SOUTH CENTRE

DPI for Democratic Data Monetization

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Abstract

Data monetization has long been discussed through narrow and fragmented lenses, often overlooking models that prioritize public value and shared benefit. While data is increasingly recognised as a strategic economic asset, conversations around its monetization have largely excluded approaches that empower individuals and communities alongside businesses. This paper proposes a more inclusive and development-centric model of data monetization enabled through Digital Public Infrastructure (DPI), referred to as DPI for Democratic Data Monetization (DPI-DDM). First, we define data monetization, explore its importance in today's digital economy, and trace its evolution, highlighting past approaches and their limitations. Second, we introduce the concept of DPI and articulate why it serves as an optimal foundation for equitable and democratic data monetization. We also outline the key drivers and precedents that have led to the emergence of DPI-DDM. Third, we present a comprehensive framework for DPI-DDM, detailing its foundational layers, potential revenue streams, and the multifaceted benefits it offers to individuals, institutions, and society at large. Fourth, we examine the key challenges in the rollout and implementation of DPI-DDM, including issues related to governance, capacity, and trust. We conclude with actionable insights and a forward-looking roadmap to operationalise DPI-DDM as a vehicle for data equity, economic opportunity, and digital democracy.

La monétisation des données fait l'objet de débats depuis longtemps à travers des approches étroites et fragmentées, qui négligent souvent les modèles privilégiant la valeur publique et le bénéfice partagé. Alors que les données sont de plus en plus reconnues comme un atout économique stratégique, les discussions autour de leur monétisation ont largement exclu les approches qui enforcent les individus et les communautés parallèlement aux entreprises. Cet article propose un modèle de monétisation des données plus inclusif et axé sur le développement, habilité par l'infrastructure publique numérique (IPN), appelé IPN pour la monétisation démocratique des données (IPN-MDD). Tout d'abord, nous définissons la monétisation des données, explorons son importance dans l'économie numérique actuelle et retraçons son évolution, en mettant en évidence les approches passées et leurs limites. Ensuite, nous présentons le concept d'IPN et expliquons pourquoi il constitue une base appropriée pour une monétisation équitable et démocratique des données. Nous décrivons également les principaux facteurs et précédents qui ont conduit à l'émergence de l'IPN-MDD. Troisièmement, nous présentons un cadre complet pour l'IPN-MDD, en détaillant ses couches fondamentales, ses sources de revenus potentielles et les avantages multiples qu'elle offre aux individus, aux institutions et à la société dans son ensemble. Quatrièmement, nous examinons les principaux défis liés au déploiement et à la mise en œuvre de l'IPN-MDD, notamment les questions relatives à la gouvernance, aux capacités et à la confiance. Nous concluons par des orientations pratiques et une feuille de route prospective pour opérationnaliser l'IPN-MDD en tant que vecteur d'équité des données, d'opportunités économiques et de démocratie numérique.

La monetización de datos se ha debatido durante mucho tiempo desde enfoques limitados y fragmentados, que a menudo pasan por alto modelos que priorizan el valor público y al beneficio compartido. Aunque los datos se reconocen cada vez más como un activo económico estratégico, los debates sobre su monetización han excluido en gran medida los enfoques que fortalecen a las personas y a las comunidades junto con las empresas. En este documento se propone un modelo de monetización de datos más inclusivo y centrado en el desarrollo, que se hace posible gracias a la infraestructura pública digital (IPD), denominada IPD para la monetización democrática de datos (IPD-MDD). En primer lugar, definimos la monetización de datos, examinamos su importancia en la economía digital actual y analizamos su evolución, destacando los enfoques anteriores y sus limitaciones. En segundo lugar, introducimos el concepto de IPD y explicamos por qué constituye una base idónea para una monetización de datos equitativa y democrática. Asimismo, identificamos los factores clave y los precedentes que han dado lugar a la aparición de la IPD-MDD. En tercer lugar, presentamos un marco integral para la IPD-MDD, detallando sus capas fundamentales, las posibles fuentes de ingresos y los múltiples beneficios que ofrece a las personas, las instituciones y la sociedad en general. En cuarto lugar, examinamos los principales retos en el despliegue y la implementación de la IPD-MDD, incluidas las cuestiones relacionadas con la gobernanza, las capacidades y la confianza. Concluimos con orientaciones prácticas y una hoja de ruta prospectiva para operacionalizar la IPD-MDD como vehículo para la equidad de datos, las oportunidades económicas y la democracia digital.

长**期以来**，**关于数据**货币**化的**讨论**始**终**囿于狭隘、零散的**视**角**，**往往忽**视了优先考虑公共价值与共享利益的模式。**尽管数据日益被**视为战略性经济资产，但围绕其货币化的讨论却基本排除了那些能同时赋能个人、社区及企业的方案。本文提出一种更具包容性且以发展为核心的数据货币化模式——**通**过数字公共基础设施（DPI）实现的民主化数据货币化（DPI-DDM）。**首先**，**我**们界定数据货币化的内涵，阐释其在当今数字经济中的重要性，追溯其发展历程，并剖析过往模式及其局限性。**其次**，**我**们引入数字公共基础设施(DPI)**的概念**，阐明其为何能成为实现公平民主数据货币化的理想基石。同时概述推动通过数字公共基础设施实现的民主化数据货币化**模式** (DPI-DDM)诞生的关键驱动力与先例。第三，我们提出通过数字公共基础设施实现的民主化数据货币化模式 (DPI-DDM)**的**综合框架，详述其基础层级、潜在收益渠道，以及为个人、机构及整个社会带来的多维效益。第四，我们将审视**通**过数字公共基础设施实现的民主化数据货币化模式(DPI-DDM) **推广**实施中的核心挑战，包括治理机制、能力建设及信任体系相关问题。最后提出可操作的实践建议与前瞻性路线图，旨在将通过数字公共基础设施实现的民主化数据货币化模式 (DPI-DDM) **打造**为实现数据公平、经济机遇与数字民主的有效载体。

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1. Introduction

In the digital age, data has emerged as one of the most valuable assets, driving innovation, informing decision-making, and economic growth. Yet the models through which data is monetised have remained largely opaque, centralised, and disproportionately benefiting a few dominant players. This has raised concerns around equity, ownership, and the exclusion of individuals, communities, and public institutions from the value derived from their own data. As countries increasingly embrace data-driven governance and economies, there is a pressing need to reimagine data monetization in a manner that is transparent, inclusive, and aligned with democratic principles.

Digital Public Infrastructure (DPI) offers a compelling opportunity to enable such a shift. By creating open, interoperable, and secure digital systems that serve as public infrastructure, DPI provides the foundation for a more participatory approach to data governance and monetization. This paper introduces the concept of DPI for Democratic Data Monetization (DPI-DDM), a framework that seeks to ensure that the value generated from data is shared fairly across the ecosystem, contributes to economic development, and respects individual rights and privacy.

The objective of this paper is to explore the evolution of data monetization, highlight the limitations of existing models, and demonstrate how DPI can serve as an enabling layer for a new, inclusive approach. We propose a structured framework for DPI-DDM, unpack its components, and examine how it can benefit a wide range of stakeholders, from citizens and governments to industry and academia. We also address key implementation challenges and offer a roadmap to operationalise DPI-DDM as a pathway toward equitable digital economies and sustainable development.

2. Data Monetization

2.1. Understanding Data Monetization

Data monetization is the process of generating financial returns from data assets. While selling data is one part of it, data monetization primarily involves using data to either increase revenue or reduce costs, thereby making a measurable, positive impact on business performance. The key idea is to make a profit by strategically utilizing data rather than merely selling it.

For instance, if a business typically spends $100 to execute a task but, after analysing its process data, discovers a way to perform the same task for $60, then the $40 saved is also considered a form of data monetization.

Data monetization can be broadly divided into two categories: direct and indirect monetization.

- **Direct Monetization:** This involves directly converting data into revenue by giving other businesses and institutions access to it. While selling raw data is one approach, direct monetization also includes licensing data for use by other businesses, selling access to data through application programming interfaces (APIs), offering data insights or analysis to other companies for a fee, or selling raw or pre-segmented data through formal, governed channels or consent-based data-sharing arrangements, rather than through informal or opaque means.

- **Indirect Monetization**: This is about deriving insights from data to make improvements that create a 'measurable' impact. This impact is measured in terms of increased efficiency, reduced operational costs, increased sales, entering new markets, and developing new products.

Thus, data monetization is about unlocking the financial value of data. By effectively leveraging data, businesses can create new revenue streams and drive significant cost savings, turning data into a powerful asset for growth and profitability.

2.2. Democratic Aspects of Data Monetization

The idea of democratic data monetization is rooted in two fundamental principles of democracy: equality and participation. First, it challenges the oligopoly where data is controlled by a few tech giants and makes it more accessible to everyone. This is crucial because the data these companies hold isn't theirs, it belongs to the users who created it. By promoting equality in access, data becomes a shared resource, not just a privilege for the powerful.

Second, it fosters participation across the data ecosystem, from individual citizens to entrepreneurs, industries, and the wider community. This democratic approach allows

people to engage with data on their own terms, whether they want to contribute, benefit, or both. By encouraging active participation, data monetization becomes inclusive, giving everyone the opportunity to define their role and gain rewards based on their own needs and goals.

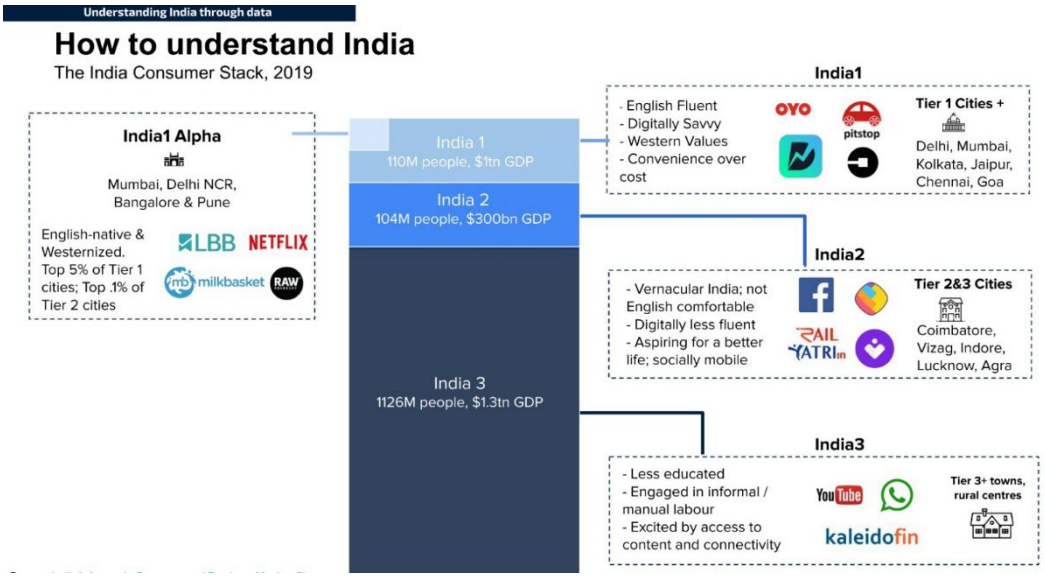
2.3. Importance of Data Monetization

In the digital age, data is an incredibly valuable asset. Companies leverage consumer data to drive business strategies, develop products, and generate revenue. However, the issue isn't that companies are benefiting from individuals' data, it is that individuals and small firms are not. Democratic data monetization offers a way to change this by enabling users/data providers to earn money from their data and contribute to the creation of quality data sets as a by-product. Thus, by concentrating on ecosystem development and addressing data monetization with an infrastructure-based approach, we can empower everyone involved.

Taking the example of India, according to the Indus Valley Annual Report 2022 by Blume Ventures (Pai, 2022), the country's population is divided into four segments, each of which can benefit from data monetization.

- *The India 2 and India 3 segments*: These two segments, comprising nearly 90% of the Indian population, primarily from Tier 2, Tier 3, and 3+ cities and towns, around 1.2 billion people contributing USD 1.3 trillion to the gross domestic product (GDP), can directly benefit from data monetization by sharing their data with consent to build data lakes. They can receive monetary benefits whenever the data pools they contribute to, seen as digital commons, are accessed and generate API requests.

- *The India 1 and India 1 Alpha segments*: These two segments make up the remaining 10% of the Indian population, primarily from Tier 1 cities and the top 0.1% of Tier 2 cities, around 200 million people, also contributing USD 1.3 trillion to the GDP. In addition to the benefits available to India 2 and 3, they have opportunities to engage in various roles across the data value chain. They can earn by offering services such as data segregation, analysis, generating insights, and more, further contributing to the economy.



Source: Indus Valley Annual Report 2022 by Blume Ventures

As data monetization incentivizes data sharing, it not only helps build data pools but also ensures the creation of high-quality data pools. This, in turn, enhances a nation's Artificial Intelligence (AI) and Machine Learning (ML) capabilities, accelerates the startup ecosystem, drives research, enables preventive medical interventions, utilizes data exhaust, fosters cross-pollination of insights across sectors, and more.

Particularly from the perspective of developing countries, the fact that most tech giants are United States-based underscores the importance of building their own infrastructure to democratize data within the country. This approach will not only empower everyone in the ecosystem but also accelerate the emergence of new tech giants—this time from developing countries like India.

2.4. Market Size and Future of Data Monetization

The data monetization market is rapidly expanding as businesses increasingly recognize the value of leveraging data for financial gain. According to a report by Kings Research (2024), the global data monetization market was valued at USD 3.38 billion in 2023 and is expected to experience significant growth over the coming years, with projections estimating it will reach USD 13.09 billion by 2031.

This growth represents a compound annual growth rate of 18.43% from 2024 to 2031, highlighting the increasing importance and adoption of data monetization strategies across various industries worldwide. As companies continue to explore innovative ways to generate revenue from their data assets, the market is poised for substantial expansion.

2.5. Evolution and Existing Models of Data Monetization

Data monetization has evolved through several approaches over the years, but many of these methods have either not proven viable or have primarily benefited only large tech companies, often leaving individuals and smaller firms without any significant gains.

Cookie Tracking and Crawler Methods: Early data monetization efforts heavily relied on cookie tracking. Cookies were used to monitor user behavior across various websites, allowing companies to gather data for targeted advertising or to sell to other businesses. However, this approach mainly benefited large corporations that had the infrastructure and financial muscle to collect and process vast amounts of data, while users and smaller businesses saw little to no direct benefit.

As privacy concerns grew and regulations tightened, the effectiveness of cookies diminished, leading to the development of crawler trackers. Yet, these methods faced hurdles as the industry shifted towards greater privacy protections, and they also primarily served the interests of large corporations, further reinforcing the imbalance in the data economy.

Platform-Based Approach: In an attempt to address the limitations of cookie tracking, platform-based data monetization emerged as a potential solution, but it too has its own limitations. This approach centralized data on specific platforms, aiming to involve users more directly. However, its centralized nature made it difficult to scale effectively, and control largely remained in the hands of platform owners, limiting the broader distribution of benefits. As a result, this method also struggled to provide a sustainable, equitable solution for data monetization.

The Need for Digital Public Infrastructure: As the limitations of cookie tracking, web crawlers, and platform-centric approaches become increasingly evident, there is a pressing need to shift towards more scalable, inclusive, interoperable, and sustainable solutions. It is in this context that DPI emerges as a critical enabler.

Data monetization is fundamentally about scale. For any data monetization strategy to be truly successful, it must be scalable, adaptable, and inclusive - characteristics that closely align with the concept and principles of DPI. The DPI approach offers a more robust and scalable solution, allowing for broader and more efficient use of data across various sectors. Unlike earlier methods, DPI provides the necessary foundation for sustainable, large-scale, and equitable data monetization, making it a more promising approach for the future.

3. Digital Public Infrastructure (DPI)

3.1. DPI: An Overview

DPI is a relatively new concept that has gained momentum in the last half-decade. However, defining DPI can still be somewhat challenging due to its broad scope and varied applications. Different organizations have provided their own definitions, highlighting the core principles and objectives of DPI.

The World Bank defines DPI as "the digital platforms, including the institutional and legal frameworks around them, that enable the provision of essential society-wide functions and services". GovStack defines DPI as "solutions and systems that enable the effective provision of essential society-wide functions and services in the public and private sectors".

Until recently, DPI was not a structured concept in international discussions. However, under India's Group of Twenty (G20) Presidency, DPI became a key agenda item, leading to its formal recognition in international policymaking. This culminated in the first global consensus on the concept of DPI. As a result, the G20 Digital Economy Ministers Meeting Outcome Document 2023 now defines DPI as: "A set of shared digital systems that are secure, interoperable, and built on open standards and specifications to deliver equitable access to public and/or private services at a societal scale, governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, competition, and respect for human rights and fundamental freedoms."

The key distinction between DPI and commercial digital products lies in their purpose and design philosophy. While commercial products are typically feature-rich and built to deliver specific value propositions directly to end users, DPI provides a foundational framework that multiple public and private applications can build upon to create diverse forms of value.

In India, foundational DPIs such as Aadhaar, the Unified Payments Interface (UPI), and DigiLocker are widely recognised examples of DPI that illustrate this approach in practice. Aadhaar, a digital ID system, provides a digital identity layer that enables online, paperless, and consent-based identity verification; UPI, a digital payment system, enables interoperable, real-time bank-to-bank payments across multiple applications; and DigiLocker allows individuals to securely store and share verified digital documents. Their value is truly realised when they are integrated by a wide range of third-party public and private service providers, enabling services such as remote onboarding, digital payments, and document verification at population scale.

Together, these systems demonstrate how DPI functions as open, interoperable, and minimal infrastructure that supports scalability, adaptability, and innovation across sectors. By separating foundational capabilities from service delivery, DPI reduces duplication, lowers entry barriers, and enables multiple actors to participate and innovate on a shared digital backbone, an architectural approach that is directly relevant

to rethinking how data can be governed and monetized at scale.

3.2. DPI as An Optimal Approach to Data Monetization

DPI stands out as the best approach for democratic data monetization because its core principles effectively address the challenges that have hindered data monetization efforts so far.

1. Interoperability and Inclusion: One of the biggest challenges in data monetization has been the existence of data silos, where data is isolated within specific sectors or organizations. DPI's interoperability principle helps bridge these gaps by bringing together data providers and consumers from various sectors in a federated manner. For smaller players who often lack access to large data sets, this interoperability and inclusivity will also enable them to tap into broader data pools and participate in the data economy.

2. Scalability through 'Protocols, Not Platforms': The platform-based approach to data monetization has often struggled with scalability due to its centralized nature. In contrast, DPI is built on the principle of "Protocols, not Platforms," which allows for a scalable, adaptable, and flexible infrastructure. By establishing open standards and protocols, DPI enables various applications and services to build on top of the infrastructure layer, making it easier to scale solutions to meet the needs of a growing market.

3. Addressing Infrastructure Gaps for Small Players: Many small organizations struggle with data monetization because they lack the dedicated infrastructure needed to process, store, and analyze data effectively. According to a Retail Systems Research survey of retailers worldwide, 56% of retailers reported lacking the bandwidth to manage their data, 38% said their analytical engines couldn't handle the data influx, and 25% didn't have sufficient storage. Additionally, 46% lacked the expertise, and 37% didn't even know where to begin gathering data. DPI addresses these challenges by providing a robust infrastructure that ensures data environments are scalable, accessible, governable, and secure. This infrastructure allows small players to overcome these bottlenecks and participate meaningfully in the data economy.

4. Robust Governance and Security: DPI embeds security and governance directly into its design. With robust and participatory governance structures, DPI ensures that participants comply with regulations and maintain trust, transparency, and accountability. This is crucial for protecting user data and fostering trust in the data monetization process.

5. Market Participation and Innovation: Unlike a platform-based approach where control is centralized, DPI thrives on market participation and innovation. By enabling third-party applications to innovate on top of a secure and scalable infrastructure layer, DPI injects life into the ecosystem, driving continuous improvement and fostering innovation. This approach not only benefits consumers but also creates opportunities for businesses of all sizes to participate in the data economy.

DPI's core architectural principles of interoperability, scalability, security, and inclusion make it the ideal foundation for achieving scalable and truly democratic data monetization. By overcoming the limitations of platform-based approaches, DPI ensures that the benefits of data monetization are broad-reaching and equitable. This approach not only supports the growth of large-scale data operations but also empowers smaller players to overcome entry barriers and participate fully in the data economy, driving innovation and economic growth across all sectors.

3.3. Precedents leading to DPI-DDM

The concept of Digital Public Infrastructure for Democratic Data Monetization (DPI- DDM) is rooted in the growing recognition of the need for robust, cloud-based infrastructures to support the monetization of data. Although DPI itself is a relatively new idea, several research papers and initiatives have laid the groundwork for this approach, often without explicitly identifying it as the same.

One significant contribution is the paper by Ramadan *et al*. (2023), which introduces the concept of 'Federated Data Marketplaces'. These marketplaces allow organizations to collaborate on data analysis without sharing the raw data itself, emphasizing the importance of a federated infrastructure, which is a key component of DPI.

Another relevant study by Faroukhi *et al*. (2020) underscores the need for technical platforms that integrate infrastructure, analysis, computing, and cloud capabilities to enable effective data monetization. This aligns closely with the principles of DPI, which aims to create scalable and adaptable systems that support data-driven innovation.

Additionally, Monge *et al*. (2022) advocate for infrastructure around data to provide alternatives to the private sector-dominated models. This perspective reinforces the need for public infrastructure like DPI that can democratize data access and use.

In Europe, the *EUHubs4Data* project, initiated in 2020 by the European Union, aimed to establish a federation of Big Data Digital Innovation Hubs (DIHs) across Europe. The project's goal was to create a European catalog of data sources and federated data-driven services, making these resources accessible to small and medium enterprises (SMEs) and startups. This initiative highlights the importance of data sharing and interoperability, both foundational elements of DPI, in fostering cross-border data-driven experimentation and supporting the growth of a global data economy.

In India, the Data Empowerment and Protection Architecture (DEPA) serves as a secure, consent-based data-sharing framework designed to accelerate financial inclusion. DEPA highlights the critical need for infrastructure to facilitate data sharing, particularly within the financial sector. However, while it effectively addresses the infrastructure required for secure data exchange, it does not fully explore the broader potential of data monetization.

DPI-DDM seeks to fill this gap by building on DEPA's foundation and extending its principles to encompass the monetization aspect, thus unlocking the economic value of data in a more comprehensive and inclusive manner.

Similarly, the International Data Spaces Reference Architecture Model (IDSRAM), developed by the International Data Spaces Association (IDSA), provides a standardized architecture for secure data exchange (International Data Spaces Association, 2019). It allows data providers to maintain control over their data while ensuring compliance with mutually agreed-upon terms. This architecture- based approach, rather than a platform-based one, further emphasizes the need for DPI to create an integrated, scalable, and secure data ecosystem.

These precedents clearly demonstrate the increasing need for a robust, interoperable, and scalable infrastructure to support large-scale data monetization. DPI-DDM builds on these key principles, offering a unified and effective solution that addresses the shortcomings of earlier models, paving the way for a more equitable and efficient data economy.

3.4. Genesis: The Idea of DPI-DDM

The idea of Digital Public Infrastructure for Democratic Data Monetization (DPI-DDM) is to create a comprehensive framework that combines the strengths of existing models such as the Open Network for Digital Commerce (ONDC) and the Data Empowerment and Protection Architecture (DEPA), while adding dedicated layers to support a wide range of participants in the data economy. ONDC is an open, interoperable network model designed to decentralise digital commerce by enabling interoperability between buyer applications, seller applications, and service providers through open protocols, rather than relying on a single centralised platform. DEPA is a consent-based data-sharing framework that enables individuals to securely and granularly authorise the sharing of their data across institutions while retaining control over its use.

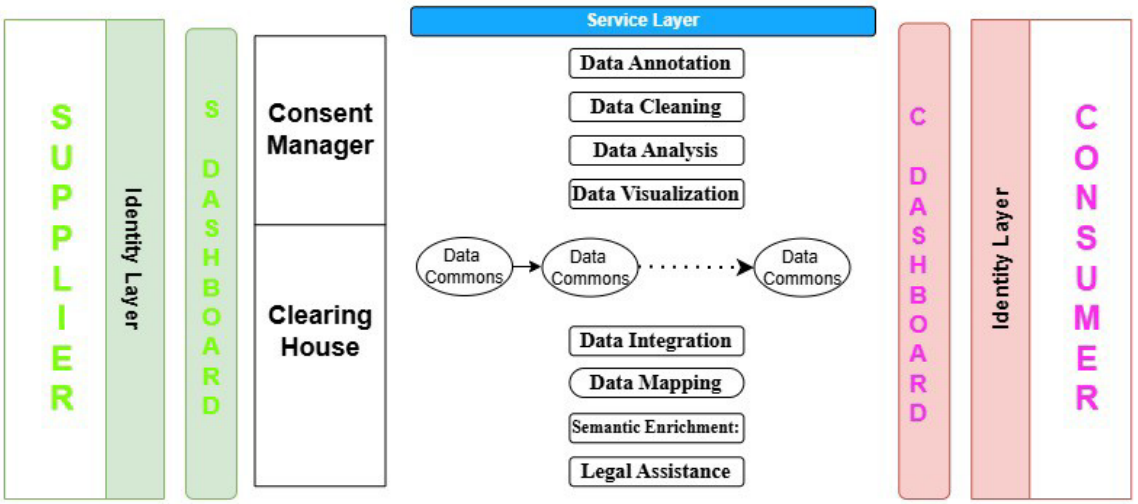
DPI-DDM blends ONDC's architectural principle of "protocols, not platforms" with DEPA's secure, consent-based data-sharing mechanisms to design an open and interoperable framework for data monetization. This combined approach integrates individuals, startups, industries, digital gig workers, and academia, ensuring that participation and value creation in the data economy are inclusive and equitably distributed.

To ensure long-term sustainability and foster trust, DPI-DDM will adhere to the existing legal frameworks of the country in which it is implemented. This legal compliance, together with the platform's inherent scalability and adaptability, will empower both data producers and consumers by enabling secure and predictable participation in the data economy. In turn, the broader ecosystem enabled by DPI-DDM has the potential to promote employment generation across multiple sectors. DPI-DDM represents a future-focused approach to data governance, one that democratizes data monetization and repositions control in the hands of individuals, thereby creating inclusive opportunities within the digital economy.

4. DPI for Democratic Data Monetization (DPI-DDM)

4.1. The Framework of DPI-DDM

The DPI-DDM is built on a layered framework designed to support seamless data exchange and monetization. At its core, the infrastructure comprises a Data Provider layer at one end and a Data Consumer layer at the other. These layers are connected by supplier and consumer dashboards, which serve as interfaces for managing data contributions and access. Central to the framework are consent managers, ensuring that data sharing complies with legal frameworks and privacy standards. In the middle, the supplier layer enables specialized entities to handle different stages of the data lifecycle.



Framework of DPI-Democratic Data Monetization

A key component of the DPI-DDM framework is the concept of data lakes or digital commons, where suppliers can contribute data and consumers can access it via secure channels such as Application Programming Interfaces (APIs). This central repository fosters a shared resource model, allowing various stakeholders to benefit from collective data while maintaining control over their contributions. Through this structured yet flexible framework, DPI-DDM supports the efficient, secure, and equitable monetization of data across various sectors.

4.2. Data Suppliers & Data Consumers (First & Last Layers)

The DPI-DDM framework begins with the Data Suppliers and ends with the Data Consumers, forming the critical outer layers of the architecture. Each type of data within the system has multiple sources and varied uses across different sectors, highlighting the vast potential of data in driving insights and decision making in modern society. Mapping Data Suppliers to Data Consumers effectively enables the alignment of supply and demand within the data economy, ensuring that the right data reaches those who need it.

Onboarding both data suppliers and data consumers into the DPI-DDM system is a meticulous process that emphasises security and trust. The authentication of suppliers and consumers is a key priority, and the onboarding process is conducted with rigorous scrutiny to ensure ecosystem integrity. For instance, in India, Aadhaar-enabled two-factor authentication can be employed alongside advanced encryption techniques to ensure that only verified participants are able to enter the ecosystem. Furthermore, the identity layers on both sides may incorporate an identity provider or certification authority that issues digital certificates. These certificates can be stored in DigiLocker, allowing for cross-verification by the other party and establishing a strong foundation of trust within the ecosystem.

The onboarding experience for data suppliers and consumers is intended to be familiar and user-friendly, drawing from widely adopted digital onboarding practices. The large-scale acceptance of platforms such as Zerodha in India or Robinhood in the United States demonstrates how trusted, secure, and streamlined digital verification systems enable mass participation, even in sensitive domains involving personal and financial information. By establishing trust through such rigorous yet accessible onboarding mechanisms, DPI-DDM aims to create a secure and reliable environment in which data can be exchanged and monetized effectively, benefiting all stakeholders involved.

4.3. Supplier & Consumer Dashboards (Second Layer)

In the DPI-DDM framework, the Supplier and Consumer Dashboards serve as critical interfaces that empower both ends of the data exchange process, data suppliers and consumers, by ensuring transparency, control, and seamless interaction. These dashboards provide each party with the tools they need to manage their roles effectively within the data economy. They operate on the Beckn Protocol, an open and interoperable framework designed to facilitate decentralised digital transactions across multiple applications and service providers.

Supplier Dashboard

The Supplier Dashboard is a comprehensive platform designed for data suppliers, whether individuals or organizations, to manage and monetize their data. Suppliers have the ability to decide which data sets they are willing to share with requesters, facilitated by their consent managers. This may include personal data such as spending data, transaction records, social data, search data, fitness data, and device-level data. Where expressly permitted by applicable law, the framework may also accommodate limited categories of sensitive personal data, such as health-related information for medical research and advancement, shared strictly on the basis of explicit, granular, and revocable consent, and subject to applicable data protection and sectoral regulations. This approach enables the inclusion of diverse data types while ensuring that heightened safeguards apply to sensitive data categories. Through this dashboard, suppliers can track the value their data generates, explore potential data sets to contribute to, and manage consents efficiently.

The platform ensures transparency by allowing suppliers to monitor where their data is

being used after consent has been granted, with the flexibility to manage or revoke that consent at any time. Additionally, the dashboard offers suppliers various options to choose the type of compensation they wish to receive in return for contributing data, including cash, cryptocurrency, goods, services, discounts, or the opportunity to donate earnings to charity. Integration with multiple payment gateways, such as bank transfers, digital wallets, and UPI, ensure that payments are processed securely and efficiently.

Consumer Dashboard

The Consumer Dashboard is equally robust, offering data consumers an intuitive platform to access and purchase data sets across various sectors. Consumers can easily browse through the available metadata, view sources, and manage consents provided by suppliers. This dashboard enables consumers to make informed decisions about the data they wish to purchase, ensuring that their specific needs are met. In addition to data access, the Consumer Dashboard facilitates payment management, tracks the progress of tasks outsourced to the service layer, and schedules regular disbursements to user accounts. This ensures that all transactions are handled efficiently and that payments are made on time.

The combination of these dashboards within the DPI-DDM framework creates a seamless, secure, and user-friendly environment for data exchange and monetization.

4.4. Consent Manager & Clearing House Layer (Third Layer)

Consent Managers play a crucial role in facilitating these exchanges, charging a nominal fee for their services. They operate within a marketplace where users can register their data and set detailed terms for its usage. Users define how, what, and how much of their data can be used, and Consent Managers ensure that these conditions are met.

The framework for consent management is guided by DEPA's Consent Artefact, which adheres to the ORGANS principles: Open standards ensure all institutions use an interoperable approach; Revocable allows individuals to withdraw consent at any time; Granular provides specific consent for each instance of data sharing, including stipulations on how long data can be accessed; Auditable maintains machine-readable logs of consent; Notice ensures that all parties are informed; and Secure by design safeguards the data throughout the process.

Additionally, this layer focuses on metadata management, enabling Data Providers to send their metadata through a dedicated interface. This metadata is then stored in an internal repository, structured for easy querying by Data Consumers.

The characteristics of Consent Managers are carefully designed to maintain security and transparency. They hold consent logs that dictate how data can flow from data sources to data users within an authorized system. Importantly, Consent Managers are data-blind—they cannot read, store, or analyze the data themselves, ensuring that they purely facilitate the transaction without compromising user privacy. Furthermore, the system supports account portability, allowing individuals to easily switch their Consent Manager service, thereby minimizing the risk of service provider lock-in.

Complementing the role of Consent Managers is the Clearing House, which logs all activities performed during a data exchange. Upon completion of a data transaction, both the Data Provider and Data Consumer log the details at the Clearing House, confirming the transfer. This logging information is critical for billing, conflict resolution (such as verifying whether a data packet was received), and providing legally valid records of the transaction. The Clearing House also generates reports on logged transactions, ensuring transparency and accountability. To further support users, a dedicated support team will be available to handle inquiries and issues related to payments, enhancing the reliability and user-friendliness of the DPI-DDM framework.

4.5. Service Layer (Fourth Layer)

The adage "garbage in, garbage out" perfectly captures one of the significant challenges in the data monetization process, that is poor data quality. Whether it is due to incompleteness, inconsistency, or irrelevance, low-quality data can lead to misguided decisions and inefficiencies, ultimately undermining the entire monetization effort. Raw datasets, in their initial state, often lack the necessary refinement to generate valuable insights. Therefore, these datasets require careful analysis, cleaning, and enhancement to ensure they are not only usable but also capable of driving informed decisions and strategies.

This is where the Service Layer of the DPI-DDM framework becomes indispensable. The framework accommodates a diverse range of service providers, from large corporations to startups and individual contributors from the gig economy. Depending on their expertise, the size of the project, and the scale of services required, different entities can plug into various stages of the data lifecycle. For instance, some companies might specialize in data annotation, while others may focus on cleaning or analyzing data. The flexibility of this ecosystem allows for service providers of all sizes and capabilities to contribute effectively, ensuring that the data is meticulously prepared for monetization.

The following sections outline the specific areas where the ecosystem may require service injections, each contributing to the overall goal of enhancing data quality and usability within the DPI-DDM framework.

• **Data Annotation**: Data annotation plays a critical role in transforming raw datasets into usable resources. Whether carried out by individuals, startups, or large enterprises, this process involves the systematic tagging of data with metadata, thereby enabling machine learning models to accurately interpret and process the information. Effective annotation ensures that the data is both relevant and meaningful, enhancing its utility for subsequent analysis and application.

• **Data Cleaning**: Data cleaning addresses the challenge of poor data quality by eliminating inaccuracies, inconsistencies, and redundancies within datasets. This process is essential for ensuring that only high-quality data is introduced into the monetization pipeline, thereby mitigating the risk of inefficiencies and suboptimal decision-making that may result from the use of flawed or unreliable data.

• **Data Analysis**: Once data has been annotated and cleaned, it must undergo analysis

to generate actionable insights. Data analysis services involve the systematic examination of datasets to identify patterns, trends, and correlations that can inform strategic decision-making. These services may be provided by a range of entities, depending on the scale and complexity of the project.

• **Data Visualization**: Data visualization involves the transformation of complex datasets into clear and comprehensible visual formats, such as charts, graphs, and dashboards. This function is essential for rendering data-driven insights accessible and actionable, thereby enabling stakeholders to effectively interpret and respond to the underlying information.

• **Data Fusion and Integration**: Data fusion and integration are critical processes for consolidating data from multiple sources into a unified and coherent whole. This service ensures that datasets originating from diverse providers are seamlessly aggregated and enriched, thereby enhancing their utility for consumers within the DPI-DDM ecosystem.

• **Data Mapping and Aggregation**: This service is centered on organizing and consolidating data into structured formats that can be readily accessed and effectively utilized. Robust data mapping and aggregation are essential for preserving data integrity as it progresses through the monetization process.

• **Semantic Enrichment**: Semantic enrichment involves the addition of contextual information to data, enhancing its meaning and making it more interpretable. This service improves the usability of data by providing additional layers of understanding, which are essential for conducting more advanced data analysis and informed decision-making.

• **Legal Assistance**: Legal assistance services are embedded within the Service Layer to assist users in navigating the complexities of data ownership, usage rights, and compensation. These services offer essential support in ensuring compliance with relevant laws and regulations, thereby safeguarding the interests of all parties involved in the data exchange.

The Service Layer of the DPI-DDM framework is a dynamic component that supports the entire data monetization process. Each service within this layer contributes to the overall goal of transforming raw data into valuable, actionable insights, ensuring that the data economy operates smoothly and efficiently. Whether provided by individual freelancers, startups, or large organizations, these services are indispensable for maintaining the integrity and success of the DPI-DDM framework.

4.6. Digital Data Commons

Within the DPI-DDM framework, the concept of Digital Data Commons is introduced as a powerful tool for collective data sharing and monetization. Drawing inspiration from Garrett Hardin's notion of the "Tragedy of the Commons" (Hardin, 1968), where shared resources risk depletion due to individual self-interest, the DPI-DDM framework counters this with the principle of mutual coercion, policies mutually agreed upon by the majority of participants, akin to how taxes are imposed. This approach ensures that the Data Commons are managed sustainably, benefiting all contributors and users alike.

Entities, whether individuals or organizations, can contribute to these Data Commons, creating diverse data pools that cater to a wide array of needs across the ecosystem. The possibilities for Data Commons are virtually limitless, ranging from a pool of translations of Dostoevsky's works to a collection of X-rays from patients, or even diet data from elderly individuals. Within the ecosystem, any consumer can initiate the creation of a new Data Common. Contributors can then use their dashboards to view existing or new Data Commons and decide to contribute their data through their consent managers.

Within the Digital Data Commons, compensation is not linked merely to the act of submitting data, but to its usefulness and contribution to the broader ecosystem. Data submission is designed to be accessible to lay contributors through guided processes and basic format requirements, enabling participation without technical expertise. Contributors may receive a limited, participation-based incentive for providing data that meets baseline requirements, even where such data is not immediately used, recognising the effort involved in contribution. However, the primary component of compensation is linked to actual use and value creation, with data that is repeatedly accessed or applied by data consumers generating higher returns over time. Data that is inaccurate, incomplete, or of limited relevance is unlikely to be used and therefore attracts little or no variable compensation. This approach ensures that incentives encourage the provision of meaningful, reliable data while maintaining inclusivity within the Commons.

Contributors to the Data Commons can also be compensated based on the type and quantity of data they provide, with sensitive personal data often carrying higher value than general personal data. Compensation is distributed whenever the data pool is accessed via an API, ensuring that contributors receive fair rewards for their participation. This system of compensation not only incentivizes active participation but also helps maintain the quality and relevance of the data within the Commons.

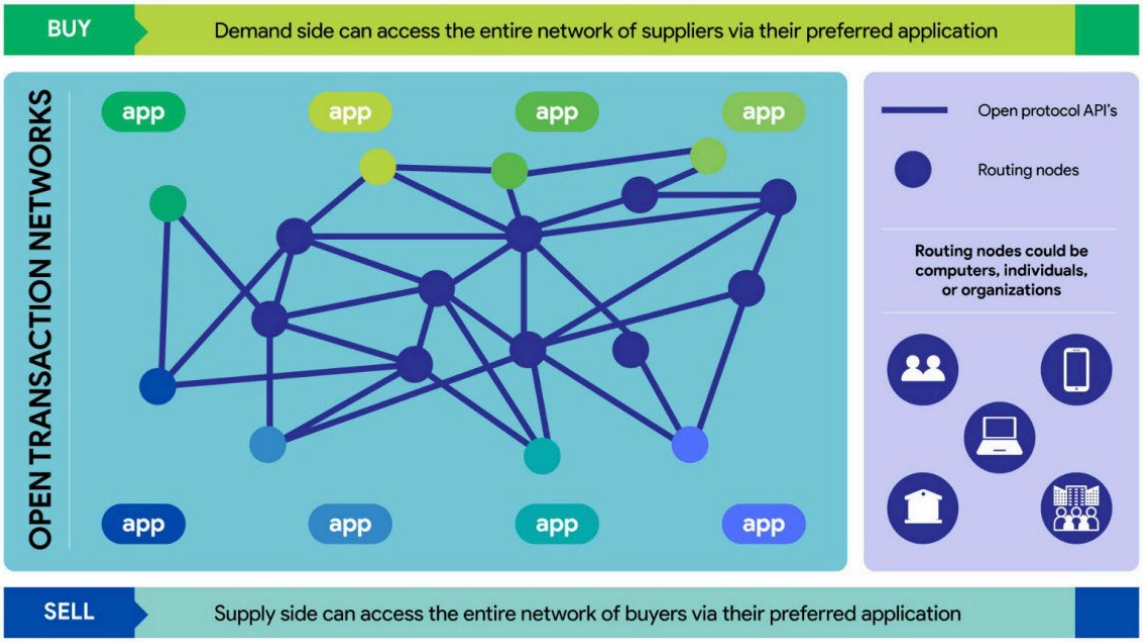
The Data Commons framework is designed to accommodate both voluntary and incentivized contributions. For example, individuals might be motivated by a desire to support the preservation and strengthening of their vernacular languages, similar to the efforts by the Indian startup Karya, which creates high-quality datasets while providing economic opportunities for rural Indians. Such initiatives can be integrated with platforms like Bhashini, where users can volunteer data to strengthen vernacular language databases. By blending the spirit of volunteerism with monetary incentives, the Data Commons within the DPI-DDM framework create a dynamic and inclusive data ecosystem that serves the collective good while rewarding individual contributions.

4.7. Technological Characteristics

Open Transaction Networks:

Open Transaction Networks (OTNs) are transformative in making tech platforms more equitable and inclusive by enabling interconnected, scalable, and efficient digital ecosystems. OTNs allow routing nodes, whether computers, individuals, or organizations, to interact without centralized control. This architecture provides

suppliers and consumers access to the entire network of buyers or suppliers through their preferred applications (Digital Impact Alliance, 2024).



Source: Open Transaction Network (OTN) Ecosystem, Digital Impact Alliance (DIAL), Open Transaction Networks – Spotlight Report (2024)

Decentralised Architecture:

In data monetization, decentralization ensures that data remains under the control of its original owners, who can decide how and when it is shared, thus enhancing privacy and security while enabling a more flexible and inclusive data economy.

Cloud-Based:

Cloud services provide the necessary scalability, allowing the framework to handle increasing volumes of data and transactions.

Asynchronous APIs:

Asynchronous APIs are critical in the DPI-DDM framework, allowing for independent processing of request-response pairs. This approach ensures that multiple transactions can be handled simultaneously without waiting for each to complete, significantly enhancing the system's efficiency. In data monetization, asynchronous APIs enable real-time data exchanges and processing, ensuring that the system remains responsive and can scale to handle large volumes of transactions without bottlenecks.

Open Protocols & Standards:

The use of open protocols and standards, such as Beckn, is fundamental to the DPI-DDM framework's interoperability. Beckn, much like the Simple Mail Transfer Protocol (SMTP) for emails, serves as a standardized protocol for economic transactions, managing the

entire lifecycle from discovery to order fulfillment and post-fulfillment stages. This ensures that any compliant platform can join the network and participate in transactions, fostering an open and inclusive environment that encourages innovation and competition in the data economy.

Unbundling:

Unbundling in the DPI-DDM framework refers to the separation of different stages of the service layer, allowing specialized entities to focus on specific aspects of data processing, such as annotation, cleaning, or analysis. This approach promotes innovation and efficiency by enabling providers to excel in their areas of expertise. In the context of data monetization, unbundling ensures that each stage of the data lifecycle is handled by experts, leading to higher-quality data services and more effective monetization strategies.

Standardized Vocabulary:

The DPI-DDM framework employs a standardized vocabulary, managed by a certifying agency, to ensure consistent data descriptions across the network. This standardization will facilitate better data sharing, understanding, and integration across different domains and services. By using a common language for data annotation and description, the framework ensures that all stakeholders can accurately interpret and utilize the data, enhancing the efficiency and effectiveness of the data monetization process.

ONDC Reference:

The DPI-DDM framework draws on the ONDC model to support various applications, including buyer apps, seller apps, and logistics providers, facilitating direct and indirect transactions between participants. This network structure promotes the creation of digital contracts, streamlining interactions across different services and platforms.

Interoperable & Scalable Infrastructure:

The DPI-DDM framework is designed with interoperability and scalability in mind, using open standards and protocols to ensure that different systems can work together seamlessly. This infrastructure minimizes the need for custom integrations and promotes a plug-and-play environment, making it easier to scale and integrate new platforms into the data monetization ecosystem.

Metadata Circulation:

In the DPI-DDM framework, only metadata is freely circulated, preserving the privacy and security of raw data while enabling efficient data trading. Metadata provides essential information about data records, allowing for future trades without exposing the underlying data. This approach minimizes the risks associated with sharing private data, ensuring that sensitive information remains protected while still allowing for the effective monetization of data assets.

The Certification Program:

The certificates issued within the DPI-DDM framework, akin to ONDC's Digital Readiness

Certification, are intended primarily for institutional participants and service providers to assess and verify their digital capabilities. Participation in the certification programme would be optional and proportionate, with simplified or no certification requirements for individual users. These certificates can enhance the credibility and market visibility of participating entities by categorising them as “DigiReady” or “Requiring Support.” The certification process can also facilitate streamlined onboarding of network participants, connecting verified sellers with relevant opportunities while ensuring that the ecosystem operates under high standards of digital readiness and trust.

4.8. Legal Compliance

Legal compliance is a foundational pillar of responsible data monetization. All data within the DPI-DDM framework, whether personal, sensitive, or public, must flow in strict accordance with applicable data protection laws and regulations. The handling, processing, and sharing of data shall adhere to applicable domestic data protection and sectoral laws of the implementing jurisdiction, along with any relevant subordinate regulations and guidelines, ensuring that individuals’ rights are safeguarded at every stage. Sensitive and personal data will be treated with the highest level of confidentiality and care, while public data will be utilized in ways that respect transparency and ethical standards. This commitment to legal compliance not only builds trust among stakeholders but also ensures the integrity and sustainability of the data economy.

4.9. Revenue Streams

Direct Revenue:

• **Data Licensing and Sales**: Organizations can generate revenue by licensing or selling valuable datasets to third parties, including businesses, academic institutions, researchers, or data brokers. Data products may be offered in various forms, such as raw datasets, aggregated or anonymized data, depending on the end-user requirements and regulatory considerations.

• **Pay per API Request**: Organizations can generate revenue based on the frequency of API usage. This model is commonly applied to data-driven APIs, such as those providing geolocation services, financial market data, or weather information. Charges are incurred per request, encouraging usage-based monetization.

• **Pay for Data Consumed**: Revenue is generated based on the volume of data consumed by the customer. Pricing tiers are typically structured to accommodate varying levels of usage, promoting efficient data consumption while aligning costs with actual usage.

• **Subscription Model**: Customers pay recurring fees to access specific datasets, analytics, or data-driven insights. Subscription plans may be tiered based on access levels, features, or service frequency, providing predictable and scalable revenue streams for data providers.

Indirect Revenue:

• **Process Improvement**: Organizations can derive indirect revenue by leveraging data to optimize internal processes. According to a 2024 study by MIT Sloan on data monetization, approximately 51% of monetization returns are attributed to improvements in operational efficiency, cost reduction, and increased sales. Additionally, 31% of returns are generated by enhancing existing datasets with supplementary services or features, thereby increasing their value to consumers (Eastwood, 2024).

• **Service Fees**: Entities within the data ecosystem, such as consent managers and service layer providers, may generate revenue by charging fees for their services. Consent managers can charge for managing user permissions, while service providers may impose service fees on data suppliers or consumers for value-added functionalities such as data processing, enrichment, or analysis.

Additional Revenue Streams:

• **API Call-Based Pricing**: Revenue is generated based on the number of API calls made by users. This model is particularly effective for services where value is directly linked to the frequency of access, such as those operating within the Digital Data Commons framework (see Section 4.6). It incentivizes efficient usage while aligning costs with demand.

• **Incentive-Based Participation**: Participants contributing data to the ecosystem may receive compensation based on the type, quality, and quantity of data provided. This model encourages active engagement and responsible data sharing, while promoting equitable participation across the data value chain.

4.10. Benefits and Beneficiaries

DPI-DDM offers several critical advantages that cater to a broad spectrum of stakeholders. First, it significantly reduces costs, time, and resource investments by eliminating the need for organizations to build and maintain their own data infrastructure. This allows companies and enterprises to monetize data they collect but do not use or do not have the resources to process, thus unlocking the potential of previously untapped resources.

Second, DPI-DDM helps create and provide access to high-quality, reliable, segmented, and relevant data that can be used immediately to meet specific business needs. Access to a wider pool of well-structured data supports better analysis and more informed decision-making. Additionally, DPI-DDM encourages collaboration across different sectors, such as Business-to-Business (B2B), Government-to-Government (G2G), Government-to-Business (G2B), and Business-to-Consumer (B2C), thereby building a more connected and cooperative data economy.

The design of DPI-DDM allows all participants to play dual roles, as both data producers and data consumers. For example, a startup could share its data with the network,

request access to a specific dataset, or offer services such as data cleaning or analysis within the service layer, thereby participating in multiple parts of the data ecosystem.

Stakeholders and Their Benefits:

1. Industry: DPI-DDM will enable industries to access well-structured data, reducing the time and effort typically spent on data collection. Structured and relevant data provides businesses with critical insights into operations, customer behavior, and market trends, allowing for more informed, data-driven decision-making. Moreover, the process of monetizing data fosters a shift toward a data-centric organizational culture, helping companies optimize operations, reduce costs, and increase productivity. For example, financial institutions and healthcare providers can leverage cross-sectoral datasets to predict fraudulent activity or identify emerging health trends.

2. MSMEs & Startups: DPI-DDM creates a more level playing field for micro, small, and medium enterprises (MSMEs) and startups by offering access to data and data-related services that they may lack the infrastructure to manage independently. This empowers smaller firms to compete more effectively with larger organizations through improved data utilization. Access to diverse services and shared data pools enables MSMEs and startups to innovate, grow, and scale their operations in a sustainable and competitive manner.

3. Gig Economy Workers: DPI-DDM opens up new avenues for gig economy workers by providing access to opportunities within the service layer. Freelancers and gig workers can offer specialized services such as data cleaning, analysis, annotation, and visualization, thereby creating additional income streams and expanding employment opportunities in the digital economy. This model promotes more inclusive participation by enabling individuals to contribute directly to the data value chain.

4. AI/ML Ecosystem: DPI-DDM provides significant benefits to the AI/ML ecosystem through a structured data monetization framework that promotes the generation of high-quality, reliable datasets. These datasets are critical for training robust and accurate AI models, enabling improved performance, finer granularity, and broader applicability across countries. For example, Natural Language Processing (NLP) models can leverage diverse, well-curated linguistic datasets to enhance multilingual processing and inclusivity. By incentivizing the creation and sharing of valuable datasets, this framework fosters innovation, strengthens competitive AI development, and contributes to a healthier and more resilient global AI/ML ecosystem.

5. Academia & NGOs: Academic institutions and non-governmental organizations (NGOs) stand to benefit significantly from access to structured, high-quality data enabled by DPI-DDM. For academia, this facilitates advanced research, supports evidence-based policymaking, and promotes interdisciplinary collaboration. NGOs can use these insights to design and implement targeted social interventions, addressing development challenges more effectively. Additionally, partnerships with research institutes and support through Corporate Social Responsibility (CSR) funding can further amplify the impact of such initiatives, driving innovation and measurable progress in sectors such as education, healthcare, and public welfare.

DPI-DDM offers a comprehensive and inclusive framework for data monetization, ensuring equitable distribution of benefits across all stakeholders. From large enterprises and MSMEs to gig workers, AI/ML communities, academia and NGOs, it establishes a scalable and integrated infrastructure that promotes innovation, drives economic growth, and empowers diverse participants within the data economy.

5. Challenges

Security Challenges

As data passes through multiple entities within the ecosystem, maintaining its security is critical. Robust encryption protocols and strict access controls are essential to prevent unauthorized access and preserve data integrity throughout the network.

Data Quality Issues

High-quality data is fundamental to effective monetization. Achieving this requires significant effort in data cleaning, de-duplication, and the enforcement of proper usage permissions. For data to hold value for purchasing parties, it must be unique, actionable, and well-maintained. Poor data quality can lead to suboptimal outcomes and reduced returns, underscoring the need for strong data management practices.

Within the DPI-DDM framework, responsibility for data quality management is distributed across clearly defined roles. Data suppliers remain accountable for the accuracy and provenance of the data they contribute, while authorised service-layer providers are permitted, under explicit and purpose-bound consent, to access data for activities such as cleaning, annotation, and standardisation. Consent managers, by design, remain data-blind and do not access or process underlying datasets; their role is limited to enforcing consent, access permissions, and policy compliance. This separation of functions enables effective data quality management while preserving trust, minimising concentration of power, and ensuring that responsibilities are shared across multiple actors rather than resting with any single entity, and that all activities remain within legally and contractually defined boundaries.

Data Privacy Concerns

The framework must address complex privacy issues, especially when handling sensitive or personally identifiable information. Different categories of data necessitate different levels of protection. While public data may require minimal safeguards, personal and sensitive data demand rigorous privacy protocols. Adherence to national legal frameworks is vital for maintaining trust and ensuring ethical data handling.

Mass Adoption Barriers

Simplifying the adoption process and clearly demonstrating the benefits of the framework are essential for encouraging participation across industries. Without mass adoption, the framework's potential to create a robust data economy remains limited.

Data Sovereignty

Balancing the need for data exchange within business ecosystems with the growing importance of data protection presents a significant challenge. Companies are increasingly concerned with safeguarding their data assets while also requiring access to more data to develop personalized services and products. This tension necessitates careful management of data to ensure that companies can protect their data while still

engaging in beneficial exchanges.

Governance Challenges

Regulating decentralized, open networks, such as those within the DPI-DDM framework, is complex due to the absence of a central authority and the need to navigate sector-specific regulations and network rules. Effective governance will require collaborative efforts among network operators, civil society, and governments to ensure compliance with cross-sectoral data protection and other applicable laws, as well as the fair and efficient resolution of grievances. Without strong governance mechanisms, the overall effectiveness of the framework could be significantly compromised.

6. The Way Forward

The future of data monetization depends on the convergence of multiple initiatives that champion both individual data empowerment and ecosystem-wide integration. While some frameworks have laid strong foundations by emphasizing user consent and restoring agency over personal data, they often fall short in enabling holistic, cross-sector monetization. Conversely, other models have demonstrated the ability to interconnect various actors across digital ecosystems, yet remain limited to specific domains such as e-commerce and do not fully address the broader potential of data as an economic asset.

To build a truly inclusive and scalable data economy, it is essential to merge these complementary approaches. A successful path forward requires integrating individual-centric consent mechanisms with comprehensive network-level interoperability, as envisioned in the DPI-DDM framework. This integration must also include the service, regulatory, and technology layers outlined in this paper, ensuring that individuals, small businesses, and large enterprises alike can engage meaningfully in data monetization.

By adopting this ecosystem-centric approach, countries can establish resilient digital public infrastructure that democratizes the benefits of data. It encourages innovation, drives economic participation across sectors, and safeguards individual rights, creating a balanced, inclusive, and globally replicable model for responsible data monetization.

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