

MILKEN
INSTITUTE

NEXT-GENERATION DIGITAL PUBLIC INFRASTRUCTURE

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In partnership with Elevandi



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KEY TAKEAWAYS

- **Developers should not expect to internalize all revenue from public infrastructure. But at the other extreme, zero-revenue models can hinder the maintenance and sustainability of projects.**
- **Adoption is not guaranteed by making usage free of charge; awareness, trust, and value-add are also required.**
- **Be highly intentional about financial inclusion—it does not arise automatically out of Web3 or open source.**
- **Open source software can help under-resourced countries leverage others' work without becoming dependent on external vendors, thus mitigating geopolitical risk.**
- **To comply with domestic regulations and international sanctions, Web3-based public infrastructure cannot be fully permissionless.**
- **Common standards are needed to prevent regulatory arbitrage and enable cross-border solutions, such as in climate.**
- **Interoperability starts with governance, and governance boils down to self-interest: economic resilience for individuals, and helping businesses and micro-, small, and medium-sized enterprises (MSMEs) grow.**

INTRODUCTION

In two private roundtables at the 2023 Milken Institute Asia Summit and the 2023 Singapore FinTech Festival, the Milken Institute and Elevandi gathered leading technologists, development banks, government officials, payment providers, and investors for off-the-record discussions on digital public infrastructure (DPI). Both sessions were moderated by Pat Patel, executive director, Elevandi. Through these convenings, the Institute hopes to leverage its networks, thought leadership, and experience in innovative finance to help smooth and support the catalytic role of finance and technology in shifting businesses, regulators, and societies toward a more sustainable and inclusive future.

Section 1 of this report covers attributes of DPI that participants believed important, such as its building blocks (e.g., digital identity, security), technologies (e.g., blockchains, central bank digital currencies [CBDCs]), and desired outcomes (e.g., innovation, resilience). Leadership is key to the development of DPI.

Section 2 explores how DPI should be financed (e.g., public, private, and partnerships), including discussions on why DPI should not automatically be free of charge.



Section 3 highlights the benefits offered by Web3-based DPI, namely a reduced need to trust one’s counterparty, the personal benefits of usage and data sharing, and the capability for open contributions.

Section 4 covers longstanding pain points facing Web3-based DPI, including inadequate value capture, incomplete data control, recentralization elsewhere in the value chain, and conflicts with sovereignty and geopolitics.

Section 5 reviews participants’ suggestions for how DPI can move forward, including a mix of centralized and decentralized layers, the need to simplify technology, and the importance of establishing good governance and common standards for truly inclusive DPI.

WHAT IS (NEXT-GEN) DIGITAL PUBLIC INFRASTRUCTURE?

First things first: Digital public infrastructure¹ and goods are not limited to finance. Wikipedia is an obvious example, but newer initiatives are abundant. For instance, Exposure Notification is an open source contact-tracing solution co-developed by Apple and Google during the COVID-19 pandemic.² The US government’s proposed Super Emitter Response Program would empower third parties to monitor companies’ methane emissions using satellites and related technologies.³ India’s eSanjeevani telemedicine platform was built on top of the India Stack, providing teleconsultations and e-prescriptions for free.⁴

Participants further noted that the Philippines is developing DPI to improve the efficiency and transparency of public service delivery, while Indonesia is leveraging DPI for education. In fact, every programming language in existence can also be considered DPI. That said, participants in the Milken Institute Asia Summit and Singapore FinTech Festival naturally specialize in finance. Hence, finance was where conversations were directed.

Across both sessions, views on what constitutes DPI were diverse (Figure 1). Most agreed that digital identity, inclusivity, and security were key components of DPI. Proper identification, for instance, is needed for Know-Your-Customer checks, sanctions screening, account verification, and accurate targeting of public services. Security, conversely, helps safeguard the general public from theft, fraud, and other illicit activities, which could build trust and grow adoption.

Figure 1: What Is Digital Public Infrastructure? (Participants’ Views)

Building Blocks	Products and Services	Examples
Digital identification	Open banking ⁵	United Payments Interface, India Pix, Brazil PayNow, Singapore
Authorization and consent	Real-time-payment networks ⁶	
Interoperability	Blockchain	
Instant, inclusive payments	CBDCs	
Secure data exchange	Digital public services	
	Open source	
	Application programming interfaces	

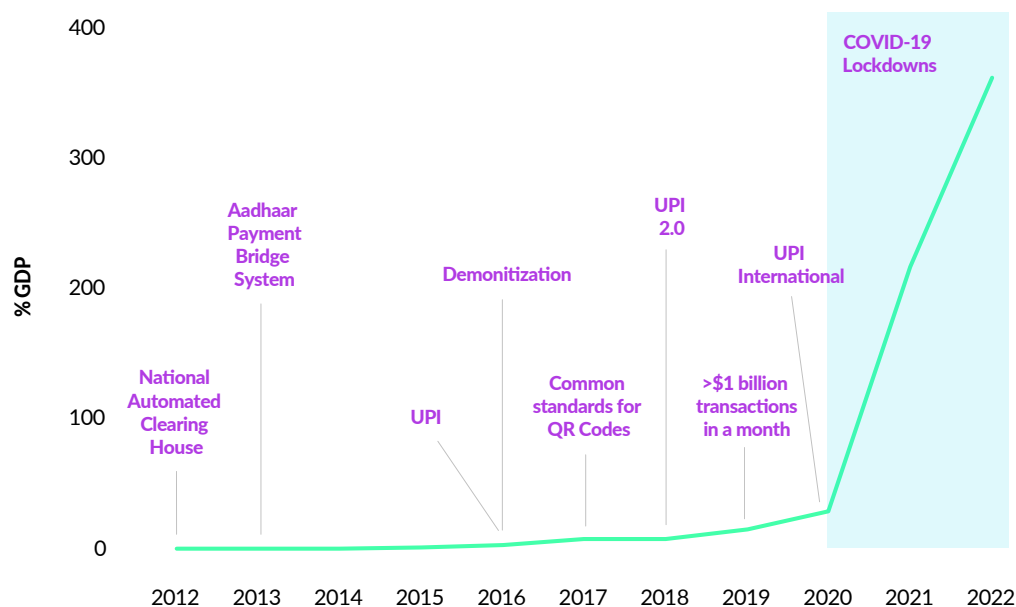
*Note: Participants did not necessarily agree fully.
Source: Milken Institute analysis of participants’ views (2023)*



That said, participants recognized that many of these components remained aspirational. For instance, while participants were highly confident in ensuring the interoperability of DPI within a country, that confidence evaporated quickly when it came to multilateral DPI. Likewise, identity is pseudonymous on blockchains, while multiple accounts can be created cheaply on decentralized exchanges without requiring identity information. Finally, open source codebases, on which components of DPI are built, are generally (but not necessarily⁷) secure if the library has a sizable community to help identify vulnerabilities. But for most repositories, the user base is small, and being an open book aids malicious efforts.

Participants agreed broadly on the outputs and outcomes of DPI (Figure 3), namely, financial inclusion and equality, and its subsequent benefits in enabling economic resilience and innovation. One participant noted that in just one decade, India had achieved financial inclusion at a scale that would have taken half a century if not for the Unified Payments Interface (UPI) on the India Stack (Figure 2). Another participant highlighted that in Singapore, cashless payments only took off among lower-income segments after PayNow had gained broad acceptance among merchants and businesses. The participant thus noted that the number of opened bank accounts is only a surface measure of financial inclusion, and widespread usage and acceptance are deeper goals to aim for once accounts have been set up.

Figure 2: Mobile and Internet Banking Transactions in India

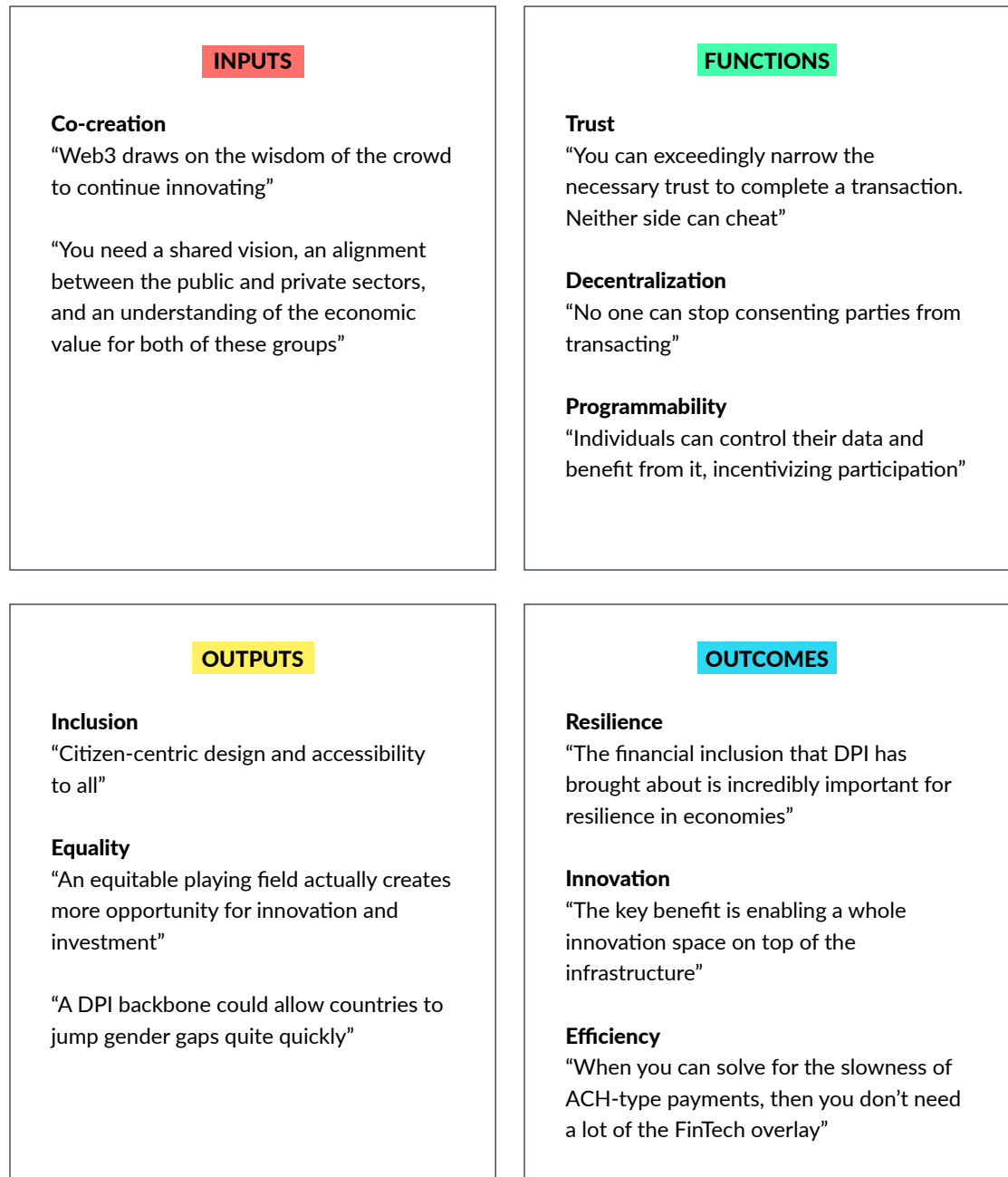


Source: Milken Institute analysis of Financial Access Survey, IMF (2023); National Payments Corporation of India (2023)

Less agreed upon was how DPI would attain these goals, specifically regarding the technologies and paradigms that DPI would increasingly be built on (Figure 3). One participant pointed out that open banking spans beyond direct payments, requiring a fundamental shift in ethos and mindsets, which future DPI should engender. Another participant likened many existing FinTech solutions to “putting a Band-Aid on a creaking system,” wondering if open banking initiatives would even be needed if state-of-the-art systems in digital identity, payments, and data exchange were in place.

Other participants highlighted that most existing FinTech solutions remained bank-to-bank balance sheet models, rather than decentralized approaches all writing to a single ledger. They believed that only decentralized finance could grant individuals and organizations the control and ability to monetize their data needed to incentivize the data sharing and interoperability that open banking seeks to achieve. Some participants noted the potential of CBDCs as an extension of decentralized finance, but none presented strong opinions on the benefits or implications of CBDCs.

Figure 3: Next-Generation DPI (Participants' Views)



*Note: Participants did not necessarily agree fully.
Source: Milken Institute analysis of participants' views (2023)*



LEADERSHIP

Leadership is central to the proper development of DPI: having a long-term vision for the uses of DPI, addressing issues of trust from the start, and aligning the interests of various sectors. A public-sector participant stressed the need to cultivate trust among users and regulators alike and to do so concurrently with DPI development, not retrospectively. The participant stated that the public sector is the slowest-moving part of the overall DPI ecosystem, which could stonewall initiatives if trust is not cultivated.

Citizens should also be involved in the co-curation and implementation of DPI, especially with regard to data privacy and protections, awareness, and literacy. Another participant concurred, noting that the UPI in India was established by the central bank, with an ombudsman, and high government-ownership in the banking system. This helped establish trust.


“People knew that we were not there to earn a few extra rupees and make money for our shareholders.”

The development of DPI takes years. The sooner countries can create a shared vision, garner political will, and align economic value, the sooner projects can move forward. Participants thus stressed the need to engage politically different constituencies when developing DPI. Other participants stressed the value of cross-border engagements—not just to pave the way for cross-border initiatives but also to learn from one another’s experiences. Participants emphasized that one size does not fit all with DPI, hence learning exchanges are important. This is the case even if the DPI codebase is open-sourced because intentions, constraints, tradeoffs—and details, most importantly—are best learned by interacting with the original authors.

FINANCING CHANGE, CHANGING FINANCE

Participants reached no easy answers for how DPI should be financed. Many participants believed that DPI is just like any other infrastructure project and should be funded by governments out of national budgets, thereby socializing the costs of public goods. For instance, UPI was established by the National Payments Corporation of India without requiring large amounts of funding, or subsidies for business adoption. Other participants, however, felt that the UPI may not be replicable elsewhere. For starters, India was already well endowed with software engineers, allowing it to develop DPI quickly. Its banking system is government-owned, engendering trust among citizens but also enabling the government to mandate usage among merchants and banks alike. Demonetization—and then COVID-induced lockdowns—forced the population to pivot toward cashless payments, while smartphones and mobile data were already cheaply available. Conversely, other governments attempting to copy India may find shortfalls in both supply and demand.

Other participants argued that where government budgets are tight, the private sector should fund DPI, perhaps with incentivizing subsidies. For instance, Pakistan’s Asaan Mobile Account scheme was developed by third-party service provider Virtual Remittance Gateway, whereas Singapore’s PayNow was developed by the Association of Banks in Singapore.



Another participant remarked that whoever has the most incentives to fund DPI should do so. The participant noted that Japan has already achieved high financial inclusion, thus the government has little incentive to push further for initiatives in open banking and similar innovations. Concurrently, banks shoulder most of the costs of financial infrastructure and have little incentive to open up. Consequently, Japan's banking system is not as open as the systems of other countries.

Regardless of who funds it, participants stressed that building in proper incentives was critical to successful development of DPI. Some participants emphasized that private investors have their own shareholders to answer to, and their investment mandates would disallow participation should risk-adjusted returns be too low. Other participants highlighted that governments face the same concerns.

“You need to convince governments that DPI is as important as health care, education, defense, because there’s a finite amount of tax revenue.”

Even after DPI has been developed, the party responsible for the adoption and the method of incentivization can vary. Foremost is the coercive power of governments. Participants noted that India's move toward a cashless society was partly driven by the government's goal of crushing corruption, fraud, and tax evasion. Hence, the implementation of UPI was more heavy-handed than, say, Pix, the instant payment ecosystem in Brazil. Other participants stated that their governments can employ much softer approaches.

“Governments possess a big degree of power when it comes to data. We’re always thinking: ‘How should we give it back to the businesses?’ because we fully understand that most of the innovation is not happening in our offices.”

FREE OF CHARGE?

That said, a participant cautioned against the predisposition toward zero fees or profitability. While making services free drives usage, a growing user base comes with new problems, such as fraud,⁸ which may be difficult to address if DPI is loss-making to begin with. As such, it may be worthwhile to consider reinvesting any profits back into further development.

Others noted the very real possibility that banking unbanked populations will be loss-making in the medium term. They stressed the urgency of bringing the unbanked into the financial system regardless of profitability so that their needs can be accounted for as DPI is further developed. A participant believed governments must accept that not all revenue streams from public goods can be internalized, and the long-term, indirect financial benefits of DPI (such as increased tax revenue) outweigh any short-term returns the government may hope to capture.

“At the protocol level of Web2, TCP/IP is free of charge. Imagine if that were monetized, where would humans be as a species?”



Some participants believed that economic benefits would trickle down, and the priority is to have DPI built out to minimize the fixed costs of private-sector participation. For instance, Pix in Brazil was developed by the central bank, which mandated bank usage but also allowed banks to charge merchants (but not consumers) market-determined fees, incentivizing banks' participation. The upshot is that liquidity begets liquidity: Once businesses are able to build upon DPI, they can innovate quickly and cheaply, and grow the economic pie.

But another participant warned that where DPI is operated by the private sector, which at times (but not always) prioritizes immediate profits and not financial inclusion, the end result can be walled gardens and a digital rentier economy.

“To gain entry, you have to pay exorbitant fees. The penetration of digital commerce in India is less than 6 percent in spite of all the big players being there.”

What complicates matters is that adoption is hardly guaranteed even when services are free. Pakistan's Asaan Mobile Account scheme, for instance, is free of charge and does not even require internet access. Yet, as of November 2023, the number of new bank accounts opened stood at just over 8.5 million⁹—far short of the 65 million targeted in the 2015 National Financial Inclusion Strategy.¹⁰ Likewise, while multiple participants praised the UPI in India for its technological capabilities, the move toward cashless payments seems to have been driven more by COVID-induced lockdowns than any other factor (Figure 2).

More broadly, challenges in adoption and buy-in also extend beyond the individuals: Companies begrudge generating positive externalities for no individual gain. Multiple participants remarked that commercial players see little value in interoperability and even less in sharing data with one another. This speaks to the importance of awareness, trust, and value-add in user adoption, turning the discussion toward Web3-based DPI.

WEB3, THE FUTURE OF DIGITAL PUBLIC INFRASTRUCTURE?

While 2022 might have been an embarrassing year for cryptocurrencies, the underlying distributed ledger technology remains valuable. In particular, Web3 can help address the aforementioned issues of trust and value-add, though awareness remains a work in progress.

GUARDING THE GUARDIANS

Participants noted that blockchains can exceedingly narrow the trust required to complete transactions. Distributed ledgers have the entire network independently verifying data, making transactions resistant to tampering, while allowing involved or third parties to audit data digitally from creation to retirement and back. For instance, even after the decentralized autonomous organization, The DAO, was hacked, the address in which the stolen cryptocurrency resides is publicly known.¹¹

Decentralized servers and databases also mean that data are no longer solely held by (and benefiting) Web2 behemoths, which could reduce the risk of data breaches and identity theft,



though decentralized exchanges are by no means immune to exploits.¹² Cryptographic proofs, such as zero-knowledge proofs, allow individuals to identify themselves using verified real-world information without needing to reveal or compromise their data.

Smart contracts built on blockchains can also specify the preconditions of transactions and data exchange, and execute them 24/7, without the need for intermediaries. And the underlying architecture of all these protocols can be open sourced, allowing open use, adaptation, and audit. For instance, payments' safety and robustness are among the top motivations for issuing a CBDC.¹³ One participant went further, stating that even mutually distrusting countries can work toward common goals within the confines of blockchain, knowing that neither side can cheat the other.

“The ability to not trust each other while completing a trusted transaction is an extremely powerful capability, and that, in the past, has not been easy to do.”

VALUE-ADD

Participants further noted that Web3-based DPI can offer benefits for adoption beyond being “just” free of charge. When apps and databases are decentralized, and data are programmable, individuals can own and control how their personal data are used and collected. For instance, decentralized apps (DApps) can have the user base vote on the aspects of usage for which data are collected and the appropriate level of payment for data collection. Users can then decide for themselves if they want to monetize their data or not. This decentralizes value capture from Web2 giants and puts value and control directly in the hands of users, which could further drive adoption.

Compensation for developer contributions can also be prespecified, open to all, and subject to any consensus mechanism the network agrees on. This could reduce some of the opacity that characterizes employee salaries today, while more closely aligning compensation with the network's definitions of merit. Even the direction of design and development can be influenced by users, giving users a greater say in the future of their favorite brands without going through the intermediated hassle of buying company stock and voting at annual general meetings.

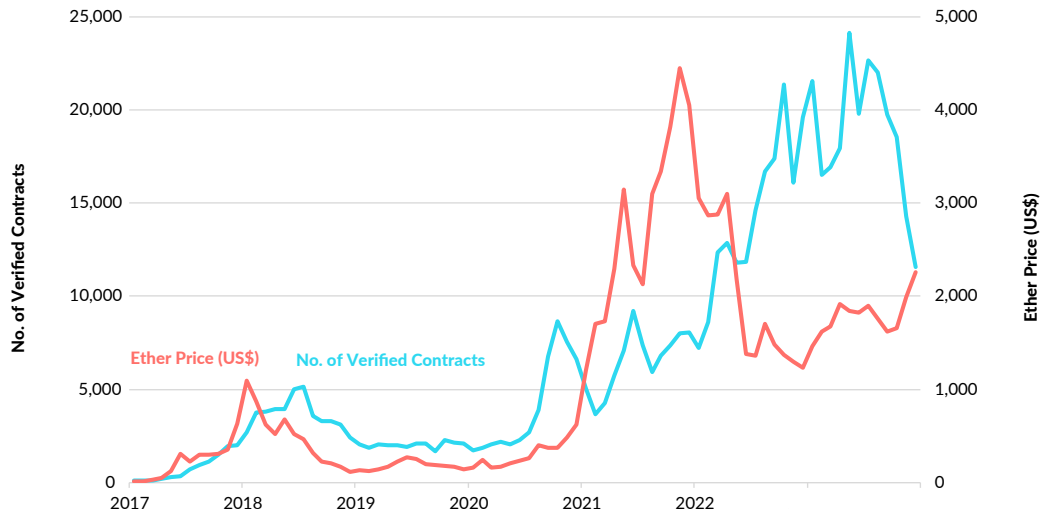
That said, a sense of community remains highly important for Web3 networks, and it is important for DApps not to transactionalize the efforts of early contributors or attract users only interested in making a quick profit. Thoughtful tokenomics design is also needed to make sure contributors are not simply gaming the system under the guise of “developer productivity.”

OPEN SOURCE

By virtue of blockchains being (mostly) open source, developers can create apps, assets, protocols, and even organizations that are interoperable and composable, bringing multiple benefits. By making tools public and modular, projects can tap the wisdom of the crowd to innovate, and create new content and services at a pace and volume that a single organization can never match. For instance, the number of Ethereum smart contracts continues to increase

even amid large declines in the price of Ether (Figure 4). In fact, community contributions are seeing rising functionality and sophistication, with contemporary smart contracts branching out from servicing initial coin offerings toward newer functionalities in token management, the development of DApps, and backend infrastructure.¹⁴

Figure 4: Verified Smart Contracts



Note: “Verified” here simply refers to checking that the source code of a smart contract compiles to the same bytecode deployed on-chain at the contract address. It is not an audit of the correctness and reliability of the smart contract.
Source: Milken Institute analysis of Etherscan (2024)

“This inherent ‘wisdom of the crowd’ element of Web3 technology to continue innovating, I think, is part of the reason it will ultimately succeed.”

In similar vein, analysis of approved open source policies worldwide finds that most governments seek to achieve modernization through open source procurement, and research and development (Figure 5).¹⁵ Cost-cutting and support for national industry are also common objectives. Other participants believed that the interoperable nature of open source could reduce the need to spend time and money lobbying governments and organizations for harmonization, in turn easing the entry of investors, defragmenting markets, and enabling the creation of cross-border solutions, such as in international remittances or carbon credits.

Figure 5: Approved Policies on Open Source

ACTIONS	OBJECTIVES					
	Cost	Modernization	Security	Sovereignty	Support for National Industry	Transparency
Cooperation		12			5	
How to Use	17	26	7	5	12	5
Procurement - advisory	57	138	11	11	57	13
Procurement - mandatory	24	31	9	9	16	12
R&D	22	110	6	7	75	10
Repository	5	12	1	1	2	8
Tech Neutrality	1	4		1	3	
Training	2	27	1	1	3	

Source: Milken Institute analysis of reference 15, CSIS (2023)

Open source has three subtler benefits. The first is increased chances of obtaining funding. Governments, for instance, may doubt the palatability of allocating millions of taxpayer dollars to projects that remain in the hands of a select few. Conversely, opening new tools, services, and data up to the public allows taxpayers to interact directly, further develop, and personally benefit, which may minimize the chances of backlash.

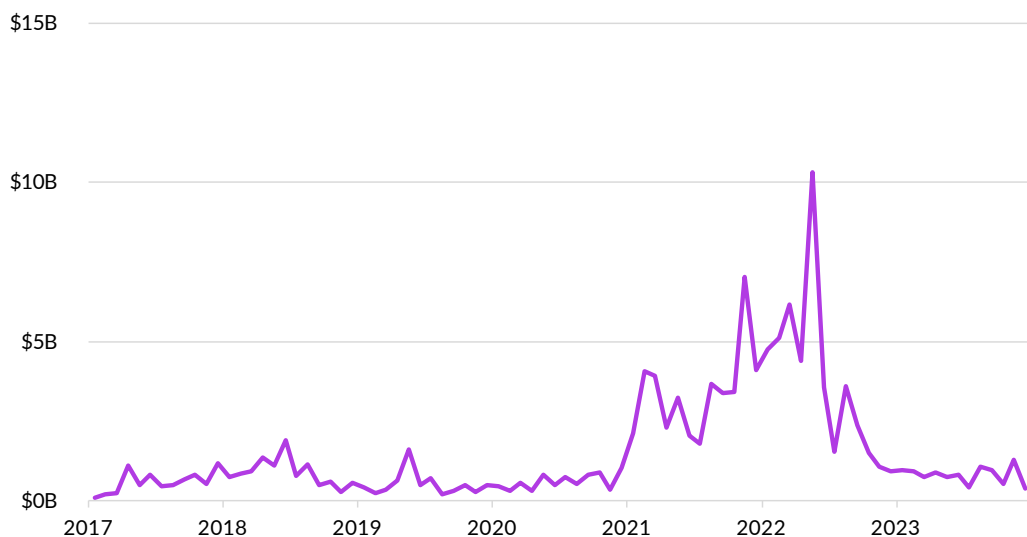
The second is that should a dominant ecosystem emerge from open source, with a critical mass of developers accustomed to the syntax of the repository, it can implicitly set common standards that subsequent, unrelated projects simply follow for the sake of convenience. For instance, the NumPy library in the Python programming language is so widely used that multiple deep learning libraries, authored decades later, largely follow its naming and syntax for cultural rather than technical reasons. Such “soft” standardizations arise only out of open source and are achieved entirely free of charge.

Third is the added resiliency that composability enables. When different modules of software can be swapped interchangeably, projects can inadvertently (or intentionally) achieve some portability between different infrastructures. With higher portability come lower exit costs, which spare developers the need to predict correctly which blockchains will dominate the future, in the knowledge that they can simply migrate their projects and assets when the picture becomes clearer.

OUTSTANDING PAIN POINTS FOR DPI

That said, investment in and adoption of DPI remain a work in progress. For instance, global funding for Web3 ventures collapsed in 2023 (Figure 6), and out of 15,000 DApps tracked, less than 0.4 percent have amassed more than 10,000 unique active wallets.¹⁶ Adoption of cryptocurrencies is so low that even the collapse of FTX did not rattle financial markets,¹⁷ but regulators from India to Singapore to China¹⁸ have already discouraged or banned cryptocurrencies before misuse and risks grow too large.¹⁹

Figure 6: Global Web3 Venture Funding (US\$)




Source: Milken Institute analysis of Crunchbase (2023)

“The Web3 industry needs to focus on actual utility.”

Already widely understood is Web3’s tendency to overengineer peripheral solutions for which Web2 often has adequate workarounds, or for pain points that never existed to begin with. Participants noted that Web3 infrastructure needs to enable and create products and services with real demand. While the challenges facing Web3-based DPI are many, participants focused not on technical implementation or product-market fit but on more longstanding barriers that will continually plague DPI in the medium term.

LEVELING THE PLAYING FIELD

Web3 is no different from Web2 when it comes to the need to accumulate users to generate value. What differs, a participant remarked, is that in Web1 and Web2, the protocol layer is free of charge.²⁰ User networks are built on applications, and value accrues to the platform that owns the application layer, rather than users. With Web3, the protocol layer itself captures a lot of value, and accumulating users on DApps would involve dismantling the application-layer user networks that dominate the tech industry today. The upshot is that even if Web3 does level the playing field, it could destroy a lot of the value in tech that has been accumulated to date. Another participant warned that a government-led approach to developing DPI could crowd out private investment and called instead for public-private partnerships.



Unsurprisingly, participants were more comfortable with leveling the playing field when said playing field is underdeveloped. The lack of legacy infrastructure also impels, eases, and accelerates innovation. Multiple participants pointed to the example of India, where cloud providers allowed access to pre-built tools and models through application programming interfaces (APIs), which gave rise to a slew of apps and, subsequently, innovation and investment. Participants believed that enabling an innovation space on top of DPI, whether with Web2 or Web3 design, would be similarly beneficial.

“In India, a level playing field does not only create limitations; it creates enormous opportunities for us as well.”

But where the playing field is already saturated with Web2 players, some participants raised the need to ensure that DPI, especially solutions built on Web3, enables the “greater good.” This further precipitated discussions on how Web3 itself can generate more value to be justifiable (see “Going Forward”).

TOKENS OF APPRECIATION

Participants frequently alluded to the benefits of allowing users to monetize their own data, thereby incentivizing uptake of, and data sharing in, DApps. But as of now, it remains unclear that user data have adequate value to provide a sufficiently strong incentive, even among the largest Web2 platforms.

Take Meta as an example: 3Q 2023 net income stood at nearly \$12 billion, while monthly active users numbered nearly 4 billion.²¹ (For comparison, the most populated DApps today have users in the low millions.)²² If Meta’s net income were redistributed wholesale back to users, each user would only receive an average of US\$1 per month, in exchange for years or decades of scrolling.

Suppose Meta distributed shares (akin to tokens) instead. Since 2022, cryptocurrencies have allocated nearly 40 percent of tokens to their communities (Figure 7A). As of December 2023, dividing 40 percent of Meta’s market capitalization over users averages out at around \$360 per user, which also happens to be Meta’s current stock price. Years or decades of data would only amount to one share (albeit more equitable than the current state of affairs). The upshot is that individual user data are not necessarily valuable even among the largest Web2 platforms, let alone Web3.

Many participants noted, however, that corporate data, with value accruing to corporates rather than individuals, are more valuable, especially when apps are built to be interoperable. This, in turn, depends on a culture of open source enabled by good leadership (see “Going Forward”).

“Where we see success is when companies realize that interoperating actually grows the market. It’s not a zero-sum game, and we’ve seen this repeatedly in Rwanda, Ghana, Brazil, India, Pakistan.”



DELETING VERSUS UNLEARNING

Concurrently, with the rising adoption of artificial intelligence (AI), the controllability of data is no longer clear-cut. Data can be deleted, and such deletion can be verified with blockchains. But most data are also ingested by machine learning models to uncover insights about individuals, and having models unlearn specific aspects of specific individuals can be very complex.²³ Meanwhile, generative AI models can be prompted, even by individuals untrained in data science, to reveal or “leak” their underlying training data.

While social media giants may possess the computational resources to retrain models regularly from scratch to omit deleted data, smaller companies may find this undesirable if not impossible. Preferable and more efficient is “machine unlearning,” where models are trained to “forget” data meant to be deleted. That said, work in machine unlearning is nascent, especially in “zero-shot” settings, where the data scientist cannot access the data meant to be unlearned (to comply with regulations on deletion). Results so far are promising but for highly limited settings,²⁴ and when applied to the real world, with cancel culture and all other kinds of deletion requests streaming in each day, performance will naturally suffer. Worse, researchers have already identified data poisoning techniques resistant to unlearning.²⁵

What exacerbates matters is the tradeoff between data privacy and model fairness. Machine learning models can easily imbibe biases from other data points even if the sensitive data in question are censored.²⁶ Conversely, companies are facing increasing restrictions in collecting the data needed to detect biases in the first place, hindering efforts to assess the fairness of their models, let alone choose between incompatible definitions of “fairness.”²⁷ It thus remains an open question how model bias can be mitigated against an increasingly seamless and granular ability to withdraw one’s data in Web3.

RECENTRALIZATION

A challenge for financial inclusion is that decentralization can be isolated, superficial, or even performative, and decentralized models can be, and have been, recentralized elsewhere in the value chain. In cryptocurrencies, for instance, token allocations to founders and private investors are on par with community allocations (Figure 7A),²⁸ whereas allocations to public investors are far smaller. In parallel, the US Securities and Exchange Commission has argued that Ethereum falls under US jurisdiction because more nodes are located in the US than in any other country (Figure 7B).²⁹ Separate studies have shown that the top 50 miners control 50 percent of global Bitcoin mining capacity,³⁰ and two-thirds of Ether on Ethereum, respectively.³¹ Study authors found that, among others, the fixed fees needed to compute and execute smart contracts on Ethereum disadvantage smaller, underserved groups, and the “new financial paradigm in blockchains and DeFi ironically features more wealth concentration” than in the real world.³²

Figure 7A: Median Token Allocations since 2022

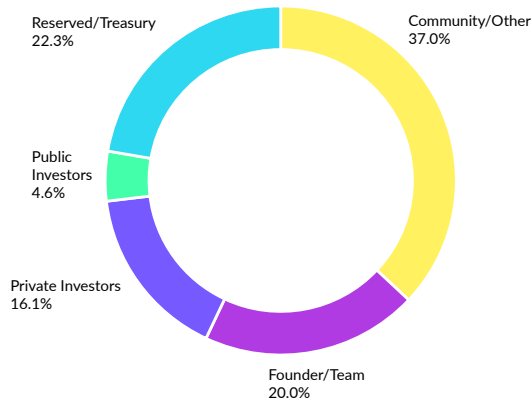
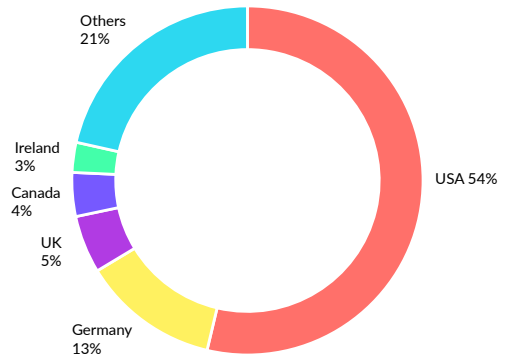


Figure 7B: Geographical Distribution of Ethereum Nodes




Sources: Milken Institute analysis of reference 28, TokenUnlocks (2023); EtherScan (2023)

“Just because we have Web3 does not mean that inclusion and access can be just decentralized and delegated to the private sector.”

The same can be said for open source. Even if GPT4 were open sourced, in reality, the sheer scale of computing hardware and talent needed to train it and optimize deployment would restrict availability to well-endowed organizations and countries, again perpetuating inequalities and resisting decentralization. Granted, “miniaturized” models have proliferated recently, but training one’s own model on smartphone-level hardware still remains out of reach for most people, especially in developing countries. The upshot is that decentralization and open source do not necessarily level the playing field, and neither does Web3 automatically bring about financial inclusion.

SOVEREIGNTY AND GEOPOLITICS

In fact, participants noted that recentralization can stem from objectives of financial exclusion. Multiple participants believed that geopolitical rivalries would heavily influence the development of DPI and were likely to produce largely incompatible systems, complicating regulatory compliance. For instance, the immutability of distributed ledgers could prevent, say, government censure of illegal content. At the same time, participants noted that on permissionless infrastructure, no organization or government can prevent consenting individuals from transacting with one another, which raises questions about compliance with both domestic laws and international sanctions, and the kinds of parties who would be most eager to fund such capabilities. In other words, decentralization can limit sovereignty, and sovereignty can limit decentralization.



“You can be as decentralized as you want, but you don’t want to end up in the US entity list.”

As such, one participant stressed the need to account for geopolitical risk when relying on foreign companies to develop DPI, suggesting that under-resourced countries could tap open source to remove their dependency on external vendors and, in turn, their susceptibility to external factors.

Another participant stated that countries needed to make their own assessments of whether open source and Web3, along with related technologies, can guarantee their sovereignty and ownership of DPI, then equip themselves with the solution and, finally, work toward interconnecting with other countries. A third participant raised the issue of accountability when DPI is decentralized and/or based on open source, wondering whether responsibility could and should be balanced between public and private sectors.

GOING FORWARD

GOVERNMENT AND DECENTRALIZATION


Participants had many views on how Web3 and DPI could be taken forward, with many believing that government still has an important role, even with a decentralized internet. One participant stated that government today increasingly fulfills the role of building fundamental infrastructure, and DPI further allows users to build on the government’s foundations. The Monetary Authority of Singapore, for instance, has initiated Project Guardian, conducting industry pilots for various applications in asset tokenization and decentralized finance.³³ Concurrently, 130 countries worldwide are exploring CBDCs,³⁴ while Thailand, China, Hong Kong, and the UAE are developing project mBridge to expedite cross-border payments using CBDCs.³⁵

Another participant remarked that after creating such DPI, there has to be an entity that governs it, such as by setting policy frameworks, or ensuring inclusivity and universal access. The participant noted that these are areas in which governments already have expertise, making government well-placed to exercise authority.

“Regulation that encourages safe and sound innovation also can harness and accelerate a vast surface area of innovative activity, much more than can public-sector actions alone.”

At the same time, participants stressed that government should not be performing all the innovation in the ecosystem or be responsible for adopting new technology. The balance between the public and private sectors varies among societies, affecting the distribution of innovation and accountability in DPI.

Building on this, a few participants suggested that decentralized finance might still comply with domestic and international regulations if the technology stack of the financial industry comprised both centralized and decentralized functions. The centralized base layer could



then act as a gateway controlled by the government. For instance, governments could deny access to lawbreakers and sanctioned persons and the like, which would allay some concerns regarding illegal activity on Web3. The Web3 community itself is increasingly recognizing the importance of regulation: In one checklist for the suitability of a blockchain, the first eight criteria focused on regulatory compliance, ranging from verified node operators to real-time regulatory monitoring, permissioned addresses, and asset-freezing capabilities.³⁶ Some other participants agreed that Web3-based DPI cannot be fully permissionless.

“There should be a core component of the stack that controls who controls their data. On Layer 1, maybe it’s the government issuing centralized DPIs, but as soon as you get your ‘passport,’ it’s a decentralized function around the individual that can accrue value and drive adoption.”


LOWERING BARRIERS TO ENTRY

Beyond coexisting peacefully with governments, some participants suggested simplifying technology for developers and users alike. Just as ChatGPT’s ease of use turned half of LinkedIn users into self-proclaimed data scientists overnight, developer-friendly Web3 tooling will make it easier to maintain, debug, and secure the network. This spares developers from incessant updates and patches, while lowering the skills barrier to community contributions. A large contributor base, in turn, broadens the range of services in the ecosystem, which helps grow the network and sustain the ecosystem.

In contrast, highly complex and technical ecosystems, which presuppose deep user familiarity, instead encourage errors by novice users.³⁷ Should these errors result in widespread asset losses, such as the \$5.8 billion worth of crypto stolen by hackers from 2022 to 2023,³⁸ regulatory pushback will be deserved and unsurprising. That said, 2023 is the first year when crypto thefts have declined.

In similar vein, multiple participants stressed the need to focus on the weakest link. One participant noted that during the design of the India stack, developers systematically envisioned the user journey of an unbanked person or a small business, to identify pain points and edge cases, and ensure value-add and uptake.

Other participants noted that the blockchain industry has thus far failed to communicate properly how blockchains will scale. One participant, for instance, lamented that too many individuals trying to sell that blockchains themselves will run faster to eventually accommodate any and all on-chain activity. The participant instead drew an analogy, observing that SWIFT handles large transactions between banks but not high-volume retail payments on debit cards. The participant believed blockchain infrastructure would head in the same direction, with large transactions recorded on-chain (“Layer 1”), while smaller transactions were recorded, computed, or aggregated off-chain (“Layer 2”).



“For a lot of very large retail payment infrastructures, they’re not going to be native to the blockchain. They’re going to be using blockchain to have the trust and transparency and the fallback when bad things happen.”

The difficulty, the participant noted, is that many Layer 2 solutions are being held back by technology decisions of current industry leaders, raising the need for common standards and goals.

COMMON STANDARDS AND CROSS-BORDER

“We need to develop common standards to move money and value in a compliant manner, particularly for interoperable identity. Users, developers, companies, interested parties—governments even—need to come together in a manner similar to the original internet engineering task force.”

Participants stressed the need for common standards, first because DPI can be built in many ways, and second, to avoid regulatory arbitrage, given the international nature of Web3. One participant pointed out ongoing initiatives, such as the Linux Foundation’s initiatives in open wallets,³⁹ and an open metaverse,⁴⁰ as part of a broader and much-needed movement toward standardization in Web3. Concurrently, the International Monetary Fund and Financial Stability Board have recommended policies to address macroeconomic and financial stability risks associated with crypto assets.⁴¹

Another participant highlighted the environmental costs of building and hosting DPI. For instance, applications like blockchains and machine unlearning can have large energy consumption, while hosting distributed computing requires a proliferation of chips, which necessitates rare-earth mining for production and proper e-waste disposal on retirement. The participant raised the need for standardized disclosure infrastructure for greenhouse gas emissions, adding that the measurement of Scope 3 emissions will require cross-border infrastructure. In turn, the development of cross-border DPI will develop trust.

At the same time, a public-sector participant noted that regulators themselves need to embrace newer technologies, rather than trying to control every aspect of technologies that their societies have yet to understand fully. But other participants were mixed on whether public authorities would embrace cross-border solutions, such as international remittances. One participant was more confident that bilateral (rather than multilateral) solutions would work, particularly between countries with high bilateral immigration flows. For instance, in a world first, Singapore and Thailand connected their instant payment systems in April 2021. Singapore and India followed suit in February 2023, and in November 2023, Singapore further linked its payment system bilaterally with Malaysia and Indonesia.⁴²

Another participant, however, stressed that trade is decentralized, and anyone should be able to transact with anyone else. The participant believed that once DPI is built, the next step will



be to interconnect countries in a way that is multilateral, not bilateral. This is because bilateral connections grow binomially: Three countries will have three possible bilateral connections between them, but 10 countries will have 45 possible connections, while 195 countries will have nearly 20,000, and with this come intermediary costs. For instance, one participant noted that while the Rwandan franc and the Kenyan shilling are not volatile against each other, they still need to be converted into US dollars before exchanging them. Multilateral connections, on the other hand, scale much better. For instance, the Bank for International Settlements Innovation Hub created the Nexus blueprint in 2021 as a multilateral network to which each country can connect, incurring a one-time individual cost that allows access to instant payment systems of all other countries in the network, present and future.⁴³


However, one participant circled back to the opening discussions on leadership, stressing that interoperability depends less on technology than governance. Leaders with a long-term vision for the uses and benefits of DPI can decide, from the start, how DPI should be built to allow for future improvements.

“The biggest lesson over the years is that interoperability starts with governance before anything else. And we have to recognize that this boils down to self-interest: economic resilience for individuals, and helping businesses and MSMEs grow.”

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