Digital Cooperation Organization

Access Partnership

Digital Public Infrastructure:

A Key Building Block for Social Inclusion and Economic Development

Policy Paper

FOREWORD

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The Digital Cooperation Organization

Digital Public Infrastructure (DPI) represents a transformative foundation for digital economies worldwide, with profound potential to accelerate sustainable development and enhance social equity. By enabling secure, inclusive, and interoperable digital ecosystems, DPI serves as a critical enabler for both public and private sector innovation and service delivery, fostering broad-based economic growth and social progress.

This joint policy paper by the Digital Cooperation Organization (DCO) and Access Partnership delves deeply into the strategic role of DPI, highlighting its capacity to bridge gaps in financial inclusion, gender equality, and digital access. DPI frameworks—encompassing digital identity, payment systems, and data exchange platforms—are pivotal in creating resilient, transparent, and inclusive societies, ensuring everyone can benefit from digital transformation.

Drawing insights from global best practices and real-world examples, including the pioneering efforts of DCO Member States such as Saudi Arabia and international benchmarks like India's robust "India Stack," this paper also outlines practical strategies and actionable policy recommendations. It addresses significant challenges, including data privacy, regulatory complexities, interoperability barriers, and sustainable financing models, offering pathways to overcome these issues through progressive policymaking, effective governance, and robust public-private collaboration.

Recognizing the critical role of DPI in achieving the UN Sustainable Development Goals, this policy paper underscores the importance of strategic investments in digital skills, infrastructure, and accessibility to ensure no one is left behind in the digital transformation journey. Moreover, it emphasizes the value of transparent governance mechanisms, accountability, and trust-building measures as foundational elements in implementing effective DPI systems.

As we navigate a rapidly evolving digital landscape, it is no longer enough to align with international frameworks—we must act boldly to translate them into real-world solutions. The principles set by the UN and G20 provide a foundation, but their success depends on our collective resolve to build scalable, inclusive, and secure digital infrastructure that leaves no one behind. This policy paper offers more than insights—it provides a clear pathway for implementation, grounded in global best practices and shared responsibility. Let it be a catalyst for meaningful cooperation across borders, sectors, and communities.

Together, let us turn ambition into action and advance a future where digital public infrastructure empowers individuals, strengthens societies, and delivers inclusive prosperity for all.

FOREWORD

Greg Francis
Executive Vice Chair
Access Partnership

Digital public infrastructure (DPI) is hard work: it's consistently beneficial, but where it confers benefit may not be. It promises greater inclusion, economic growth, and more efficient governance, but only when it grows out of a thoughtful vision. Easy re-treads of rules written for yesterday's technologies won't provide DPI that serves everybody – especially those who have been historically excluded. Good DPI is challenging, but very much worth it.

At Access Partnership, we help build and enable innovation while safeguarding the public interest. This paper underscores the importance of that and of properly strategic DPI implementation, and draws on global best practices to offer a blueprint for sustainable and scalable digital infrastructure. In our experience globally, it is interoperability, secure data, and inclusive access that allow governments and the private sector to create baseline DPI frameworks that empower societies and drive economic progress.

The Digital Cooperation Organization has been a leader in championing uptake of best practice, and of uniting member states around a shared vision for digital inclusion. As the international community navigates the complexities of DPI, that collaboration across borders, industries, and communities will be essential. We salute the DCO for that work and look forward to shaping the outcomes – the thoughtful vision – that turns DPI into a catalyst for lasting and equitable development, worldwide.

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EXECUTIVE SUMMARY

Digital infrastructure in general, and Digital Public Infrastructure (DPI) in particular, is increasingly recognized as a foundational enabler for both public and private sector service delivery. Key actors driving this narrative include international organizations such as the UN Development Programme (UNDP), the G20, the Digital Cooperation Organization (DCO), and the International Telecommunication Union (ITU), among others.

The international community promotes DPI as an essential element the transformation of societies, as it supports the creation of digital networks that enable economic opportunities and improve public service delivery. Moreover, DPI plays a role in fostering innovation, competition, and closing gaps in gender and financial equality by leveraging digital platforms for services and transactions across the public and private sectors.

Organizations in the private sector and civil society initiatives such as the Gates Foundation and the Carnegie Endowment for International Peace also highlight the importance of DPI[1]. They advocate for interoperable, secure, and inclusive digital infrastructure to support both public services and private sector innovations. DPI is seen as crucial for creating resilient digital economies and improving governance, technology, and market integration, globally.

In the public sector, for example, DPI improves healthcare delivery, streamlines social services, and enhances tax compliance. In the private sector, DPI facilitates personalized financial services, innovative payment solutions, and improved customer experiences. By fostering interoperability and data integration, these systems drive innovation and efficiency, benefiting citizens and consumers.

Successful DPI generates significant spillovers and benefits across various sectors. It connects people to economic opportunities, enhances digital inclusion, improves education and healthcare, fosters greater social, economic, and gender inclusion, and promotes digital literacy. These outcomes contribute to broader economic growth and social equity, leading to more resilient and inclusive societies. The strategic implementation of DPI is crucial for harnessing these benefits and driving sustainable development.

While DPI offers numerous benefits it also presents significant challenges. These include concerns related to data sovereignty, privacy and data security, the digital divide and accessibility, regulatory and legal hurdles, interoperability and technical challenges, as well as sustainable funding and investment.

Fostering reliability, security, and trust through effective policies, robust regulatory frameworks, significant investment in infrastructure, and a commitment to inclusive digital transformation is necessary to overcome these challenges and fully realize the benefits of DPI.

By leveraging definitions and frameworks from the UN and G20, nations and organizations can align their strategies and collaborate on implementing inclusive, secure, and scalable digital infrastructure. These efforts will contribute to a cohesive global approach to digital transformation, ensuring that DPI initiatives are effective, equitable, and sustainable.

This policy paper explores DPI, its opportunities and challenges, presents a framework to scale DPI adoption globally, and provides actionable recommendations for policymakers.

01

The Social and Economic Opportunity of Digital Public Infrastructure

THE SOCIAL AND ECONOMIC OPPORTUNITY OF DIGITAL PUBLIC INFRASTRUCTURE

Digital technologies are dramatically transforming our world. They offer immense potential benefits for the well-being and advancement of people and societies. They hold out the promise of accelerating the achievement of the UN Sustainable Development Goals.[2]

Digital Public Infrastructure (DPI) is a key building block in the provision of technology-powered digital services, offering significant social and economic opportunities. Specifically, the UNDP highlights that DPI can enable:

A 20-33% potential acceleration in economic growth by 2030 through financial DPI.

A 4% carbon emission reduction for low- and middle-income countries through carbon trading DPI.

A 28-42% potential increase in access to justice by 2030 through faster case management and reliable online dispute resolution.[3]

DPI has a further impact on inclusion, participation, and innovation, as detailed below.

a. Inclusion

Elements of DPI such as national digital ID systems allow residents and citizens to verify their identities, which in turn enables full participation in the economy and ease of access to employment and education as well as services such as government programs and healthcare.

This is particularly important as the World Bank estimates that more than 850 million people globally do not have an ID. [4]

Similarly, the International Labour Organization (ILO) estimates that more than 2 billion people work informally, with significant implications for Gross Domestic Product (GDP).[5] DPI, in particular digital payments systems, integrate more people into the formal economy, boosting financial inclusion and expanding national productivity gains.

For example, India's Aadhaar platform provides biometric IDs to over a billion people and has significantly improved access to financial and government services.[6]

Estimates indicate $66 billion in savings through the elimination of fraud and duplication of government programs, more than $5 billion in benefits distributed digitally, and 4 billion transactions between 2009-2021.[7]

Gender Equity

Directly linked to inclusion, DPI can be a powerful tool to enhance gender equality by reducing the barriers that hinder women's participation in economic activities.

For example, 54% of the 1.4 billion adults worldwide who remain excluded from formal financial services are women.[8]

Through simple and interoperable society-wide digital payment systems linked to a unique digital ID, women in underserved areas can gain access to a myriad of financial services and achieve financial independence.

b. Political and Economic Participation

Increased participation is directly linked to expanded inclusion. DPI offers renewed opportunities for direct communication between governments and citizens. For example, Estonia's i-Voting system, allows citizens to vote remotely in elections or referenda, improving democratic participation. It is worth noting that DPI also increases transparency, and, as a result, countries witness growing levels of commercial activity as the ease of doing business improves, enabling compounded foreign direct investment (FDI), which is echoed by the World Bank.[9]

Saudi Arabia's Etimad platform is a good example of a DPI tool designed to streamline and digitize government procurement, making it easier for businesses to engage with government projects.[10]

c. Innovation

Interoperable and modular DPI tools such as e-payments and their its underlying infrastructure lower barriers to entry for startups, allowing entrepreneurs and innovators to connect easily to these systems and launch businesses quicker and at a lower cost, with an impact on innovation and creativity.

For example, the API Exchange (APIX) platform – founded by the Monetary Authority of Singapore, the ASEAN Bankers Association, and the International Finance Corporation – demonstrates how DPI can foster innovation in the fintech sector.[11]

The platform has enabled 134 financial institutions to connect with fintech firms across 100 countries, accelerating the development of new financial products and enabling financial inclusion.

It also offers a secure environment for testing and experimenting with various fintech solutions before full implementation. This open architecture platform exemplifies how DPI can create an ecosystem that nurtures innovation, facilitates collaboration between established institutions and startups, and ultimately drives the development of novel financial solutions tailored to diverse market needs.

Furthermore, Brazil's Open Finance initiative is a comprehensive framework designed to enhance financial inclusion, foster competition, and promote innovation in the financial sector. It is part of the broader effort to develop DPI in the country. Launched by the Central Bank of Brazil, Open Finance builds on the foundations laid by the Open Banking system, expanding the scope to include a wider range of financial services.[12] This example represents a significant advancement in DPI in Brazil, aiming to create a more inclusive, competitive, and innovative financial ecosystem.

02
Definitions, Policy Approaches, and Global Best Practices

DEFINITIONS, POLICY APPROACHES, AND GLOBAL BEST PRACTICES

DPI today is more comprehensively understood as a platform that facilitates the provision of public and private services within societies. In simpler terms, DPI is similar to roads, which form a physical network essential for people to connect with each other and access a wide range of goods and services.

2.1 Definitions

Several stakeholders have attempted to define DPI, including the G20 and UNDP:

G20 Digital Economy Ministers defined DPI as "a set of shared digital systems that should be secure and interoperable and can be built on open standards and specifications to deliver and provide equitable access to public and/or private services at societal scale and are governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, and competition as well as respect for human rights and fundamental freedoms."[13]

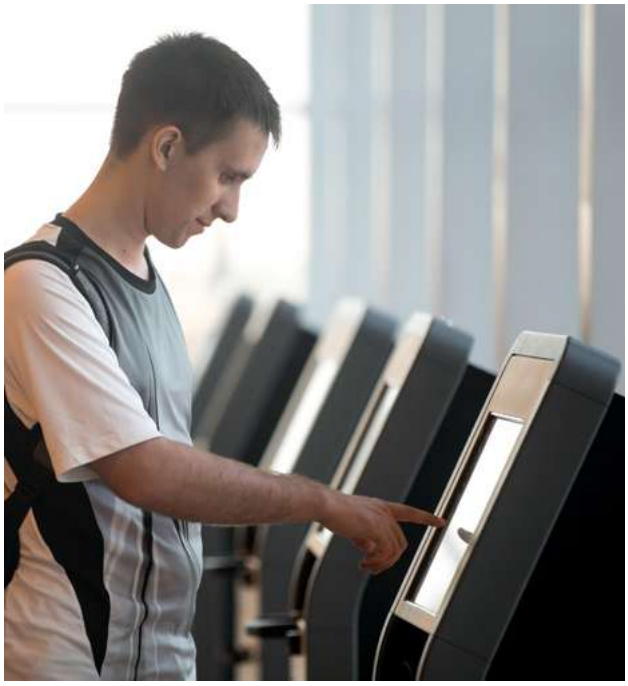
The UNDP defines DPI as "an evolving concept combining

I. Networked open technology standards built for public interest

II. Enabling governance

III. A community of innovative and competitive market players working to drive innovation, especially across public programs."[14]

From the existing definitions, we can conclude that the development and deployment of DPI encompasses several layers:



1. **The physical layer,** which includes critical components such as connectivity infrastructure, electrical grids, and data centers.

2. **The digital layer,** which builds on the physical foundations and incorporates key elements (systems/services) such as digital ID, payment systems, and data exchange platforms, to enable the secure and efficient flow of information.

3. **The domain layer,** localizing sector-specific solutions, such as payment platforms, healthcare systems, and civil registration functions among others.

4. **The public services layer,** such as citizen and business-facing applications, including electronic passport and visa renewals, online land title registrations, permit applications, and digital banking services, making public and private service delivery more accessible, efficient, and secure.

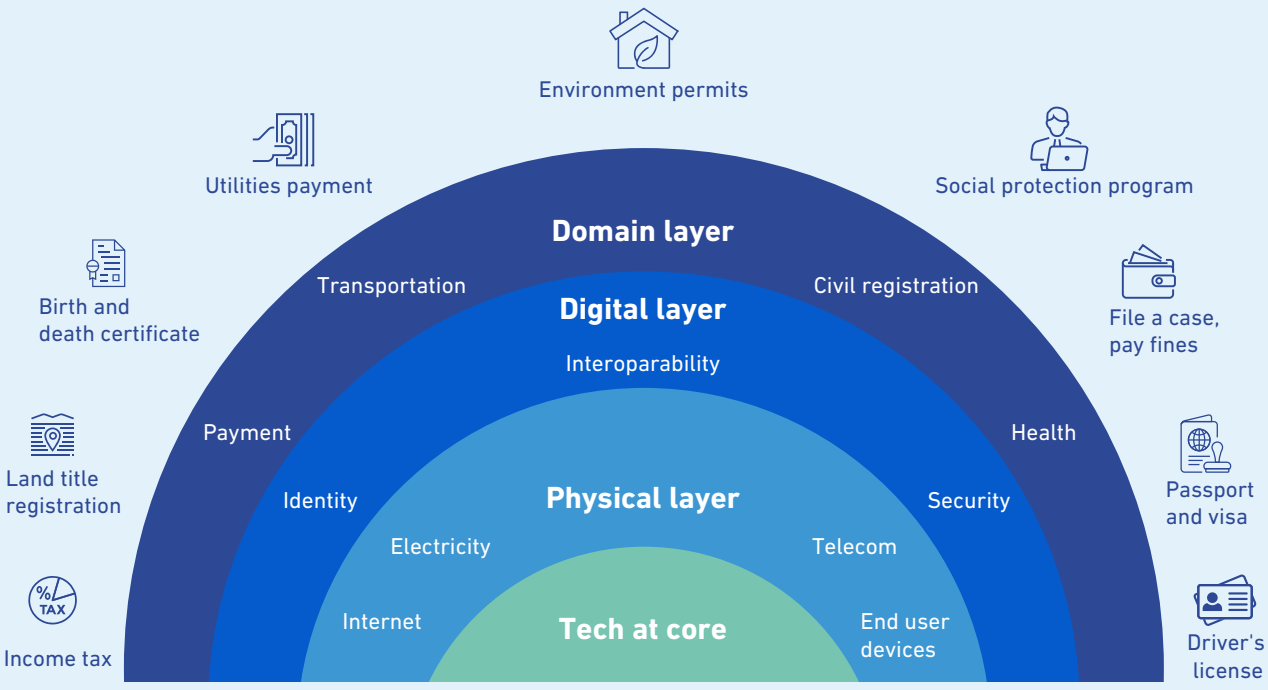


Figure 1: DPI Layers

Source : https://www.thoughtworks.com/en-au/insights/blog/platforms/digital-public-goods-platform-citizen-services

2.2 DPI in Practice

Case Study 1: Saudi Arabia

Saudi Arabia offers a good example to aid the understanding of DPI and associated physical infrastructure in practice. To begin with, through its Vision 2030 and the National Transformation Program, the Kingdom has:

- Earmarked significant resources toward enabling a connected nation for a thriving digital economy.

Then, to strengthen the physical layer, the Kingdom has:

- Allocated or improved access to more than 23 GHz of spectrum, enabling near - universal connectivity and facilitating the deployment of 5G networks and Fiber to the Home (FTTH).
- Offered substantial incentives to cloud service providers with the launch of Cloud Computing Special Economic Zones, resulting in enhanced capacity for cloud-based public/private service delivery.
- Boosted basic infrastructure with investments in the national electricity and energy grids, as well as healthcare, financial services, and transportation.

Moreover, at the digital layer, the Kingdom has developed:

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The Nafath service, enabling citizens and residents to verify their identities through a secure and reliable unified access point.

The Absher portal, as a building block for the incorporation of a wide range of public and private services.[15]

سداد SADAD Payment App

SADAD[16], a centralized system for secure government and private digital payments.

Advanced APIs ensure the interoperability and security of such tools so that after verifying an identity using Nafath, one can access services through Absher, and pay for these services utilizing SADAD, seamlessly.

إيجار EJAR

Finally, the domain and public services layers are bridged through sector-specific and citizen/business-facing applications such as electronic passport and visa renewals, online land title registrations, permit applications, and digital banking services. For example, "EJAR" is a complete electronic network that aims to organize the real estate leasing sector in the Kingdom. It is designed to protect the rights of tenants, landlords, and real estate brokers involved in leasing activities. "EJAR" offers electronic solutions that help develop and streamline the real estate leasing sector, promoting balance, trust, and investment.[17]

Case Study 2: India's DPI Approach

India's implementation of DPI, known as the "India Stack," is one of the most comprehensive and successful DPI implementations globally.[18] Built on four key technological layers, this system has transformed how citizens interact with government services and participate in the digital economy. The India Stack comprises four main components: digital identity products, a payments interface for digital payments, a data governance architecture, and open networks. These layers interact to create a robust digital infrastructure that enables seamless service delivery and fosters innovation across various sectors. This comprehensive approach to DPI has transformed government service delivery and created new opportunities for innovation and economic growth.

Aadhaar

The Aadhaar system, managed by the Unique Identification Authority of India (UIDAI), is one of the world's largest biometric identification systems.[19] , Aadhaar aims to provide every Indian resident with a unique identity number, facilitating access to a range of public and private services. It thus provides biometric IDs to over a billion people and has significantly improved access to financial and government services. Aadhaar is integrated with various government schemes and services such as subsidies, pensions, and healthcare, ensuring efficient and targeted delivery. The system is also used for opening bank accounts, facilitating direct benefit transfers, and enhancing access to financial services, thereby promoting financial inclusion.[20] By leveraging biometric technology and digital platforms, Aadhaar has improved the efficiency, transparency, and accessibility of services, driving economic and social benefits. However, addressing privacy concerns and ensuring inclusive access remain critical to its continued success.

DigiLocker, a key component of India's DPI, is a government-operated digital document storage and verification service. Linked to Aadhaar, DigiLocker allows users to securely store and access documents such as driver's licenses, diplomas, and insurance policies. With over 4.6 billion documents issued by 1,460 institutions, DigiLocker has streamlined document verification processes. The platform also enables 233 integrated requesters to verify user documents with consent, enhancing efficiency in both public and private sector services. Available as both a mobile and web application, DigiLocker exemplifies how DPI can improve governance and reduce bureaucratic friction for citizens.[21]

Case Study 2: India's DPI Approach

Unified Payments Interface

The Unified Payments Interface (UPI), launched by the National Payments Corporation of India (NPCI), has transformed India's digital payment landscape. As a real-time mobile payments system, UPI enhances financial inclusion and enables citizens to participate in the digital economy. UPI operates on a three-tier architecture:

1. The public payment rails provided by NPCI for routing payment messages;

2. Regulated banks that hold user funds; and

3. Fintech applications that access the system.

This structure allows interoperability among financial institutions. The rapid adoption of UPI is due to its superior user experience compared to traditional payment methods. Users can make real-time payments directly from their bank accounts without intermediaries, utilizing a UPI PIN for security and Virtual Payment Addresses for added flexibility.[22] By empowering millions of smartphone users to transact digitally, UPI has become a cornerstone of India's DPI, driving economic growth and fostering innovation in the fintech sector.

Data Governance Architecture

The Data Empowerment and Protection Architecture (DEPA) enables secure, privacy-protected data transfer while empowering individuals with control over their personal information. DEPA has three pillars: the Personal Data Protection Bill; an electronic consent artifact, and regulated entities known as "consent managers" which facilitate consented sharing of financial information in real-time.

Open Networks

There are currently two implementations of open networks – the Open Network for Digital Commerce and the National Digital Health Mission.[23] The former supports the easy transmission of credit to consumers and businesses, and the latter is an open network for consumers to securely share their health data with an ecosystem of healthcare apps and providers.[24]

The Saudi and Indian case studies provide a framework for scaling DPI as detailed below.

2.3 Framework for Scaling DPI

First, DPI commitments must be codified in forward-looking and ambitious **strategies** supported by progressive **policy-making** that promotes a multistakeholder approach to DPI development and deployment. Examples of demonstrating the link between DPI strategy and policy include:

01 The European Union (EU)'s eGovernment Action Plan [25] , which seeks to modernize public administrations and provide interoperable digital services across the EU, and the European Data Strategy, which focuses on creating a single market for data, promoting data-driven innovation while ensuring high standards of privacy and security.[26]

02 The United Kingdom's (UK) Government Digital Service (GDS), and its GDS 2021-2024 strategy which oversees the design, implementation, and maintenance of the digital infrastructure supporting government services.[27] The UK's DPI strategy focuses on establishing a resilient and secure digital framework that enables the efficient delivery of essential public services, including healthcare, education, and transportation.

03 Colombia's Vive Digital Plan focuses on expanding broadband infrastructure, improving digital literacy, and fostering a digital economy. This plan includes significant investments in Information and Communication Technology (ICT) infrastructure, the allocation of more spectrum for mobile services to increase the availability of digital services, and improvements in the accessibility and efficiency of e-government services.[28]

Secondly, **Investing** in the physical layer underpins the success of **DPI strategies and policies.** Across DCO Member States, this is evident in Cyprus, Greece, Jordan, Kuwait, Morocco, Nigeria, and others' efforts to boost last-mile connectivity and upgrade basic infrastructure grids. Public investments play a crucial role in the development and scaling of DPI. Governments often provide the initial capital and ongoing funding for core DPI components. For example, India's government invested heavily in the development of Aadhaar. There is also a need for continuous investment in education and digital upskilling to support DPI projects.[29]

Public-Private Partnerships (PPPs) offer a valuable model for DPI investment. PPPs can leverage private sector expertise and resources while maintaining public oversight. The scope of PPPs in DPI can range from infrastructure development, such as broadband networks, to the creation and maintenance of digital platforms, such as e-government services. For instance, as mentioned below, Estonia's X-Road, a data exchange layer for the country's e-services, was initially developed with public funds but is now maintained through a PPP model.

Thirdly, across the digital and domain layers governments must ensure **interoperability** and guarantee the **security** of data through regulatory frameworks such as open data regulations and personal data protection laws to safeguard citizens' information while facilitating data-driven innovation. Examples include:

01 **Brazil's Gov.br** platform, which offers over 4,200 digital services, including digital ID and e-government services, to over 156 million users.[30]

02 **Hukoomi,** Qatar's official e-Government portal, which is designed to provide a wide array of government services to citizens, residents, and businesses online.[31]

03 **Ghana Card,** a biometric national ID that facilitates access to various government services.[32]

Interoperability must be accounted for at four different levels: technical, organizational, legal, and semantic, as per the European Interoperability Framework.[33]

Equally important is empowering users with agency over their **personal data.** This can be achieved through mechanisms such as consent management systems. **Privacy** must be protected through comprehensive regulations, such as the EU's General Data Protection Regulation, which sets standards for data protection and user rights. Governance frameworks should include oversight bodies, regular audits, and transparent reporting mechanisms to ensure adherence to privacy and security standards. For example, India's DEPA aims to give citizens control over their data while enabling its secure and consensual sharing for various services.

Finally, scaling DPI involves expanding the reach and adoption of DPI components, including adapting them to local contexts. This process often occurs in phases and requires ongoing refinement based on user feedback and technological advancements. Examples of successful DPI scaling include:

01 **India's UPI:** Starting with 21 banks in 2016, UPI now processes billions of transactions across more than 550 banks integrated into the UPI framework.[34] Its success is attributed to its open architecture, allowing easy integration for new players.

02 **Estonia's e-Residency:** This program allows non-Estonians to access Estonian services digitally. It has scaled to over 118,900 e-residents from 180 countries, demonstrating how DPI can extend beyond national borders.[35]

There are various critical success factors for successful DPI scaling:[36]

01 A clear strategic vision and timeline planning.

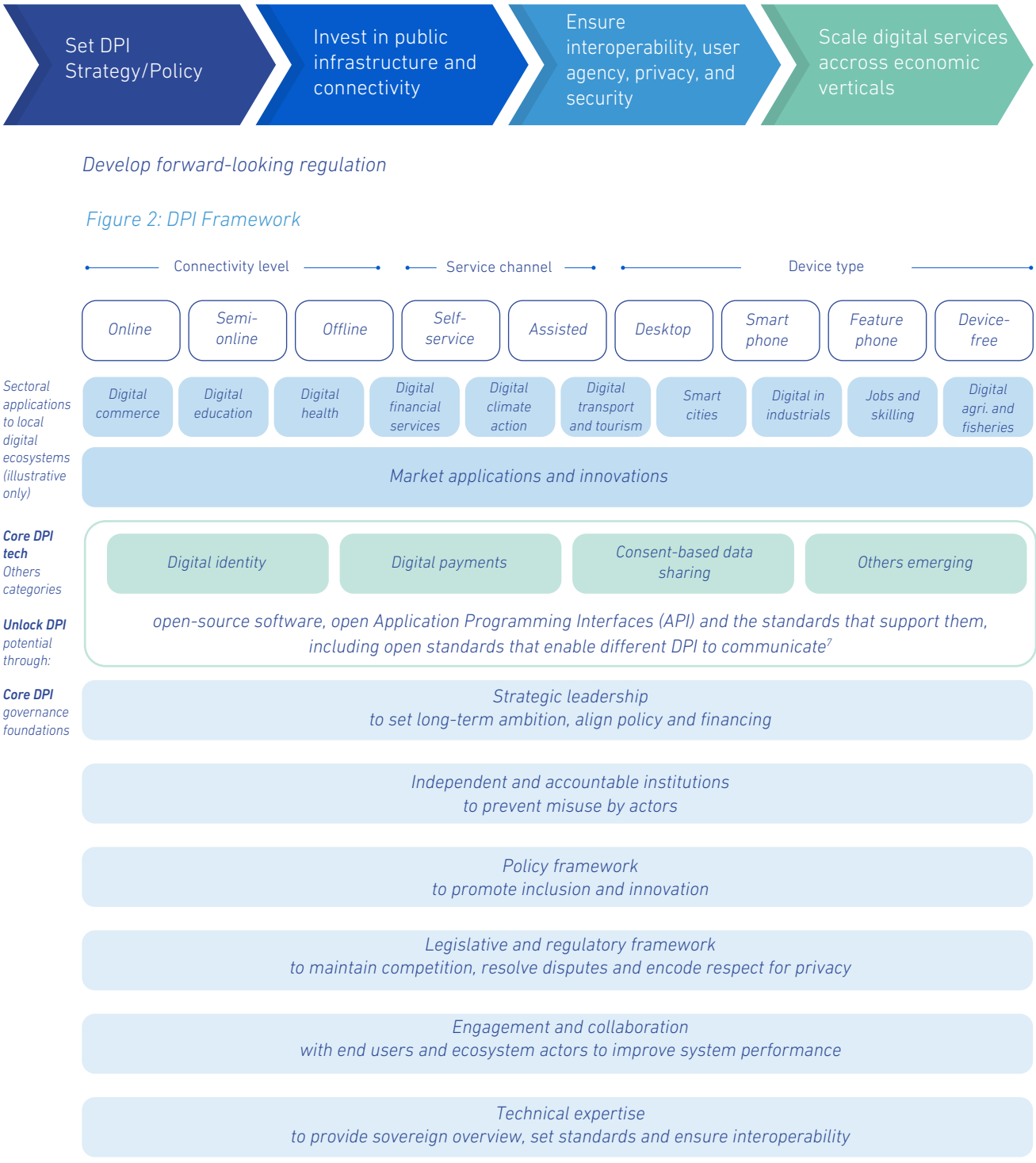
02 Alignment with governmental policies and strategies.

03 Partnership and collaboration, including clear contractual agreements between public and private sector stakeholders.

04 Financial sustainability, including private sector investment.

05 Contractual duties and outsourcing, including clear requirements and scope for projects.

06 Smart integration, including interoperability and incorporation of smart technologies and ensuring seamless integration with existing infrastructure.



Source: UNDP. Accelerating the SDGs through Digital Public Infrastructure.

Figure 3: A Framework to Understand the DPI Approach

2.4 Measuring DPI Implementation

Several indices and scoreboards benchmark the progress of countries in DPI by evaluating various metrics that speak to the digital ecosystem more broadly, and are closely related to aspects of DPI, such as digital maturity and readiness, connectivity, inclusion and accessibility, digital regulation, and digital finance.

For example, the DCO's Digital Economy Navigator (DEN) offers a global assessment tool that enables countries to better understand the path toward digital maturity, find opportunities for growth, and benchmark progress over time.[37] With the DPI framework in mind, DEN showcases that:

01 Enhancing internet speeds and promoting affordability through competitive market policies are key priorities, despite global progress on digital infrastructure.

02 ICT skills need further development, especially among underserved populations if citizens and businesses are to fully utilize services offered through DPI.

03 Increased focus on establishing and regulating the digital environment for effective governance is required. This encompasses the regulatory framework and fundamental administrative operations necessary for the efficient functioning of digital activities within a country.

The EU's Digital Economy and Society Index (DESI) offers an alternative measurement tool, benchmarking digital performance across connectivity, digital skills, technology integration, and public services.[38]

03

Challenges and How to Address Them

CHALLENGES AND HOW TO ADDRESS THEM

DPI creates endless economic and social possibilities, as demonstrated above. However, several challenges also exist.

Privacy and Data Security

The extensive collection of personal data within DPI raises significant privacy concerns. If improperly managed, this data can fall into the wrong hands, leading to identity theft, surveillance, and exploitation. Regulatory bodies play a crucial role in ensuring the security, privacy, and interoperability [39] of DPI initiatives.

By implementing and continuously updating robust policy frameworks and regulatory environments, regulatory authorities can help protect personal data from misuse, secure critical infrastructure against cyber threats, and ensure seamless integration of diverse digital systems.

Digital Divide and Accessibility Issues

A key challenge is addressing existing accessibility issues and the widening digital divide, which can undermine the social and economic impact of DPI. For example, Sub-Saharan Africa (SSA) still has the largest coverage and usage gaps in the world.[40] According to the Global System for Mobile Communications Association, 180 million people (15%) in SSA are not covered and connected. A further 680 million people (59%) are covered but remain unconnected due to not having the means or devices to benefit from that coverage.[41]

While DPI aims to make public services more efficient and accessible, those without reliable internet access, digital literacy, or necessary devices may be left behind. This is particularly problematic for marginalized groups, such as low-income individuals, rural populations, and the elderly, who often face barriers to engaging with digital platforms.

By committing to bridging the digital divide and increasing digital literacy, governments (as well as the private sector) can ensure DPI is beneficial for all.

Interoperability and Technical Challenges

DPI systems rely on multiple platforms – such as digital identity, payment systems, and public services portals – working seamlessly together. However, a lack of interoperability between these systems can lead to fragmented user experiences, inefficiencies, and duplication of efforts, limiting the potential of DPI.

Additionally, technical challenges such as outdated infrastructure, system integration issues, and varying technical standards across sectors or regions can further hinder the smooth operation of DPI. Without addressing these challenges, governments risk creating siloed systems that cannot fully support the connected, efficient, and scalable digital ecosystem that DPI is intended to achieve.

Ensuring interoperability and resolving technical barriers are therefore critical to maximizing the strategic value of DPI. This can be achieved through public-private sector partnerships, under which governments can leverage privately developed APIs and similar tools to solve the interoperability dilemma.

Sustainable Funding and Investment

The effective rollout of DPI requires substantial and sustainable investment in basic infrastructure and recurring financing to ensure regular upgrades, system maintenance, and cybersecurity.

To ensure the resilience and scalability of DPI, a well-structured, sustainable financial model that includes public investment, private sector partnerships, and long-term cooperation with international organizations and donors is essential.

Estonia's X-Road platform demonstrates a sustainable funding model through:

01 Initial government investment

X-Road was initially developed by the Estonian government in 2001. The Estonian Government's State Information Systems Department commissioned Estonian software company Cybernetica to develop the initial pilot of X-Road.[42]

02 Usage-based fee structure

X-Road is designed to be scalable and supports a variety of services, which can include usage-based fees for accessing different data services. [43]

03 PPP for maintenance

The Nordic Institute for Interoperability Solutions (NIIS), a non-profit organization, handles the maintenance and development of X-Road.[44]

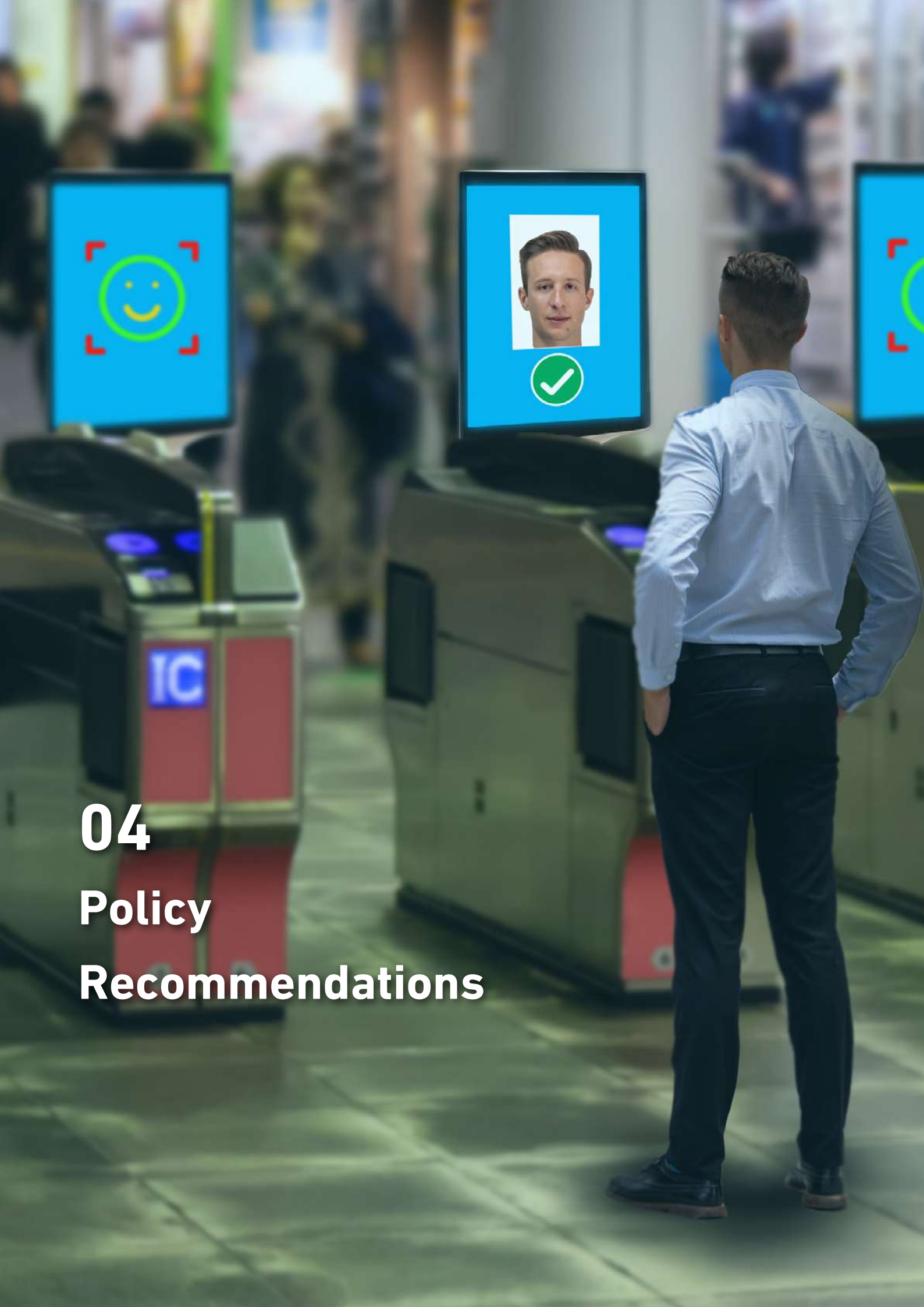
04 Cost-sharing among participating agencies

The distributed nature of X-Road allows various public and private sector organizations to share the costs of maintaining and operating the platform and helps the Estonian government with cost savings.[45]

05 International licensing revenues

X-Road has been adopted by over 20 countries and includes cross-border components through connected X-Road systems between Estonia, Finland, and Iceland.[46]

X-Road's open-source version is published under the MIT License, which allows for international collaboration and potential licensing revenues. [47] These elements combined ensure the long-term financial sustainability of DPI initiatives.



04
Policy Recommendations

POLICY RECOMMENDATIONS

Realizing the social and economic benefits of DPI requires a set of concrete policy actions, as outlined below:

01 Governments must codify DPI commitments in forward-looking and ambitious strategies supported by progressive policymaking that promotes a multistakeholder approach to DPI development and deployment.

02 Governments must complement DPI initiatives with DPI-enabling frameworks to enhance societal and economic progress by providing equitable access to public and private services.

03 Governments must arrange funding for connectivity and basic infrastructure as key building blocks in the development and deployment of DPI. Substantial efforts are required to maintain and boost investments in bridging the digital divide and the associated accessibility and skills gaps. This can be done through fostering public-private partnerships to serve as a vital funding avenue, enabling governments to leverage private sector expertise, innovation, and financial resources to complement public investments and accelerate progress in achieving inclusive and sustainable digital infrastructure.

04 Governments must adopt good governance and enforcement mechanisms for successful deployments of DPI built on the foundations of trust, accountability, and transparency.

05 Governments and private sector stakeholders must collaborate for the technical development of DPIs to ensure transparency, interoperability and sustainability by design, which requires multistakeholder participation.

06 Governments, private sector stakeholders, international organizations, and donors must all be included in DPI development to ensure its resilience and scalability.

As such, the main DPI stakeholders are public sector organizations such as ministries; private sector authorities such as tech companies, academic and research institutions, and citizens as the recipients of services and information.[48]

Table 1 below outlines in more detail their key roles and responsibilities and highlights the collaborative efforts required to ensure the successful promotion, development, and implementation of DPI solutions.

The table also outlines collaboration partners, as stakeholder interaction is a key factor for successful DPI implementation.

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
Strategic Integration of DPI	Develop and implement comprehensive national DPI strategies aligned with development goals	Align business strategies with national DPI frameworks	Create enabling regulatory environment	International organizations (World Bank, UNDP, ITU), tech companies, industry associations, academic institutions
	Establish clear governance frameworks and implementation timelines	Invest in compatible technologies and systems	Invest in compatible technologies and systems	
	Allocate budgets for DPI initiatives	Contribute expertise to strategy development	Ensure compliance with standards	
	Prioritize equitable and easy access for public and private entities to promote competition			

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
DPI-Enabling Frameworks	Create comprehensive legal frameworks for DPI deployment	Ensure DPI is designed using open technical standards and embeds flexibility to adapt to evolving technologies and changing public needs	Monitor framework effectiveness	Legal experts, standards organizations, consumer protection groups, cybersecurity firms
	Establish clear data governance guidelines	Develop solutions that align with frameworks	Update regulations as technology evolves	
	Develop interoperability standards	Contribute expertise to strategy development	Enforce compliance measures	

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
Infrastructure Investment	Prioritize connectivity infrastructure	Participate in infrastructure development through PPPs	Ensure fair competition in infrastructure development	Development banks, infrastructure investment funds, telecommunications companies
	Create incentives for private investment	Invest in last-mile connectivity solutions	Monitor service quality standards	
	Establish clear PPP frameworks	Share infrastructure where appropriate	Oversee pricing mechanisms	

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
Governance and Trust	Establish transparent governance mechanisms	Adopt transparent data practices	Enforce privacy and security standards	Privacy advocates, cybersecurity experts, civil society organizations, ethics committees
	Analyze lessons learned	Implement strong security measures	Build resilience and redundancy into DPI systems, possibly through decentralized data management, to avoid single points of failure, especially in cases of hacking and data breaches	
	Create public communication channels	Implement privacy-by-design principles in all DPI systems to protect user data from the outset	Investigate and address violations	
		Minimize personal data collection, adhering to the data minimization principle	Establish robust oversight and accountability mechanisms to ensure responsible DPI development and use	

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
Technical Development	Promote open technical standards	Contribute to standards development	Ensure standards compliance	Technology companies, research institutions, standards bodies, innovation hubs
	Fund research and development	Share technical expertise	Promote interoperability	
	Support innovation initiatives	Invest in innovative solutions	Monitor technical performance	

	Government Role	Private Sector Role	Regulators' Role	Collaboration Partners
Sustainable Financing	Develop contractual arrangements through public procurement processes	Develop innovative financing solutions	Ensure fair competition in infrastructure development	Financial institutions, development agencies, investment funds, economic experts
	Create incentives for private investment	Participate in PPP arrangements	Ensure fair pricing	
	Conduct market research before procurement	Share financial risks	Oversee requirements and scope for PPPs and projects	

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