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FORMATION OF DIGITAL NETWORK SPATIAL HUBS IN THE CONTEXT OF THE TRANSFORMATION OF THE GLOBAL FINANCIAL ARCHITECTURE

The object of this research is the process of forming digital networked spatial hubs as an organizational basis for the reconcentration of global financial flows amidst the transformation of the global financial architecture. A key unresolved issue is the systematization of how international financial centers are transforming under the influence of asset tokenization and the convergence of TradFi and DeFi – phenomena that neither classical theories nor established typologies had originally envisioned. This gap defines the research direction: examining how tokenization and DeFi affect the reconfiguration and existing hierarchy of financial centers, and the role played by digital networked spatial hubs in this process. The research analyzes empirical trends in the transformation of the global financial architecture to determine whether this shift is accompanied by decentralization or, conversely, by a reconcentration of financial activity within leading international financial centers. It substantiates the concept of the digital networked spatial hub as the organizational and institutional foundation for the reconcentration of global financial flows within the hybrid TradFi/DeFi financial architecture. Furthermore, the research identifies the energy, regulatory, and security factors that either constrain or stimulate the development of these hubs as the "core" of the evolving global financial architecture. The practical significance of the findings lies in establishing approaches to assess the reconcentration of financial activity and in formulating regulatory policies for integrating national financial markets into the global digital space. The proposed concept of a digital network-based spatial hub integrates the classification of tokenized real-world assets (RWAs), functional elements of digital financial infrastructure, TradFi/DeFi topologies, and concentration metrics. This approach enables the adaptation of analytical tools used to study international financial centers to the context of asset tokenization, stablecoin-native settlements, and regulatory competition among digital jurisdictions.

Keywords: *RWA tokenization, TradFi/DeFi convergence, international financial centers (IFCs), concentration, network-based spatial hubs, financial architecture.*

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1. Introduction

The development of integration processes in the global economy is accompanied by the concentration and consolidation of business processes – horizontally, vertically, and spherically – at the level of corporate entities, specific industries, and national economies as a whole. Additionally, processes of technology-driven regionalization and the formation of local consumer markets are being observed. Crisis phenomena witnessed in recent years are only accelerating these processes. At the same time, the acceleration of scientific and technological progress, the reorganization of logistics networks, and the shift toward new business models create a need for novel approaches to stimulating national economic development and addressing the spatial interaction of economic agents. While traditional models of such interaction, such as free trade zones, Euroregions, and special agreements, retain some potential, they are considered limited in the medium term. On the other hand, there is growth in global trade and the transnationalization of investment and payment processes based on new technologies; effectively, a new financial architecture driven by digitalization is emerging.

In the current context of the financial sector's digital transformation, the channels and instruments for delivering financial services are evolving, as is the distribution of risk and control among financial system participants. The adoption of real-asset tokenization, cloud computing, artificial intelligence, distributed ledger technology, and smart contracts is laying the foundation for the decentralization of financial operations. At the same time, control is becoming concentrated within innovative infrastructure nodes, specifically protocol developers, operators of oracles and cross-chain bridges, validators, stablecoin issuers, and providers of digital financial platforms. The emergence of a new digital financial architecture should be viewed not as a linear progression from centralization to decentralization, but rather as a multi-level process of transformation. Consequently, the adoption and proliferation of decentralized financial technologies may be accompanied by a reconcentration of financial intermediation hubs (infrastructure nodes).

Contemporary research views digitalization not merely as a technological upgrade of financial processes, but as a driver of financial management transformation that influences the information base for decision-making, management efficiency, and financial performance outcomes [1].

The theoretical underpinnings of digital financial ecosystem development are established in [2], which identifies the key conditions for their formation, namely digital infrastructure, the institutional environment, financial innovations, and the capacity of economic agents for network-based interaction. Further analysis of this subject is presented in [3], which focuses on refining the typology of tokenized financial instruments; this approach enables the systematization of various forms of digital assets and positions tokenization as the foundation of new financial intermediation architecture. Indeed, the digitalization of finance, specifically the tokenization of real-world assets (RWA) and the convergence of traditional finance (TradFi) and decentralized finance (DeFi) technologies, has emerged as a fundamentally new phenomenon that is reshaping the very architecture of financial intermediation.

The penetration of digitalization into markets for payment and investment instruments (assets) creates new opportunities for financial markets while simultaneously heightening risks associated with fraud, cyber threats, market manipulation, and regulatory uncertainty [4]. A distinct manifestation of this transformation is the emergence of DeFi-integrated CBDCs, where technological infrastructure and liquidity serve as key performance criteria; this underscores the financial architecture's shift toward a hybrid model that combines regulatory oversight with decentralized financial solutions [5]. Thus, the digitalization of finance, along with the development of digital financial ecosystems, tokenized instruments, stablecoins, CBDCs, and DeFi technologies, is shaping a new hybrid financial architecture.

A primary challenge remains the integration of and transactions between financial instruments that are based on different technological platforms, operate under distinct regulatory regimes, and are subject to varying pricing mechanisms and protocols.

Usually, these problems: the convergence of different payment systems, investment assets, regulatory regimes were solved by creating international financial centers (IFCs). IFCs performed the functions of financial intermediation between markets with different regulatory regimes, payment and investment instruments, determined global asset pricing. But, in modern conditions of development and penetration of digitalization processes into all spheres of the economy, the emphasis is increasingly shifting to interaction in certain directions in virtual decentralized entities.

Thus, this is echoed by the techno-determinist narrative prevailing throughout the 1990s, most clearly formulated in the concepts of the "end of geography" [6] and the "death of distance" [7], which asserted that digitalization diminishes the significance of the location of financial activity and will lead to its dispersion. But the modern practice of its implementation refutes this prediction.

The theoretical basis of the IFC research is scientific works that investigate the understanding of the nature of the spatial concentration of financial intermediation. The work [8], in which the agglomeration logic is transferred to financial intermediation, became the basis. It argues that economies of scale and agglomeration become the basis of a hierarchical spatial organization with a single center – the "keystone of the vault". This work emphasizes that centers are necessary both for balancing savings and investments over time, and for making payments and moving value between different local markets. It justified the effectiveness of the single center by reducing the number of necessary channels of interaction between counterparties from $n(n-1)/2$ to $n-1$. This is, in fact, the earliest justification of savings on the concentration of financial flows.

In work [9], hierarchical cluster and discriminant analysis are used to rank the centers, which became the basis for identifying their typology host → international → supranational. The work [10] shows that the global economy, despite the notion of "placelessness", needs specific territorial "inserts", and this need is most acute precisely in the most digitized sectors, primarily in finance. In work [11], the concept of "space of flows" was introduced, where it is stated that flows are immaterial, but nodes (hubs, nodes) remain material and hierarchical.

The GaWC research network operationalized the concept of world cities through the classification of their integration into the world economy based on advanced producer services, distinguishing levels Alpha, Beta and Gamma [12]. The further development of this approach is implemented within the framework of the interlocking network model, where cities are considered as nodes of the global urban network, and global firms providing professional services form the subnodal level of intercity connectivity [13]. In modern GaWC classifications, London and New York are consistently assigned to the Alpha++ level, which allows them to be interpreted as the core of the global network of world cities [14].

The stability and continuity of the centers are explained by the institutional and cluster-relational approaches. In work [15], the concept of path dependence is substantiated – a self-sustaining institutional matrix with increasing returns. The substantiation of relational capital retention mechanisms is presented in works: [16], where the emphasis is on the cluster theory, [17], in which the emphasis is on untraded interdependencies – non-market interdependencies (informal relationships, mutually beneficial exchange of tacit knowledge, social capital, joint labor market and special skills) and [18], in which the concept of sticky places is proposed (concentration of capital in certain geographical locations). The modern continuation of this line – the concept of "sticky power" (Sticky Power) is contained in works [19, 20], which reveal and extend the theory of global financial networks (GFN). But, given the rapid spread and scaling of decentralized digital financial technologies, they do not sufficiently substantiate the impact of financial innovation on the re-concentration of global financial flows.

Techno-determinist concepts presented in works [6, 7] serve as an antithesis to the hypothesis regarding the re-concentration of international financial centers (IFCs). However, three decades of empirical evidence have refuted their radical prediction. Research [19] demonstrates that FinTech leads not to disintermediation but to re-intermediation, which reinforces existing centers.

Contemporary research in financial geography is increasingly shifting its focus from the general impact of digitalization to an analysis of the spatial organization of financial intermediation and digital financial networks. A special issue dedicated to the interrelationship between FinTech, the economy, and space [21] emphasizes that FinTech cannot be viewed merely as a technological phenomenon, as its development is linked to the role of the state, financial centers, and uneven spatial development. This logic is corroborated by research [22], which views FinTech as a new platform of political economy characterized by processes of re-intermediation, consolidation, and capitalization; in other words, it does not eliminate financial intermediaries but rather creates new digital hubs of control and value accumulation. Research [23], adopting a global financial networks approach, shows that FinTech development is accompanied by a concentration of investment flows in metropolitan centers and offshore jurisdictions that link emerging digital financial ecosystems with established international financial centers. Thus, contemporary literature confirms that the digitalization of finance does not negate the significance of space; rather, it alters the forms of its organization through platformization, network connectivity, and the emergence of new digital financial hubs.

A review of the literature reveals that the interplay between structural-institutional changes, resource constraints, and specific risk factors remains insufficiently explored. In particular, issues such as energy supply, energy efficiency, decarbonization, cybersecurity, and digital operational resilience are predominantly examined in isolation, without determining their cumulative impact on the architecture of the digital financial ecosystem.

The challenge of systematizing the transformations of International Financial Centers (IFCs) driven by asset tokenization and the convergence of TradFi and CeDeFi also remains unresolved; no classical theory or established typology had anticipated these phenomena in their current form. This very gap defines the research focus: how tokenization and DeFi technologies influence the reconfiguration and

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existing hierarchy of financial centers, and what role digital network-based spatial hubs play in this process.

The object of this research is the process of forming digital network-based spatial hubs as an organizational foundation for the reconcentration of global financial flows amidst the transformation of the global financial architecture.

The aim of research is to develop a concept for establishing digital networked spatial hubs as an organizational basis for the reconcentration of global financial flows amidst the convergence of traditional financial institutions and decentralized financial technologies; this approach enables increased liquidity and turnover velocity for real assets and payment instruments, thereby ensuring the resilience of digital financial ecosystems.

To achieve this aim, the following objectives were addressed:

1. To analyze empirical trends in the transformation of the global financial architecture and determine whether the adoption of decentralized financial technologies triggers a reconcentration of financial activity within leading international financial centers.
2. To substantiate the organizational and institutional foundations for establishing a digital networked spatial hub as a basis for the reconcentration of global financial flows within a hybrid TradFi/DeFi financial architecture.
3. To identify the energy, regulatory, and security factors that either constrain or stimulate the development of digital networked spatial hubs as the "core" of global financial architecture evolution.

2. Materials and Methods

To analyze the transformation of the global financial architecture, a combination of systemic, institutional, and structural approaches was employed, alongside comparative analysis methods. To test the hypothesis regarding the reconcentration of global financial centers, data from international rating platforms, reports from national regulatory and supervisory bodies, and open-source information covering the period 2022–2026 were utilized. This enabled an assessment of the spatial concentration of financial flows and assets within international financial centers based on parameters such as currency exchange operations, derivatives turnover, the adoption of tokenized Real-World Assets (RWAs) and stablecoins (digital payment instruments), and the use of DeFi protocols, all of which serve as instruments for shaping digital financial infrastructure.

Concentration analysis tools were applied to analytically assess reconcentration processes. Specifically, this involved comparative analysis of GFCI rating dynamics and digital financial market structures, concentration ratios for leading market participants, and the Herfindahl-Hirschman Index. A taxonomic approach was used to conceptualize the digital network spatial hub; this approach entails systematizing tokenized assets according to RWA classes, lifecycle stages, functional elements of digital financial infrastructure, and TradFi/DeFi convergence topology.

3. Results and Discussion

3.1. Analysis of empirical trends in the transformation of financial architecture

Global economic development is characterized by the regionalization of the production and consumption of goods and services. So-called regional technological and economic zones are taking shape. Many researchers point to a decline and regionalization in the global exchange of goods and services and in international trade more broadly. However, considering the growth of exports (including services) alongside the expansion of international financial centers, one can argue that international trade is shifting to a qualitatively new level.

In practical terms, processes of concentrating value-added production and corresponding consumer zones, based on regional technical and technological standards, are underway. Coupled with the adoption of new technologies such as AI, blockchain, and decentralized energy grids, this signals a restructuring of the global economy and a reorganization of logistics flows. Meanwhile, the hubs facilitating financial links between these various centers of concentration are themselves undergoing processes of reconcentration and spatial network organization.

An analysis of the changing roles of traditional financial centers reveals that their status has remained virtually unchanged in recent years.

The clearest evidence of the stability of these international financial centers lies in their rankings and their continued concentration at the top of the hierarchy. In effect, processes of reconcentration or the intensification of financial capital concentration are taking place. This conclusion is supported by the Global Financial Centers Index 38 [24] ratings (September 2025), in which the international financial centers (IFCs) of New York (766 points), London (765), Hong Kong (764), and Singapore (763) dominate. They are separated by only a single rating point, whereas in the previous edition, GFCI 37 (March 2025), the gap between them was approximately 19 points. This compression persists in GFCI 39 [25] (March 2026). Meanwhile, other IFCs, such as San Francisco, ranked fifth, already lag behind by about 20 points. This confirms the conclusion regarding processes of concentration or re-concentration based on new technological foundations. In other words, new innovative financial technologies merely accelerate the concentration of global liquidity. Moreover, this liquidity concentrates within a dense core, while the significance and role of peripheral centers decline (Table 1).

Table 1

Rating dynamics of leading IFCs according to GFCI 37–39 (in points) [24–26]

Center/Research	GFCI 37	GFCI 38	GFCI 39
New York	768	766	767
London	765	765	766
Hong Kong	760	764	765
Singapore	758	763	764
San Francisco	752	752	744
Top-4 gap (max-min)	~19	~3	~3

Standard tools, specifically the Herfindahl-Hirschman Index (*HHI*), can be used to assess reconcentration

$$HHI = \Sigma s_i^2, i = 1...n, \quad (1)$$

where s_i represents the share of the i-th participant (center, issuer, or network) in the aggregate metric (currency turnover, volume of tokenized assets, or stablecoin supply). Concentration ratios are defined as the combined share of the four and five largest participants, respectively. Distribution inequality is assessed using the Gini coefficient and the Theil index. Concentration dynamics are analyzed via the non-parametric Mann-Kendall trend test, while the convergence or divergence of centers is examined through σ-convergence (dynamics of the coefficient of variation for GFCI ratings) and β-convergence.

The composite Reconcentration Intensity/Liquidity Index (RILI) integrates geographic concentration, tokenization issuer concentration, and stablecoin concentration into a single aggregate measure.

A similar trend is observed regarding the concentration of currency transactions in international financial centers (Table 2). For instance, according to a BIS survey [27], global foreign exchange market turnover rose to 9.6 trillion USD per day (an increase of approximately 28% compared to April 2022), while the concentration in four leading centers – the UK (37.8%), the USA (~19%), Singapore (11.8%), and Hong Kong (7.0%) – accounts for approximately 75% of global turnover. Notably, Singapore's share rose from 9.4% to 11.8%, indicating a trend of selective rather than uniform reconcentration.

Table 2

Concentration of global foreign exchange turnover, 2022–2025

Indicator	April 2022	April 2025
Global daily turnover, USD trillion	7.5	9.6
UK share, %	38.1	37.8
US share, %	19.4	≈19.0
Singapore share, %	9.4	11.8
Hong Kong share, %	7.1	7.0
CR4 (four centers), %	≈74	≈75

Furthermore, it should be noted that the UK's international financial center (IFC) holds approximately 49.6% of the global over-the-counter (OTC) derivatives market. The Bank of France asserts that the market is "increasingly concentrating in a few established financial centers".

Moreover, as research [24] indicates, regulatory predictability is the most significant factor driving this re-concentration, whereas institutional costs play a far less significant role.

This explains the concentration of business activity regarding the introduction of digital financial assets, tokenization, and stablecoin issuance within "traditional" jurisdictions, namely the US, the EU, Hong Kong, Singapore, Switzerland, and Dubai. Meanwhile, the role of "virtual" hubs is viewed as merely supplementary; in other words, the "end of geography" hypothesis is not borne out. Instead, one observes a decentralization of the financial infrastructure "within" IFCs.

On the other hand, trends toward the digitalization of economic processes and the tokenization of real-world assets (RWAs) are giving rise to new financial market players.

For instance, the market for tokenized RWAs (excluding stablecoins) grew from approximately 5–6 billion USD in early 2025 to around 31 billion USD by mid-2026. By the end of December 2025, the RWA segment had surpassed decentralized exchanges, securing the fifth position among DeFi categories. However, this growth is accompanied by a high concentration of issuers: six institutional entities control 88% of tokenized Treasury obligations. The BlackRock BUIDL fund held approximately 34% of this segment. This confirms the thesis of re-intermediation [19]: tokenization does not eliminate intermediaries but rather reproduces them in a new, digital form, concentrating activity around major institutional players in the financial market.

The market for payment and settlement instruments exhibits the highest level of concentration (dominant stablecoins show the greatest concentration within the entire digital financial architecture). In terms of issuance volume, the aggregate value of stablecoins rose from 205 billion USD at the beginning of 2025 to over 310 billion USD by the turn of 2025–2026. Two issuers – USDT (Tether) and USDC (Circle) – account for approximately 85% of the market, and up to 93% within the segment of stablecoins serving as fiat currency equivalents. Market concentration is also evident at the protocol and network levels: Ethereum at 170 billion USD (about 55% of the market), TRON at 81 billion USD, and Solana at 16 billion USD. Stablecoin-native payment and settlement operations are becoming increasingly institutionalized. Indeed, the Circle Payments Network unites dozens of financial institutions, while USDC facilitates approximately 70 trillion USD in on-chain settlements.

Thus, concentration (or re-concentration) is observed simultaneously across three levels: geography (International Financial Centers), the issuance of both traditional and tokenized Real-World Assets (RWAs), and settlement and payment operations (stablecoins). Consequently, trends in the development of International Financial Centers and digitalization validate Kindleberger's hierarchy thesis: the "keystone" of classical theory is transforming into the modern core of a spatial network hub for financial interaction among economic agents.

3.2. The digital network spatial hub as a basis for reconcentration

The formation of a hybrid financial infrastructure intersects with the implementation of the digital network spatial hub concept, which provides an organizational and institutional rationale for the reconcentration of the global financial market. In essence, the hub is a network platform that connects economic agents from different jurisdictions (or regions within a single jurisdiction). It ensures the synchronization (adaptation) of institutional regulatory norms, currency regimes, and financial instruments, while unifying technological protocols and standards. Such an organization entails the creation of a key (central) interaction node where information, resources, and counterparties are aggregated. In the context of financial asset tokenization, this central element takes the form of hybrid architectures (the "DeFi Mullet" T2.5 topology) and stablecoin-native payment and settlement networks, which require physical and institutional anchoring to a traditional jurisdiction.

Synthesizing existing research, the key principles for forming a digital network spatial hub in the era of tokenization are:

- consolidation – the transnational or cross-sectoral nature of the entity, involving liquidity aggregation;
- concentration – identifying key growth areas and incorporating the core entities of value creation;
- integration – the interaction of structural elements from international value chains within a unified center;
- adaptation – the harmonization of technical, technological, and regulatory standards across different jurisdictions;
- unification – the implementation of recognized international institutional norms (specifically, tokenization standards such as ERC-3643 for regulated assets, among others);
- risk minimization – independent expert assessment and the disclosure of standardized financial indicators;
- network organization – the creation of a digital portal (hub) for the interaction of economic agents based on decentralized DLT infrastructure.

From the perspective of state regulatory influence, the formation of such hubs entails a comprehensive set of fiscal, monetary, and foreign trade policy measures, as well as the introduction of technical regulations and institutional norms (standardization, certification, licensing, and accreditation). Crucially, the hub's effectiveness is determined not by the degree of technological decentralization, but by its ability to ensure regulatory certainty and integration into global financial networks – precisely the factors that drive reconcentration (Fig. 1).

The presented concept aligns with the principles of "Sticky Power" [20] and is based on the thesis presented in [8] regarding a hierarchy of centers featuring a "keystone". Moreover, this reconcentration occurs selectively: specific spatial network hubs, such as Singapore (as an international financial center), and technological protocols (involving the digitization and tokenization of financial assets, exemplified by Solana) are expanding at the expense of others, a pattern consistent with Markusen's typology of "sticky places" [18]. This indicates a reconfiguration rather than a decline of international financial centers under the influence of tokenization and the convergence of TradFi and DeFi, manifesting as digital spatial network hubs that serve as a key element in the formation of a new global financial infrastructure.

A more detailed research of the organization of digital network-based spatial hubs entails defining its comprehensive financial-organizational architecture. When viewed through the lens of a hybrid financial architecture topology, specifically, the taxonomy of Real-World Asset (RWA) tokenization it serves as a classification framework for introducing digital financial assets into circulation and determining their depth of market penetration. The DiFi (digital finance) matrix maps the convergence of TradFi and DeFi technologies within the financial architecture.

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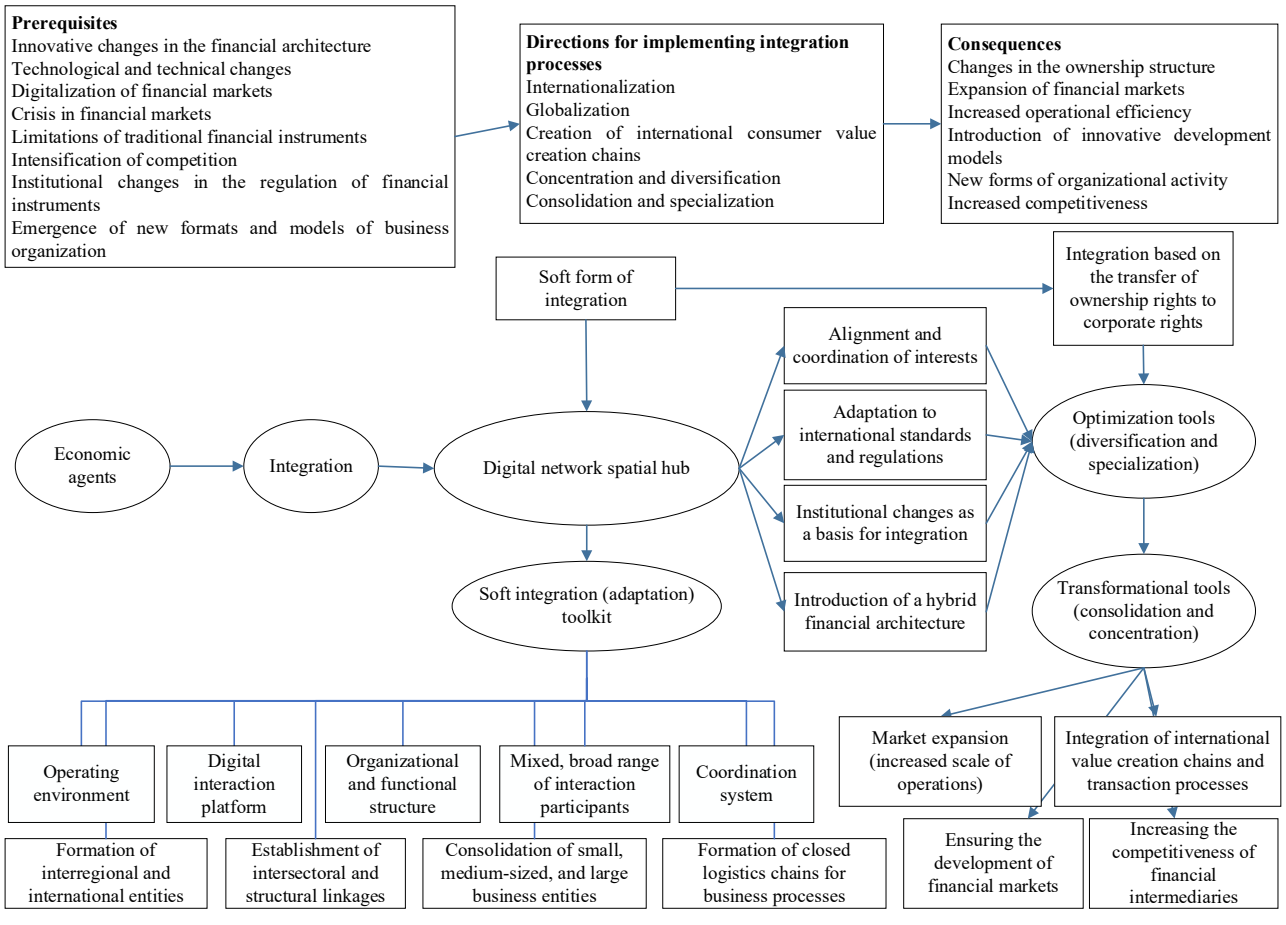


Fig. 1. General approach to forming a digital network spatial hub

First and foremost, it is necessary to examine the asset classes circulating within digital financial ecosystems. The asset classification is presented in Table 3 and encompasses seven groups of tokenized RWAs, the largest of which consists of debt instruments.

Table 3

Classification of tokenized assets [28]

Asset class	Asset types	The main subjects and the volume of the market in 2025–2026
Debt instruments	Treasury, municipal, and corporate bonds; ESG bonds; structured credit; and other loans	BlackRock, Franklin Templeton, Ondo, Superstate – about 4 billion USD
Real estate	Commercial and residential real estate (fractionalizable)	RealT, Blocksquare, ADDX – Growing – about 4 billion USD
Commodities	Exchange-traded mineral and energy resources	PAXG, XAUT – about 1 billion USD
Funds	Private equity and credit	KKR, Hamilton Lane, Apollo ACRED, JPMorgan – about 1 billion USD
Equities	Tokenizable equities and derivatives	Ondo, JPMorgan, BlackRock, Franklin Templeton – about 100 million USD
Energy assets	RECs, climate securities, green bonds, and energy infrastructure stakes	Powerledger, KlimaDAO, Energy Web – about 100 million USD
Other RWAs	Intellectual property, royalties, etc.	Just forming

From the perspective of the issuance and circulation cycle of tokenized RWAs, that is, their lifecycle, several stages can be identified; these effectively function as components of the financial architecture and define the hub's participants. These stages include issuance, custody, compliance, oracle services, settlement, redemption, lending, payments, governance, yield, and exchange. The key elements of the tokenized RWA lifecycle are presented in Table 4.

The main elements of the life cycle of tokenized RWAs define the functions and, accordingly, the participants of digital network spatial hubs.

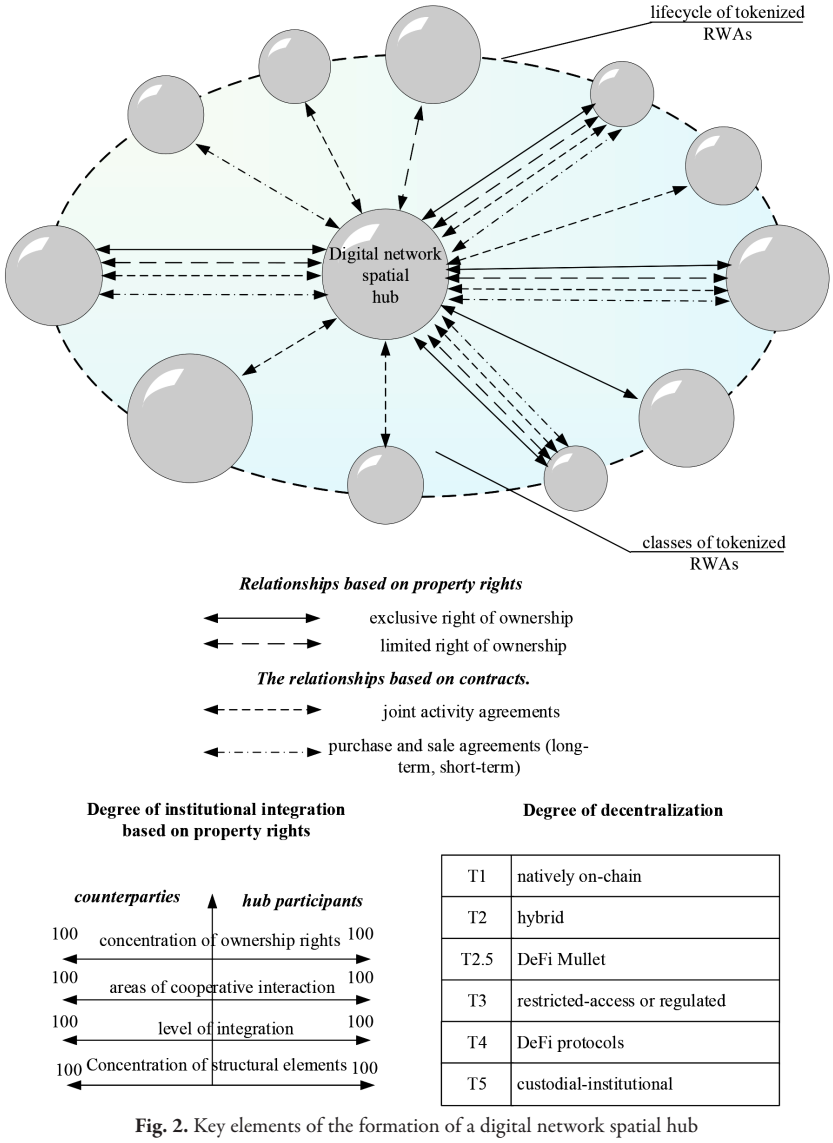
Table 4

Key elements of the tokenized RWA lifecycle within the DiFi infrastructure

Code	Lifecycle stage	Function within the financial architecture
I	Issuance	Issuance of tokens pegged to underlying assets (RWA)
C	Custody	Custody of underlying assets/digital keys
K	Compliance	KYC/AML, transfer restrictions, and allowlist (registry) management
O	Oracle	Provision of off-chain data (prices, NAV) to blockchain protocols
S	Settlement	Delivery-versus-payment (DvP) settlements
R	Redemption	Token redemption and return of underlying assets
L	Lending	Lending collateralized by tokenized RWAs
P	Payments	Stablecoin-based settlement and payment networks
G	Governance	Protocol governance and ownership rights regarding tokenized RWAs
Y	Yield	Revenue generation from tokenized RWAs (staking, farming, etc.)
X	Exchange	Secondary market trading on DEXs/CEXs, market making, and exchange of tokenized assets across different protocols and issuers

According to the degree of introduction of decentralized financial technologies, the following states of digitization of network spatial hubs can be distinguished: natively onchain (On-chain Native, T1); hybrid (Hybrid, T2); "DeFi Mullet" (traditional frontend with decentralized backend, T2.5); restricted access or regulated (Permissioned, T3); DeFi protocols (DeFi Protocol, T4); custodial-institutional (Custodial/Institutional, T5). The T2.5 topology deserves special attention as the main current form of convergence in financial markets: the regulated (Permissioned) TradFi interface is superimposed on the DeFi infrastructure. The most revealing is the example of the Coinbase integration interaction with the Morpho protocol [29]. As of 2025, the volume of active loans in this system amounted to 960 million USD, the total digital collateral (BTC and ETH) – 1.7 billion USD. And, about 1.4 million people became clients. Société Générale became the first general regulation bank to integrate DeFi to scale its own loan portfolio using Morpho [29] by issuing its own stablecoins under the MiCA regulatory metric [30].

The combination of the above components reflects the convergence of traditional finance and decentralized financial technologies. Thus, the taxonomy of the formation of digital network spatial hubs can be built along four axes: asset classes; legal entities participating in the issuance and circulation of tokenized financial assets; technical standards; ecosystem participants. In the most generalized form, the key elements of the architecture of the digital network spatial hub are presented in Fig. 2.



T1	natively on-chain
T2	hybrid
T2.5	DeFi Mullet
T3	restricted-access or regulated
T4	DeFi protocols
T5	custodial-institutional

Fig. 2. Key elements of the formation of a digital network spatial hub

Concentration metrics give an idea of the scale, depth and breadth of penetration of digitalization of financial instruments in the creation of network spatial hubs. Moreover, the degree of institutional integration determines the concentration of certain elements of the life cycle of tokenized RWA in the digital network spatial hub, which is based on the ownership of its stakeholders. And, the decentralization metric, determines the state of digitization of the spatial network hub.

The proposed approach allows determining the degree of convergence of traditional MFCs into spatial network hubs on the one hand. On the other hand, to what extent the existing players of the DeFi market concentrate the components of a financial spatial network hub in their structure.

3.3. Key limiting factors for the development of digital network spatial hubs

The adoption of digital financial infrastructure is hampered by several key constraints. Energy – the functioning of the digital financial infrastructure requires significant amounts of energy consumption. Regulatory – related to regulatory regimes in certain national jurisdictions. Security – military actions cause a significant impact on the functioning of the hub core.

The energy factor must be considered in two interrelated aspects related to reconcentration [31, 32].

The first aspect relates directly to the tokenization of energy assets as a distinct class of Real-World Assets (RWAs), such as renewable energy certificates (RECs), carbon credits (a tokenized market valued at approximately 400 million USD in 2024 and showing growth momentum), power purchase agreements (PPAs), energy infrastructure, and electricity tokens. Specialized platforms, including Powerledger, KlimaDAO, and Energy Web, have been established for these purposes, creating a distinct financial niche.

Thus, the development of the climate derivatives market organically complements the concept of digital network-based spatial hubs. Expanding the trading of these instruments on digital financial platforms facilitates the decarbonization of the digital financial infrastructure itself.

The second aspect concerns energy consumption and the need to decarbonize the power generation capacities supporting distributed financial infrastructure (a matter linked to the geographical distribution of that infrastructure). For instance, according to the International Energy Agency, electricity consumption by data centers rose from 460 TWh in 2022 to over 1000 TWh in 2026; notably, the cryptocurrency sector consumed approximately 110 TWh in 2022, with consumption projected to reach 160 TWh by 2026. Furthermore, roughly half of the new data centers in the US are being built within existing data center clusters (Northern Virginia, Dallas, Chicago, and Phoenix). Thus, energy, specifically its availability, cost, and decarbonization, acts as a driver of geographic concentration rather than the dispersion of distributed infrastructure. For example, the Ethereum protocol's transition to the Proof-of-Stake consensus mechanism in 2022 reduced the network's energy consumption by approximately 99%.

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Consequently, the availability of energy resources is becoming a key factor in the operational stability of digital financial infrastructure, while the potential to implement large-scale energy-reduction projects serves as an additional driver for the reconcentration of international financial centers on a new technological foundation.

Regarding the EU's energy regulatory framework, Article 66 of the MiCA Regulation and Commission Delegated Regulation (EU) 2025/422 establish regulatory technical standards concerning the content, methodologies, and presentation of sustainability indicators related to adverse climate impacts [33]. These regulations require crypto-asset service providers to disclose key metrics regarding energy consumption and consensus mechanisms. In effect, this excludes jurisdictions lacking transparency in energy usage and intensifies the concentration of activity within regulated hubs.

Based on the research conducted, the regulatory regime emerges as a key independent factor determining the geography of re-concentration (or the specific jurisdiction). The 2023–2026 periods is characterized by the emergence of competing national and supranational regulatory frameworks for RWA (Real-World Asset) tokenization and stablecoins. Essentially, each framework establishes an institutional environment that serves to attract digital financial activity. A comparative analysis of the regulatory regimes in key financial centers is presented in Table 5.

Table 5

Comparison of regulatory regimes for tokenization and stablecoins

Regime/jurisdiction	Status	Key features
MiCA (EU) [30]	In effect	Uniform rules for the issuance and circulation of crypto-assets; mandatory disclosure of energy consumption metrics; licensing of issuers and financial intermediaries
GENIUS Act (USA) [34]	Signed on July 18, 2025; entry into force no later than January 18, 2027	First federal law on payment stablecoins – mandates 100% backing (cash and US Treasury obligations); monthly reserve disclosure; establishes holder priority in bankruptcy
Stablecoins Ordinance (Hong Kong) [35]	In effect	Licensing for fiat-backed stablecoin issuers; minimum capital of HKD 25 million; 100% reserves; part of the LEAP regulatory framework
MAS (Singapore) [36, 37]	Regulatory framework for single-currency stablecoins (2023); draft Guardian regulatory framework	100% reserves; redemption requirements; tokenization pilot projects involving regulatory bodies
FINMA (Switzerland) [38]	In effect	Token classification (payment, utility, and real-world asset tokens); legal and regulatory certainty for DLT infrastructure

An analysis of the regulatory regimes under consideration makes it possible to single out the factor of regulatory certainty. Indeed, it is this factor, rather than low transaction costs or the regulations that reduce them that emerges as the primary driver of attractiveness, a conclusion supported by data from the GFCI survey.

Furthermore, the security situation in the jurisdiction hosting the core of the digital network-based spatial hub must be identified as a distinct, significant factor. Recent military actions in the Middle East have demonstrated not only the vulnerability of physical infrastructure, including energy systems but also the very viability of the concept of establishing distributed networks in jurisdictions facing a high risk of armed conflict.

The research findings lead to the conclusion that financial activity, within the context of shaping a digital financial architecture, is concentrated within a select group of jurisdictions. These jurisdictions are characterized by a combination of regulatory predictability, energy capacity, integration into existing global financial networks, and low security-related risks. This refutes the notion of the "end of geography": the technological and financial potential for decentralization fails to materialize because institutional and energy-related factors drive the trend toward the concentration of financial activity.

3.4. Research limitations and future directions

The practical significance of the research lies in the development of an analytical approach to assessing the processes of reconcentrating global financial flows amidst the convergence of TradFi and DeFi, as well as the digitalization and tokenization of assets.

The proposed concept of a digital network-based spatial hub can serve as a basis for formulating state regulatory policy regarding the integration of national financial markets into the global digital financial architecture. It enables the identification of priority jurisdictions and financial market sectors for the development of asset tokenization. Furthermore, it allows for the assessment of the roles played by regulatory certainty, liquidity, digital infrastructure, and energy factors in the emergence of new centers of financial activity.

The research has certain limitations. First, the analysis relies on publicly available data from regulatory reports, international indices, and analytical platforms; this may constrain the assessment of specific digital finance segments due to varying data collection methodologies. Second, financial markets are highly dynamic; consequently, the quantitative indicators presented reflect the situation at the time of the research and are subject to rapid change.

Promising avenues for future research include the empirical verification of the proposed digital network-based spatial hub concept and the construction of a composite index for the reconcentration of international financial centers, taking into account the limiting factors that influence the formation of new digital financial centers.

4. Conclusions

1. Analysis of trends in the transformation of financial architecture confirms that the digitalization of financial markets does not lead to the spatial dispersion of financial activity; rather, it is accompanied by its re-concentration. This is evidenced by the stability and strengthening dominance of a narrow core of leading international financial centers, specifically the top four in the GFCI rankings, which account for approximately 75% of global foreign exchange turnover. Furthermore, there is a noted dominance of a limited number of issuers of tokenized real-world assets (RWAs) and a high market concentration of stablecoins around USDT and USDC. Thus, asset tokenization and the development of stablecoins and DeFi are replicating the hierarchy of financial centers on a new technological foundation, transforming the traditional core of financial intermediation into a digital, spatial-network hub that concentrates liquidity, infrastructure, and regulatory trust.

2. It has been established that the digital network-based spatial hub serves as an organizational lever for the re-concentration of global financial flows within the hybrid TradFi/DeFi architecture. Such a hub functions as a central node integrating liquidity, digital infrastructure, regulatory certainty, technical standards, tokenized assets, and stablecoin-native payment and settlement networks. Its formation proceeds through the implementation of key elements of financial architecture, which can be categorized into four primary components of its taxonomy. It is characterized by a classification of tokenized RWAs, the economic agents that drive the lifecycle of tokenized assets, technical and technological standards, and ecosystem participants. This allows digital networked spatial hubs to be viewed as a new evolutionary form of international financial centers.

3. It has been determined that the development of digital networked spatial hubs faces a number of limiting factors, the primary ones being energy, regulatory, and security-related. Energy capacity and the decarbonization of digital infrastructure influence the geographic location of these hubs; regulatory certainty fosters institutional trust and integration into global financial networks; and a jurisdiction's security resilience determines the operational reliability of the hub's core. Consequently, digital networked spatial hubs emerge not in a distributed virtual space, but within jurisdictions capable of simultaneously ensuring liquidity, regulatory predictability, an energy base, and the protection of critical infrastructure.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

Manuscript has no associated data.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies in creating the submitted work.

Authors' contributions

Oleksandr Manoylenko: Methodology, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; ***Svitlana Kuznetsova***: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Supervision, Project administration, Funding acquisition.

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