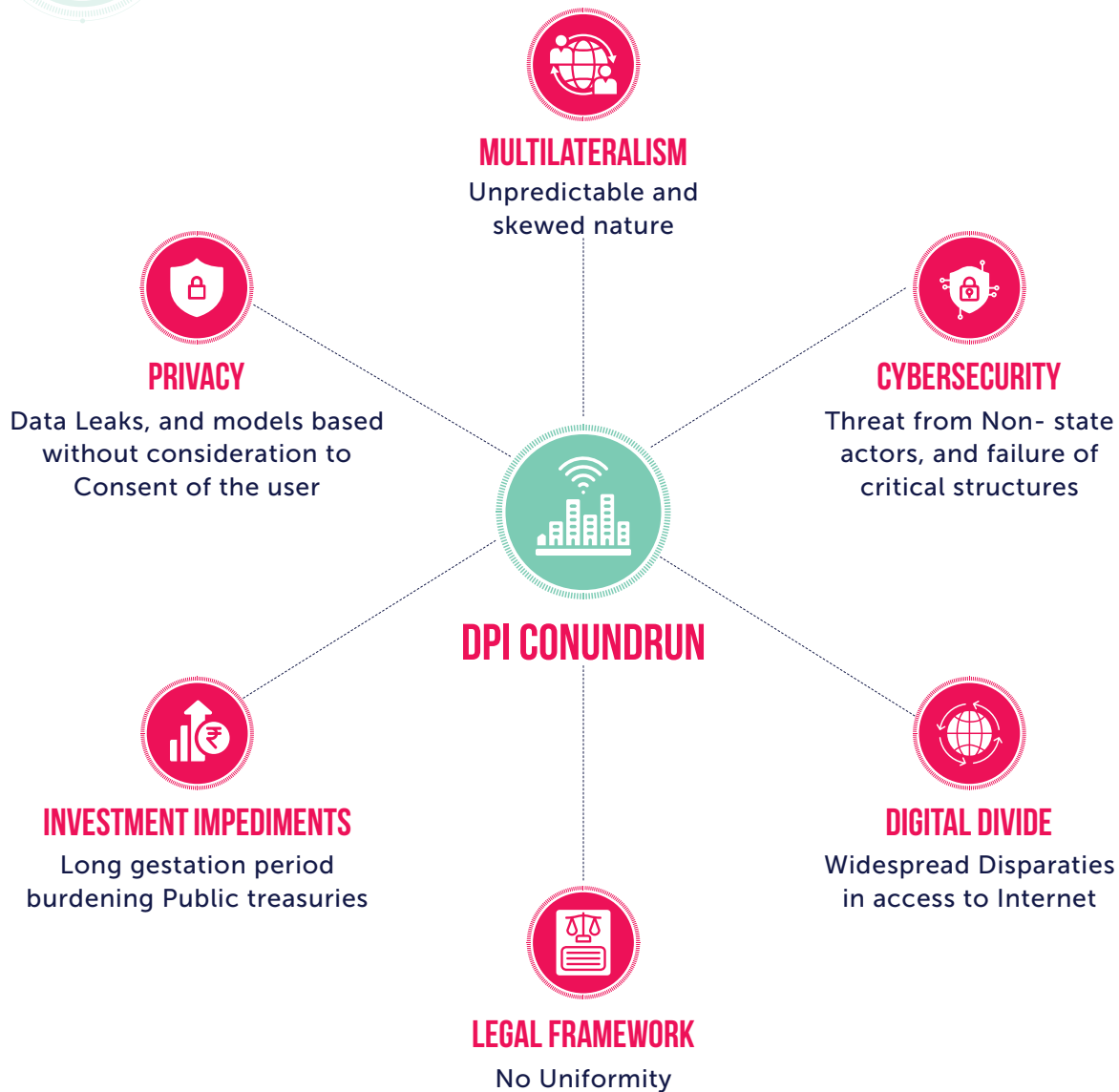
$950 BILLION

in the annual income of the G20 alone.(UNDP 2023)

The above analysis is a brief attempt to assess the utility of the DPIs in all-round development. While digitalization is non-optional at this juncture, there is a need to build solutions on the values of inclusivity and competitiveness. The DPIs as a set of technologies can drive great changes in the world, across all Sustainable Development Goals, regions, and sectors. A trust-based multilateral process needs to be developed to steer these changes and to create DPIs as the structures of equality, inclusion, and governance.

CHALLENGES

MULTILATERALISM
Unpredictable and skewed nature

CYBERSECURITY
Threat from Non- state actors, and failure of critical structures

PRIVACY
Data Leaks, and models based without consideration to Consent of the user

DPI CONUNDRUN

DIGITAL DIVIDE
Widespread Disparaties in access to Internet

INVESTMENT IMPEDIMENTS
Long gestation period burdening Public treasuries

LEGAL FRAMEWORK
No Uniformity

As the world grapples with new realities of multilateralism and international order, the DPIs as a rising global phenomenon are not untouched by the impacts. There is an awareness in the international community regarding the power which comes with harnessing DPIs, and also regarding the danger it may pose in affecting a nation's free will. The concerns, however, are not confined to the national level. At the individual level as well, there are doubts regarding the actual effectiveness of the DPIs in balancing welfare and privacy. Here are some of the prominent challenges relating to the developing DPIs.

A   The Multilateral Model

Uncertain Multilateralism

In recent times, multilateral institutions have been mere spectators to the conflicts, and the majority of the solutions have either been bilateral, or mediations. May of the conflicts remain unresolved and ongoing. In this environment, where coercive unilateral action is increasingly becoming the norm, many stakeholders are hesitant to seek assistance on the DPIs as the dispute resolution remains unclear.

Lack of Institutionalization

While the DPIs are new, the developments related to the DPIs are extremely fast, which provides a very small window for the stakeholders to address, asses, or resolve an issue. While many multilateral institutions addressing other subjects have been questioned recently on their efficacy, the very presence of an institution provides structure and direction to the development. In the absence of such a platform, the developments occur at the instance of respective nations and are often guided by their policy priorities, leading to a lack of streamlining in the guiding principles.

Digital Colonization

At present, while DPIs are increasingly being sought after by nations, there are very few countries which have gained significant growth in building successful domestic DPIs. Having seen the difference, it can make on the development goals, many nations are eager to experiment with the DPIs. However, the majority of the nations lack the capacity expertise, or resources, or all of these to initiate the mammoth task of starting with the foundational work. While the collaborative approach as put forth by India appears sublime, it is relatively recent and may lack the trust element as of now.

The small nations being aware of the current international realities such as coercive actions, unilateral sanctions, debt-trapping, etc. may hesitate to seek assistance from larger nations as it may affect the sovereignty in a political as well as digital sense. (ORF 2023)

Lack of Global Standards

As stated earlier, at present the respective nations are developing the DPIs as per domestic priorities, and while a fair number of these nations are located in the Global South, there are still gaps to bridge to cater to the developing world. This can be attained only by determining and concluding on a policy or guidelines on global standards with representations and effective participation of all the stakeholders.

B The State Power

The DPIs hold great potential to transform the world and are correctly prioritized by countries with the same view. However, as we provide digital wheels to development, we must also keep in mind the necessity of checks and balances, as the state power combined with the DPIs can lead to arbitrary exercise of power.

India, which is leading the drive to digitally transform the development by DPIs, has also seen the greatest number of internet shut-downs in the past 5 years.(Access Now., 2023) The Internet shutdown is a regular feature of police action dealing with any kind of apprehension and has been implemented in the National Capital Region and other conflict-prone areas alike. While such a shutdown has been hailed as against national and international legal standards, the maintenance of law and order takes precedence over the citizen's fundamental right to access the internet. (Bajoria, J., 2023)

The state control over the internet and digitization of public services can't be harmonized, as once the public services are digitized, depriving individuals of the internet would also mean depriving them of these public services. The recent technology law and other rules do not provide an effective solution to this issue.

C Data Leaks and Cybersecurity

As new models of DPIs emerge from different countries, the flaws in those are also coming to the front simultaneously. With the very inherent nature of the DPIs, the amount and nature of data shared can be varied and sensitive. The correct channelization of data is so crucial that even a 1 per cent increase in data restrictiveness reduces the productivity of a nation by 3%.(ITIF 2021) Despite the crucial nature of this element, many of the successful DPI models, for example, India, have seen data breaches and vulnerabilities, despite being one of the countries with elaborate and robust legal frameworks to govern data. (Maheshwari, A., 2023) (Jovan., 2023, December 27) The number of entities involved in it also complicates the issues relating to the attributability of the legal consequences. (WEF 2023)

D Monopolization of the Public Infrastructures

DPIs are envisioned as an ecosystem, where the public sector builds the essential foundational blocs and the private sector has a varied role in the operation and innovation of these blocs. Thus, considering the involvement of the Private Sector and the public nature of these structures, it is important to ensure and maintain the public nature of the same. In the case of Physical infrastructure, this was achieved with the help of introducing a partnership of policy and technology, which can be replicated in the case of DPIs as well.

E Risk Factor and its Distribution- too big to fail

Infrastructure development projects are often funded out of public resources, as long-term endeavours with costs related to public money, time and resources. Thus, these projects are considered to be "Too Big to Fail" and the governments have to consider various aspects before starting on such projects. The accountability of the results also often falls on the next government (in most of the political systems).

Considering the urgency and inevitability of the DPIs, it is important to craft a new set of models and methods to distribute the responsibility of such projects to multiple stakeholders, especially those related to funding and investments. The present models do not offer a viable solution to effectively distribute the risks of long gestation periods and the grand scale of resources involved.

F Implementation challenges

While the conceptual vision of DPIs appears a panacea to many issues, in the absence of the correct implementation strategy, these solutions can prove to be counter-productive. (Maheshwari, A. 2023) Eliminating historical biases has been a prominent challenge for the technocrats, and provided the grand scale that DPIs are designed to operate at, the slightest deviation from the original intent can prove to be an irreversible mistake.

G Tech Dispute Resolution

As elaborated earlier, the international order has not yet evolved to provide niche governance to the DPI regimes. Thus, envisioning a technology dispute resolution mechanism might appear far-fetched. The DPIs by nature are beyond borders and the possibilities of domestic or international disputes cannot be ruled out. Hence a platform is much needed to adjudicate the potential disputes that may arise shortly at multiple levels.

H Synergizing Technology and Law

While many countries are desiring the fruits borne by the DPI and related technologies, there are more complexities involved in digitizing public services. The successful implementation of DPI-related solutions demands a clear policy to begin with, and while it may seem like an obvious requirement, the maturity of the policy is affected in both positive and negative directions by many factors such as the polity of the country, development level, effective consultation etc. Additionally, considering the level of integration with the global data and information flow, every country needs to consider the creation of a legal framework which offers flexibility to adapt to fast-developing technologies, and certainty in terms of adherence to the fundamental justice values.

However, the lawmaking process has proven to be a complex issue in each nation regardless of its history and system. The highly proximate nexus of law with development makes the lawmaking process more nuanced than merely outlining the bounds of a subject matter. In the absence of clear international guidelines, developing a legal mandate for the whole DPI ecosystem which balances multiple aspects can be challenging.

05
PRACTICES FROM AROUND THE WORLD & RECOMMENDATIONS

There seems to be a discrepancy in terms of the acknowledgement of the importance of the DPIs, and in suggesting a way forward to take the DPIs forward.

As the 2023 G20 summit concluded by bringing the DPIs to the centre stage of public policy, there has been skewed attention to the issue from an advocacy angle whereas the conceptual and practical components of the DPI need equal attention. There seems to be a discrepancy in terms of the acknowledgement of the importance of the DPIs, and in suggesting a way forward to take the DPIs forward. The successful models such as India and Singapore have elements which can be replicated, however, these would need a closer consideration at both macro and micro level.

As we present recommendations, it is pertinent to look at the New Delhi Declaration concluded in the 2023 G20 presidency as these recommendations were the result of nearly yearlong deliberations among substantial stakeholders in the global policy related to the DPIs. Being one of the most prominent multilateral outcomes on the matters of DPI, these points are likely to direct the current and future discourses on the matter as they provide a value orientation to the discourse surrounding DPIs. The focus of the discussion was primarily on the Digital Economy aspect of the DPIs, yet the principles agreed and shared upon can be applied to the entire ecosystem of the DPIs.
The Outcome document acknowledged the limited capacity of many countries in advancing their DPIs with the values of sophistication in design, inclusion, safety, resilience, sustainability, interoperability, and due consideration to Human Rights, among others as foundational values for the DPIs. Noting the evident digital divide (with specific mention of the Gender Digital Divide), the forum emphasized the need and efforts for digital connectivity. It was agreed upon for the DPIs to be built as Human-centric and open-source systems having cross-border interoperability. There was also a proposal for One Future Alliance as a platform to enable deliberations on the matter.
Another major theme in the G20 outcome was the issue of security, where the members agreed and acknowledged the previous work done by the G20 presidencies since 2017, while also noting the mutual dependency of the stakeholders, and consequent vulnerability causing disruptions. The members came up with non-binding principles and a toolkit for Cybersecurity specific to children and youth.

RECOMMENDATIONS

1   Institutionalization

The talks around DPIs so far are based on the experiences of a few nations, and the cooperation till now is being channelized primarily through bilateral agreements. While bilateral agreements do offer greater flexibility to both parties, in the long run, this practice may harm the development of common practices.

A promising solution to resolve this issue could be institutionalization at multiple levels such as national, regional, and global. The countries having successful DPI experience have shown the trend of steering this feat via domestic institutions. For example, India's Digital ID Aadhar was created under a legal entity UIDAI. As the countries cooperate more to create their own DPI system, it is important to attribute accountability and responsibility to an institution dedicated to and specializing in the domain of public technology.

The argument for creating a regional institution has its basis in essential equity. Many of the countries aspiring for DPI developments may lack the resources or expertise to develop such a structure on their own, while individual countries entering into a bilateral agreement with another country having success in DPIs may lead to an unequal bargain. The regional forums may step in for collective bargaining and guidance for these nations, mostly situated in the global south, in their journey to developing DPIs. This can also be a step in the right direction for the development of common principles for DPIs.

Lastly, the basis for a global institution comes from a need to carefully observe the practices around the world and simultaneously guide the global community in technological development conducive to human development. As has been seen in previous technology-related developments the element of state power and monopolization have dominated the discourse. While these elements can not be neutralized at once, their influence can be mitigated by the creation of an institution with fair representation of nations. In Arguendo, the technology related to DPIs is fast-paced, and it would not be prudent to wait for complexities to arise to define the bounds which can easily be determined now. For example, the application of international principles such as Jus Cogens in the context of the DPIs or the Applicability

> The countries having successful DPI experience have shown the trend of steering this feat via domestic institutions.

of the Common heritage principle can be elaborated upon at present with available information. In a positive development, in the G20 2023 Digital Economy outcome, the members did imply the UDHR protection to the DPIs. This approach might be more useful as it may provide the nations with appropriate information beforehand and may help them in creating just structures of the DPIs.

2 Global Standards

There is an urgent need to develop global standards, considering the fast-evolving technology backing DPI. The multilateral dialogues of the past have failed the developing world on various occasions, where the standards of the developed world were adopted as default rules. However, the anomaly in the DPI movement lies in the fact that many of the successful DPI examples come from the global south which creates a unique opportunity for the developing world to not only lead by example but also shape the upcoming global standards. A process of setting global standards led by all would leave less scope for countries to be vulnerable to dominant players with better capacity. Additionally, it would also allow the governments across world to govern the fair distribution of power and capacity among all the stakeholders.

③ Model Bilateral Agreements

The DPIs are emerging as a new area for international collaboration where the countries holding expertise in the DPIs are providing guidance to other countries desiring to build these systems. (Singal, N. 2023) This arrangement is largely bilateral at this point with the parties themselves determining the terms and conditions as per their diplomatic relations.

This trend might be deterring many smaller countries from entering into such agreements as there might be a trust deficit, which becomes even more strict when the parties to the agreement are not on equal footing in terms of resources and development. The Nuances of DPIs do raise concerns relating to Data Sovereignty and State security, which is causing policy paralysis for many countries leading to inaction on their part. Provide the small window the technology has provided, a trust-building exercise appears to be a long-term solution, and in addition, it may not be very effective in changing the geo-political context.

One effective solution to this issue which can be drawn from the international arbitration regime is the Model Treaty or Agreement. While the universal framework or instrument governing DPIs is a better solution, the process of arriving at such an instrument may be time-consuming. In the meantime, the international community can come together to draft Model Agreements with ideal values ingrained to serve as a guide to the countries on Do's and Don'ts in a bilateral Agreement.

> The awareness and adoption of technological solutions like this is essential at this juncture as the damage caused by the cybersecurity slips may be irreversible, and may even undo the progress attained by the DPIs.

The salience of such an instrument comes from the range of flexibility it allows. For instance, these agreements can be drafted at the regional level with a recommendatory tone, allowing countries to add their specific conditions. Such an agreement can evolve to become a more accepted international norm, where violation of its principles may be tracked easily. It will also guide the countries having less experience with the DPIs on the essential elements to protect their interests in the agreements.

4 Technical Safeguards by Design-Zero Knowledge tech

The DPIs are essentially technologies applied towards public utility, and like any other technology, can be vulnerable to misuse.

There are already instances of data breaches from around the world and by 2025, these data breaches may cost the world an annual sum of

$10.5 TRILLION

(Cybercrimemag. 2021) Thus, before we build on the new and existing structures, we must consider the need for in-built safety gears within these structures to ensure the resilience of the DPIs.

The solution may lie in small due-diligence-oriented changes like an in-built Zero-knowledge Technology Model. These are cryptic frameworks which reveal only essential information to the system ensuring minimal information leakage while conducting a transaction. The modular nature of this framework being flexible to be used at the structure as well as application level makes it a suitable candidate for adoption into DPI stacks.

The awareness and adoption of technological solutions like this is essential at this juncture as the damage caused by the cybersecurity slips may be irreversible, and may even undo the progress attained by the DPIs. More importantly, these solutions can bring the element of trust into the ecosystem of DPIs which is essential to create public components of these structures.

> Thus, there is a need to rely on strengthening the institutionalism in offices handling DPIs, to enable consistency in development.

## 5 Accountability and Feedback Mechanism

As we prepare for a world comfortable with digital governance, the lessons point towards a want of certainty in terms of accountability. The very nature of infrastructures makes accountability difficult as the political and other public offices around the world have different persons at different times making the continuity challenging. Yet, such continuity is necessary, especially in the case of the DPIs, because time is of the utmost essence in the field of technology. Thus, there is a need to rely on strengthening the institutionalism in offices handling DPIs, to enable consistency in development.

Accountability and feedback are not difficult to install in the design of the DPIs as many examples from the public services are increasingly using these tools to improve upon service delivery. However, effectively building the institutional mechanisms can be challenging, considering the scale of DPIs.

6 Robust Legal and Policy Framework

The DPIs are systems designed to operate within society and are largely built as a tool for catering to civic needs. From the experience of countries with successful DPI structures, the legal and regulatory mandate behind the creation of such a structure appears necessary. It is to ensure the maintenance of civic nature and compliance with the respective laws while developing these structures since the very inception. While taking on projects related to infrastructures with long gestation periods, the policy evolves with experience, and if a generic framework is used to govern these, it can deviate from the actual purpose of the infrastructures.

The framework must consist of laws mandating the establishment of digital public infrastructures, institutions overseeing compliance and policy adherence, and adjudicating authorities preferably with expertise in the domain of technology to address any disputes. One prominent example of the first two components can be seen in India, where the Aadhar Act and UIDAI enabled the diligent development of DPIs from the very early stages. As per the judicial intervention, the Indian Supreme Court did effectively perform the role of an adjudicator. The court intervened after a petition was received and examined the constitutional validity of the Aadhar Act.
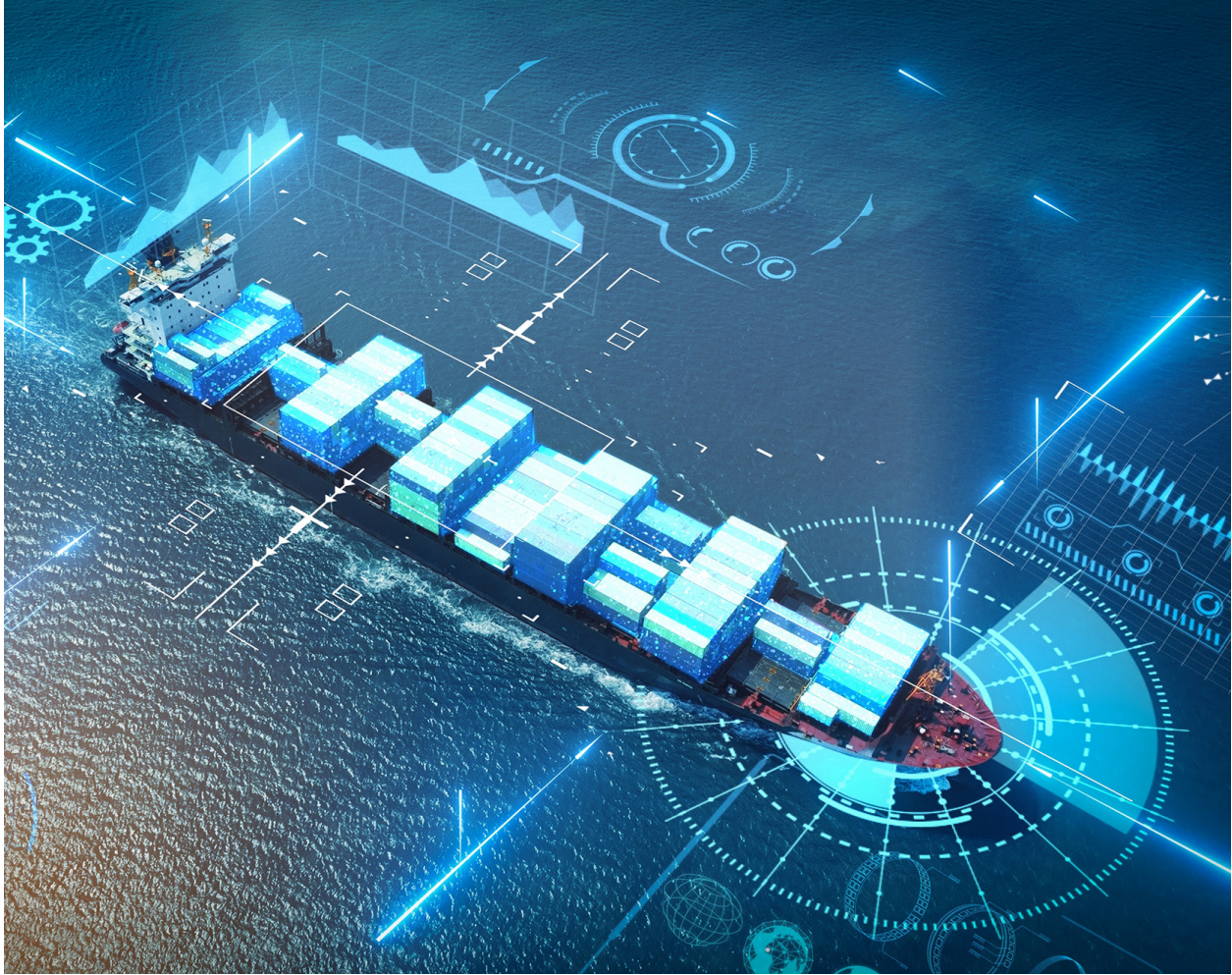
However, as the DPIs become more integrated and countries develop more use cases, the need for an adjudicator can not be ignored. Most countries are dealing with the issue of litigation pendency, establishing a norm of dedicated judicial or quasi-judicial authority which can be tasked with defending civic rights, dispute resolution, and adjudication of DPI-related matters.

7 Regional Uniformity- interoperability

 DPIs are being developed in a world where the world has fewer boundaries and more integration, especially in terms of information and data exchange. Global trade is ever expanding and with the growth of multinational entities, it is expected to grow more. Having this context, any structure being developed in any country needs the element of interoperability to allow the transition to digital services. Similar to how creating single trade markets for a group of countries enables more influx of trade, the interoperability of the DPI systems across countries, even if within a region, would certainly reduce the compliance cost for the stakeholders involved, attracting more participation and willingness to adhere to the rules.

However, at present, envisioning uniformity in a new domain such as DPIs which are at a nascent stage might need a closer consideration. There is a need to actively seek platforms where some level of integration and uniformity can be achieved without being confronted with the interference of too many actors. Such a type of consensus can emerge at regional multilateral platforms, as there is a better understanding of the geography, economy, and priorities. While there are certain regions like South Asia which lack such mature regionalism, most other parts of the world have demonstrated a sophisticated level of regional cooperation where the trust deficit is less, and thus policymaking can be more successful.

8 Funding Instruments- Social Impact Bonds

As stated, the resources involved in developing the DPIs are immense and may be outside the capacity of many countries. As seen in the environmental discourse, this may pose a significant constraint on their part to develop sustainable solutions. Historically, sourcing funding has not only been challenging for the developing world but has also led to compromise on the sovereignty of smaller nations. Perhaps keeping this issue in mind, the 2023 G20 summit decided to establish a Social Impact Fund to enable a better financing model for the developing world.(PIB 2023)

Similar to technical safeguards, financial tools need to be crafted and adopted in order to channel funds for the governments of multiple nations to initiate and sustain these projects with long gestation periods. Drawing on examples from other global issues, Government-issued Bonds can be one of the potential solutions to this issue. As these instruments allow the investors to be engaged with varied commitments, these can also be modified according to the needs and context of the entity investing. To illustrate, Social Impact Bonds have seen success in the past in projects of this nature, (Walker, T et all 2023) which when combined with the other recommendations, can increase the availability of capital for the countries to take forward the DPI-related endeavours with autonomy.

9 Index or alike tools

In the earlier chapters, we discussed more than 30 countries have some level of DPI-related developments ongoing in the domestic jurisdictions, and the DPI-related discussions being conducted on various multilateral fora. However, the only repository available on the DPI related practices features 14 countries and the EU. This clearly highlights the need for information to be consolidated for the stakeholders to make informed choices.

In recent times, indexes have seen a greater utility in tracking the progress of countries on various issues. While it is the most known function of the indexes, with minor modifications, they can integrate within it a repository of best practices. They can also highlight specific issues related to specific regions, prompting early action. An issue as complex as the DPI can also benefit from an index in multiple ways, as it can help countries identify the trends, emerging issues etc.

Perhaps keeping this issue in mind, the 2023 G20 summit decided to establish a Social Impact Fund to enable a better financing model for the developing world.(PIB 2023)

APPENDIX

1.   11 'First-Mover' Countries Launch 50-in-5 Campaign to Accelerate Digital Public Infrastructure Adoption around the World. (n.d.). UNDP. https://www.undp.org/news/11-first-mover-countries-launch-50-5-campaign-accelerate-digital-public-infrastructure-adoption-around-world

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