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## IS CBDC THE REMEDY TO REVOLUTIONIZE COUNTRIES BANKING & FINANCIAL SYSTEMS (WITH PRIMERELY OBJECT TO UKRAINE)?

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**Abstract.** In our days that's hard to find countries in the world with central banks that not undertake energetic actions toward developing own digital currencies (CBDC – Central Bank Digital Currency). Those efforts are caring out in a similar way with advancing traditional centralized money system set under legal tender by a government. In a parallel mode we observe rapid demand growth for use of decentralized digital currencies, represented by different classes financial assets such as coins, tokens, e-money. The question arises: does CBDC transform and replace any traditional monetary system, assuming that new arrangement ought to satisfy practical needs for all contestants of complicate ecosystem structure starting from households/private investors, businesses, government?

**Key words:** Central Bank Digital Currency, CBDC architecture, decentralized digital currencies, centralized money system, coins, stable coins, tokens, e-money, legal tender, NBU, wholesale CBDCs, Stellar Development Foundation (SDF), distributed ledger technology (DLT), CBDC ecosystem, nonbank financial institution (NBFII), an application programming interface (API).

**Introduction.** In modern centralized monetary system, the only one party has the legal right to issue currency no matter how to we call that currency: dollar, euro, real, pound, yen, hryvna...and in well-developed and well-functioning banking and financial system of every single country the central bank makes money is absolutely available to the wide-ranging public and at this point we don't argue *in what way* central bank money are backed (reserves, direct obligation etc.); however, the most important is the answer on question: who is liable for central bank money taking into consideration all possible consequences for losing (gaining) money value, and who is responsible before money holders/investors over course of actions such as raising or lowering interest rate, changing discount rates and discount windows, interest for funds rate and reserves requirement, eventually for operation on open market over marketable/nonmarketable securities? The answer on that keystone quest can vary from country to country depending on numerous internal as well as external conditions of economy and banking/financial system. But ultimately the answer supposed to be determined: the only central banks are absolutely liable for stability monetary system. Now, we have to split liability taking into account the fact that central bank is liable for only the issued currency by itself and digital balances held by commercial banks at the central bank; although commercial banks clients that keep money mainly in digital form like bank checking, money market accounts, cd accounts and use available applications to move them from account to account (including online transactions) should be aware about no direct central bank liability for that part of money. So, by issuing CBDC and making them obtainable by public the central banks (not a commercial banks) become liable for "printing" own digital currency.

**Literature review and output conditions.** Criteria's for accuracy, reliability, authority, objectivity, currency and coverage for evaluating information from given information sources part "references".

**Purpose of the Article.** To perform qualified research on mentioned subject (CBDC) with respect to a fit object (Ukraine). Having a sense of that purpose, develop comprehensive professional as well as scholar knowledge, based on existed and personal judgements for that matter, provide gathered information, and sources of works.

**Methodology statement.** Set of allied intellectual enquiry methods for quantitative research, data gathering with use of data extraction, data analysis, case studies; qualitative & factual research - historical analogies, comparative dynamic, ethnographical, cultural absolute and relative business advances.

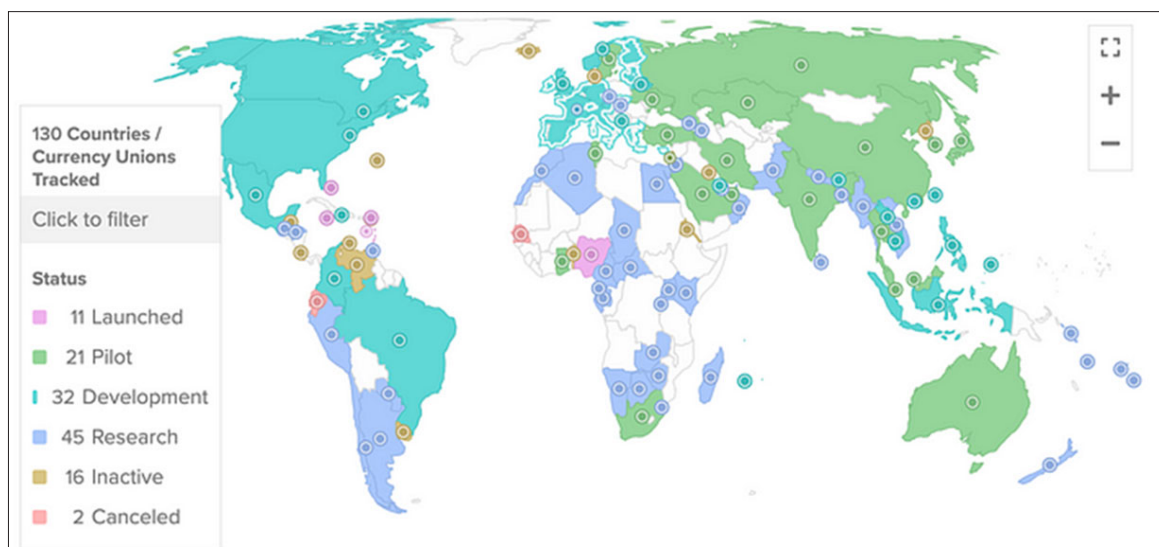
### Results of the study

#### 1. CBDC Timetable, Geography, Purpose

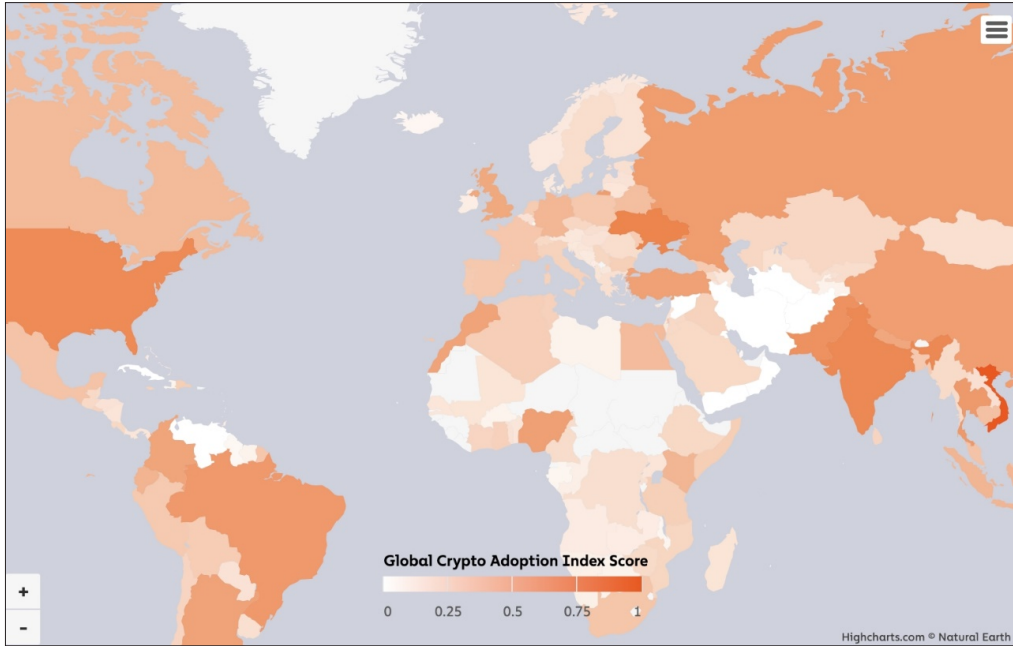
Modern history of central banks digital currency, in the context that researchers use today, count down from 1993 with effort the Bank of Finland to create Avant smart card system [1] or Avant Electronic Purse with aimed “to establish one national purse system” [2]. Project was had been completed in 1997. Since that, on june’23 130 countries all around the world have taking participation in CBDC race (almost 70% of countries in the world today). Most active participation stage has observed from the pandemic covid-19 start, from the end of 2019 almost 90 central banks have joined central banks “future money” bandwagon. Not all central banks today are on the same stage of development own digital currency, the most them are on the research stage 35% from total number, 25% banks are on development stage, 16% on pilot stage, 12% inactive, 8% already launched CNDC, 2 banks canceled project and another 2 banks not officially declared appropriate stage [3] (Fig. 1).

What is the phenomena of enthusiastic participation in “future money” run for vast majority of central banks? Let’s look, for instance on corresponding reality in Ukraine, one of the advanced countries in the world for practical use of cryptocurrency and corresponding marketplaces. In term of percentage of population owning crypto, Ukraine possesses 8<sup>th</sup> spot in the world with 10.3% skipping ahead United Arab Emirates, Vietnam, Saudi Arabia, Singapore, Iran, United States and Philippines, and 21<sup>st</sup> spot in the world with number of crypto ownership – almost 3.8 million people [5] even though Ukraine ranks 41<sup>th</sup> in the list of countries by population [6]. Taking into account cryptocurrencies transaction volume, which is measured by “Global Crypto Adoption Index” (Fig. 2), Ukraine’s ranked for the 3<sup>rd</sup> spot with index score 0.694, skipping ahead Vietnam and Philippines (first and second spots respectively); keep in minds that Global Crypto Adoption Index is “made up of five sub-indexes, each of which is based on countries’ usage of different types of cryptocurrency services with ranking 146 countries and the closer the country’s final score is to 1, the higher the rank” [7].

Truly remarkable results for Ukrainians who are accustomed to use cryptocurrency long time not appear to be random; can be explained by a following reason. First of all, country in 1991 historically acquired monetary & banking system model of the Soviet Union with no well-developed for personal



**Fig. 1. CBDC by Countries [4]**



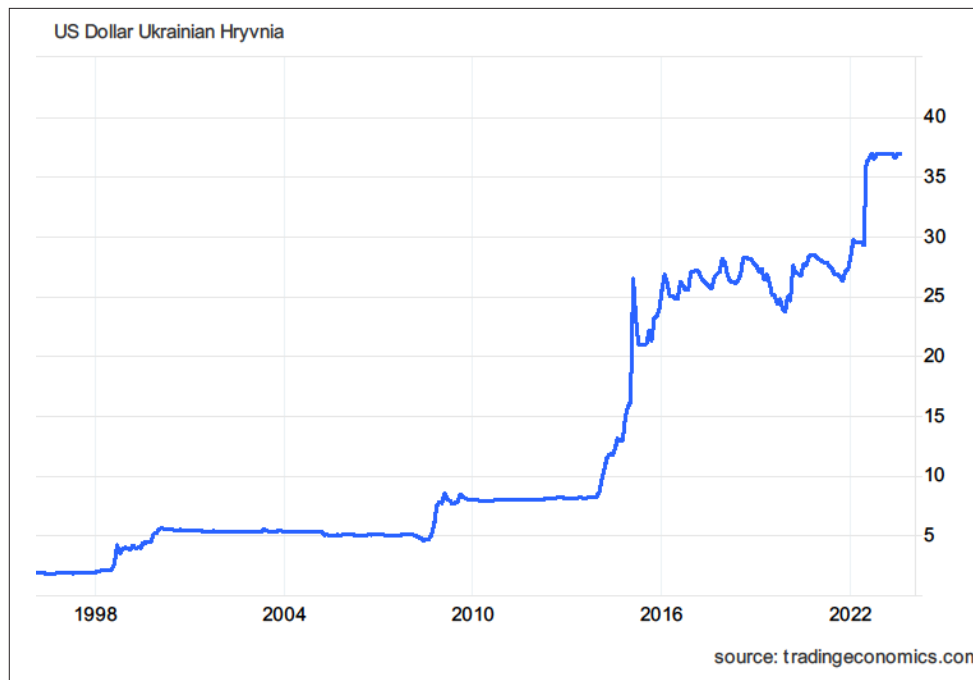
**Fig. 2. Global Crypto Adoption Index 2022 [6]**

use checking account banking structure, so very big part of money circulation circuit was out of banking system, merely in “cash on hands arrangement”, even our days no official data from NBU (National Bank of Ukraine) on question how much uncontrollable money circulate in economy; different estimations give range numbers from \$50 up to \$120 billion, if any of them are true, it accounts up to 50% of national GDP depending on official data for GDP; moreover, NBU reviles its official opinion, grounded on Ernst & Young and MasterCard study, Ukraine’s shadow economy 23.8% in UAH (Ukrainian Hryvna – Ukraine national currency) of total GDP, respectively with 19.7 cash shadow economy (Fig. 3).



**Fig. 3. Shadow Economy in Ukraine [8]**

The next reason also has historical roots and can be interpreted as mistrust to the monetary and financial government policy because of enormous lost of national currency value; par USD/UAH 1.73 (February – March of 1996) and 36.87 (august 2023) accordingly World Bank data (Fig. 4).



**Fig. 4. USD/UAH historical data [9]**

Level of Ukrainian currency inflation can be recognized as one of the highest in at least Central and Eastern Europe; data basis: International Monetary Fund, World Bank and OECD Inflation CPI indicator (Table 1).

Table 1

**Historical inflation rates in comparison [10]**

Year	Ukraine	EU	USA	World
1	2	3	4	5
2022	20.18%	8.83%	8.00%	8.27%
2021	9.36%	2.55%	4.70%	3.48%
2020	2.73%	0.48%	1.23%	1.93%
2019	7.89%	1.63%	1.81%	2.21%
2018	10.95%	1.74%	2.44%	2.44%
2017	14.44%	1.43%	2.13%	2.19%
2016	13.91%	0.18%	1.26%	1.55%
2015	48.70%	-0.06%	0.12%	1.43%
2014	12.07%	0.20%	1.62%	2.35%
2013	-0.24%	1.22%	1.46%	2.62%
2012	0.57%	2.66%	2.07%	3.73%
2011	7.96%	3.29%	3.16%	4.82%
2010	9.37%	1.53%	1.64%	3.35%
2009	15.88%	0.84%	-0.36%	2.94%
2008	25.23%	4.16%	3.84%	8.95%
2007	12.84%	2.51%	2.85%	4.82%

Continuation of the table

1	2	3	4	5
2006	9.05%	2.67%	3.23%	4.28%
2005	13.57%	2.49%	3.39%	4.11%
2004	9.05%	2.29%	2.68%	3.38%
2003	5.18%	2.09%	2.27%	3.03%
2002	0.76%	2.42%	1.59%	2.83%
2001	11.96%	3.37%	2.83%	3.84%
2000	28.20%	3.15%	3.38%	3.49%
1999	22.68%	2.16%	2.19%	3.08%
1998	10.58%	2.42%	1.55%	5.11%
1997	15.94%	3.11%	2.34%	5.57%
1996	80.33%	3.56%	2.93%	6.55%
1995	376.75%	4.43%	2.81%	9.15%
1994	891.19%	4.72%	2.61%	10.32%
1993	4734.91%	4.85%	2.95%	7.51%

Next problem is about keeping currency practically nonconvertible for cross border transactions (up to 2019 some currency liberalization practices) for major part of population; thus, on February 2019 NBU has launched new regime for Foreign Exchange regulation accordingly the Law of Ukraine On Currency and Currency Operations adopted in 2018 [11]; basically major idea is about easing for Ukrainian citizens as well as for Ukrainian businesses transactions on a forex market without obtaining individual licenses that for years have been granted by NBU (on a single transaction bases – separate license), in case if citizen or business does not have so called “currency contract”; before mentioned act had been adopted, citizens or businesses that had “currency contracts”, could apply to needed transaction over one legally possible channel – National Currency Exchange (basically functional structure of NBU with some additional authorities). Accordingly, currency liberalization road map looks as following (Fig. 5).

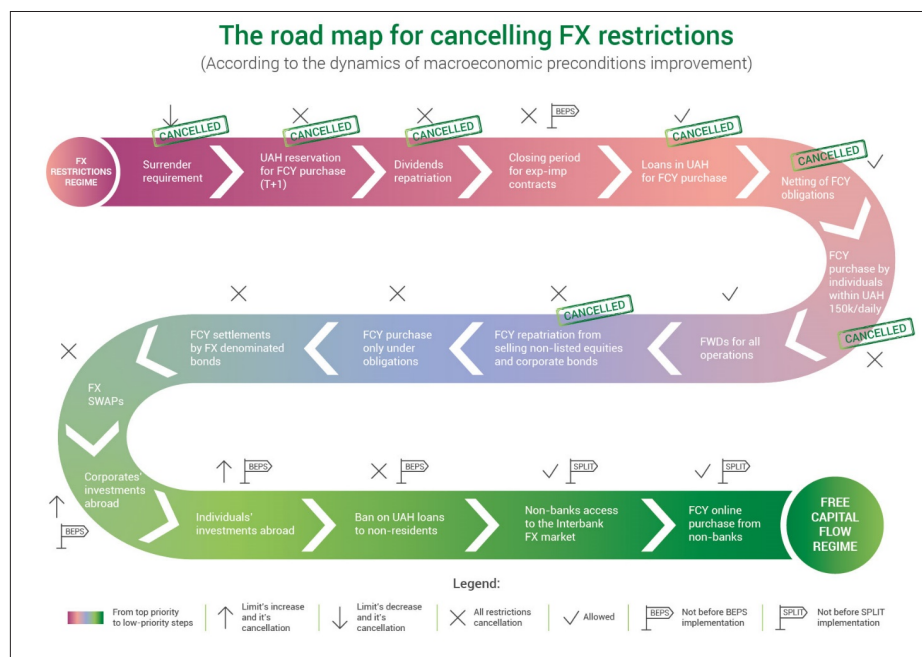



Fig. 5. A new regime of FX regulation road map [12]

Next motive is the corruption system which sophisticatedly transformed over last almost ten years from simple schemes and methods of compensation interested parties in cash (dollar or euro mostly) on the soil of Ukraine toward much more elegantly structured transactions with use of cryptocurrencies and accepting cash on legally opened digital vaults not only in “tax haven” zones. Mostly for that purpose widely has been used range of suitable *stable coins*.

Let’s have a closer look on some important parameters of Ukrainian CBDC and officially declared purpose of government digital currency. It has own name “e-hryvnia”. Seems, the term “e-hryvnia” is not exactly reflects the essence of what NBU aims on that. Basic idea about non-cash form of national money has formulated and practically grounded in mid-90<sup>th</sup>, since that diverse approaches and arrangements have been tested and used on different scales and scopes. One of the latest pilot projects started from the use so called “electronic money” or simply “electronic hryvnia” [13]. Three banks have been granted relative license in Ukraine (table 2).

Table 2

### Information from the Register of Payment Infrastructure about Issuers of Electronic Pennies [14]

 <b>Національний банк України</b>		Інформація з Реєстру платіжної інфраструктури про емітентів електронних грошей				
№	Повне найменування емітента електронних грошей	Код за ЄДРПОУ емітента електронних грошей	Тип емітента електронних грошей	Дата внесення в РПІ	Дата виключення з РПІ	Перелік фінансових платіжних послуг
1	АКЦІОНЕРНЕ ТОВАРИСТВО “СЕНС БАНК”	23494714	Банк	10/21/2022		Послуги з випуску електронних грошей та виконання платіжних операцій з ними, у тому числі відкриття та обслуговування електронних гаманців
2	ПУБЛІЧНЕ АКЦІОНЕРНЕ ТОВАРИСТВО АКЦІОНЕРНИЙ БАНК “УКРГАЗБАНК”	23697280	Банк	11/14/2022		Послуги з випуску електронних грошей та виконання платіжних операцій з ними, у тому числі відкриття та обслуговування електронних гаманців
3	ПУБЛІЧНЕ АКЦІОНЕРНЕ ТОВАРИСТВО “МТБ БАНК”	21650966	Банк	12/6/2022		Послуги з випуску електронних грошей та виконання платіжних операцій з ними, у тому числі відкриття та обслуговування електронних гаманців

In term of scalable use of electronic money, was “Sense Bank” (up to 2022 “Alfa Bank”), mostly due to practice of innovative approach by its major clients such as “Nova Poshta”, the most active player with electronic money. But we have to recognize the fact that arrangement for electronic money is fairly different for what cryptocurrency require for its procedure; electronic money can be used as a set of interbank regulations between commercial bank and clients reflecting that transaction on correspondent account in the central bank on the daily basis, and reminds the logic of opening dedicated account on which client in the beginning of the operational day put some amount of cash and do not use that cash, instead all daily transactions are performed by bank on interbank non-cash basis, so no needs for any cash or cash equivalent instruments transactions. The algorithm and arrangements for cryptocurrency suggests different technological and software platforms.

The widely used answer on question about major aim for central bank digital currency very simple – “to boost the digital economy” along with issuing “fiat currency as a medium of exchange to exchange goods and services” [15]; states that central banks are not willing to loose exclusive power to control money emission center preserving dominant consolidated financial and monetary system under own control. Let’s turn to e-hryvnia NBU, in addition to what proclaims every central bank, Ukrainian regulator points out a few more purposes such as “promoting and reducing the price of noncash payments, improving transparency of settlements, ensuring confidence in the domestic currency in general, supporting circulation of virtual assets, and cross-border payments” [16].

#### 2. CBDC Types

In order to reach stated goals, central banks use two major CBDC types: Wholesale CBDCs and Retail CBDCs. Basic idea behind Wholesale CBDCs is about large-value financial transfers like cross-border or interbank and securities transactions established from end to end financial market reg-

istered representatives, and not all financial institutions are proxies for use Wholesale CBDCs; moreover, undermanned that central bank wholesale CBDCs can be functionally used for own reserves pooling.

In contrast to Wholesale CBDCs, the dominant idea of Retail CBDCs is about conducting central bank digital money transactions for businesses and people as advanced version of cash, not replacing the monetarist functionality of storing value for end users. Fruitful example, Cambodia's CBDC (Bakong): "the associated Bakong smartphone app can be used at stores and for transferring money. People do not need a bank account to register for Bakong, as long as they have a Cambodian mobile phone number. Users can send funds by scanning QR codes or specifying the recipient's phone number" [17].

Retail for NBU e-hryvna retail architecture has been represented by Accenture in 2019 [18] and conceptually corresponds with a prototype for Two-tier Central Bank Digital Currency (CBDC) from Bank for International Settlements Innovation Hub [20].

NBU e-hryvna is given structure of token with Stellar know-how provider (Stellar Development Foundation (SDF) on distributed ledger technology (DLT), wherein NBU owns and manages the system (ecosystem) as governing structure.

### 3. CBDC ecosystem

Viability of every single digital asset which undoubtedly communicates to CBDC, is about how that asset fits ecosystem, if ecosystem can be identified and described at all. Attempts to identify own ecosystem suppose not only all shareholders to use CBDC, fears that push those shareholders to create system and support it with regard to benefits and costs that underlie respective *economic* and *financial* models for, in our case CBDC.

In fairness to attentive ecosystem research we ought to point out attempts with bitcoin and other digitalized assets; "modern" stage might be reviewed with Central bank digital currencies. System design and inter-operability by BIS [21] and Project Rosalind is an experiment exploring application programming interfaces (APIs) for retail central bank digital currency (CBDC) (by Bank of England)

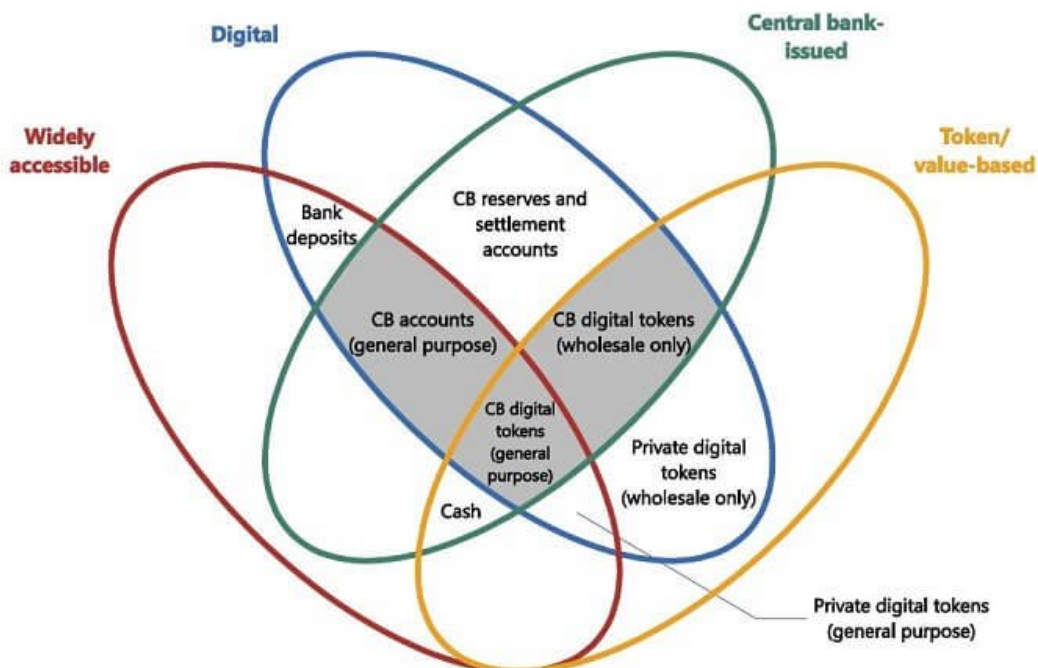


Fig. 6. Digital medium of exchange [19]

[22]. By the way, in our personal assessment, one of the best efforts to describe ecosystem landscape belongs to AWS (Amazon Web Services) with Objectives and architectural considerations 2021 [23].

Furthermore, we should recognize that no single template for central bank CBDC is existed so far due to numerous internal as well as external factors of economic, financial and country banking structure. Thus CBDC E-Hryvnia centralized ecosystem (tested February 2020) looks as follow (Fig. 7).

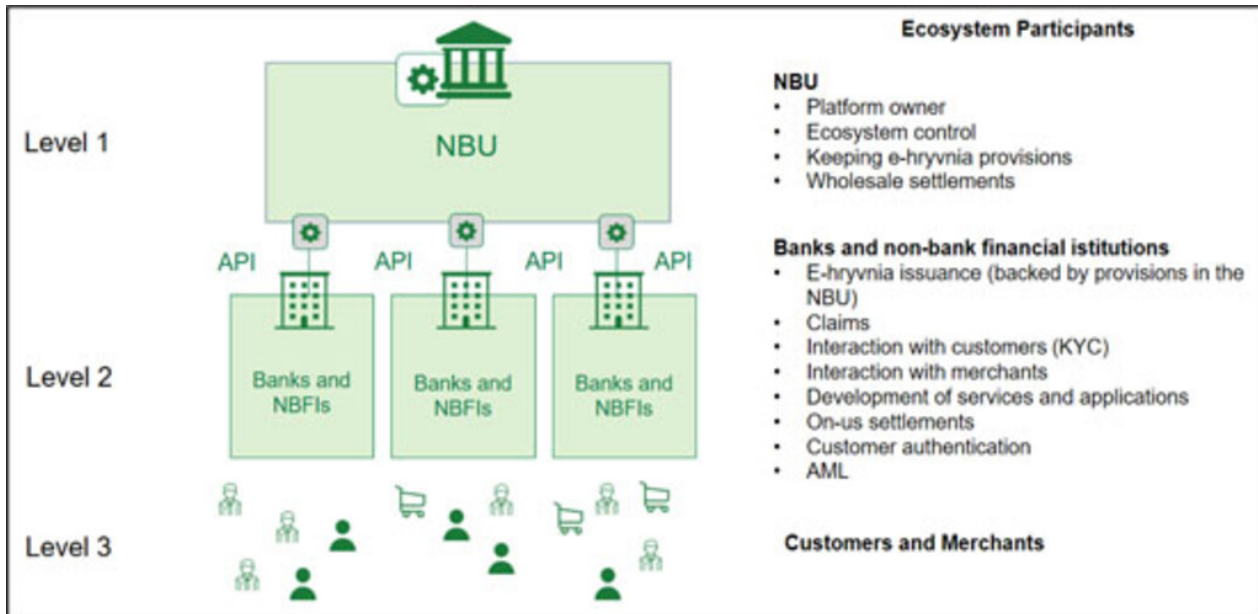


Fig. 7. E-hryvnia centralized ecosystem (tested) [24]

What pricks on alert with indorsed e-hryvna ecosystem? The fundamental point is about missed e-hryvna value proposition and what makes that value unique for its users; basically authorized by regulator ecosystem exemplifies only simple draft potential banks (including NBU) and NBFIs as possible e-hryvna operators. In our opinion that happened due to no clear acknowledgment for focus: set of goals for value proposition in ecosystem delivering for stakeholder's tangible and intangible values; basically understanding focus grounded on deep and comprehensive external and internal analysis. For external analysis supposed to be awareness of ecosystem, business environment, social environment, technological environment, legislative environment; for internal analysis: knowledge of ecosystem capabilities comprised from ecosystem contributors' competencies collectively represented by customers, merchants, vendors, operators and foundation. As a result, no strong commitments for ecosystem performance with must have attributes such as knowledge, technology, security, accessibility, personability, exchangeability, tradability, raising customer retention ratio (or trust in new currency), enriching brand relationships, higher level of customer satisfaction with merchants as well as with e-hryvna brand.

Strategic focus of NBU CBDC model ought to rely on profound understanding ecosystem up-to-date capabilities in order to make decisions for forthcoming arrangements. Analytical techniques use rational about frameworks that allow identify, clarify, and understand relevant factors setting NBU CBDC future course. Frameworks are irreplaceable to help one to come to grips with ecosystem sophistication. The results for the model is in a prediction of how the ecosystem works and how all ecosystem' stakeholders are involved in that system. In our consideration, NBU CBDC supposed to become a pathway getting from a current state to a future state of monetary system but not additional to fiat currency mean of regulator centralized control, mainly by creating an ecosystem's position

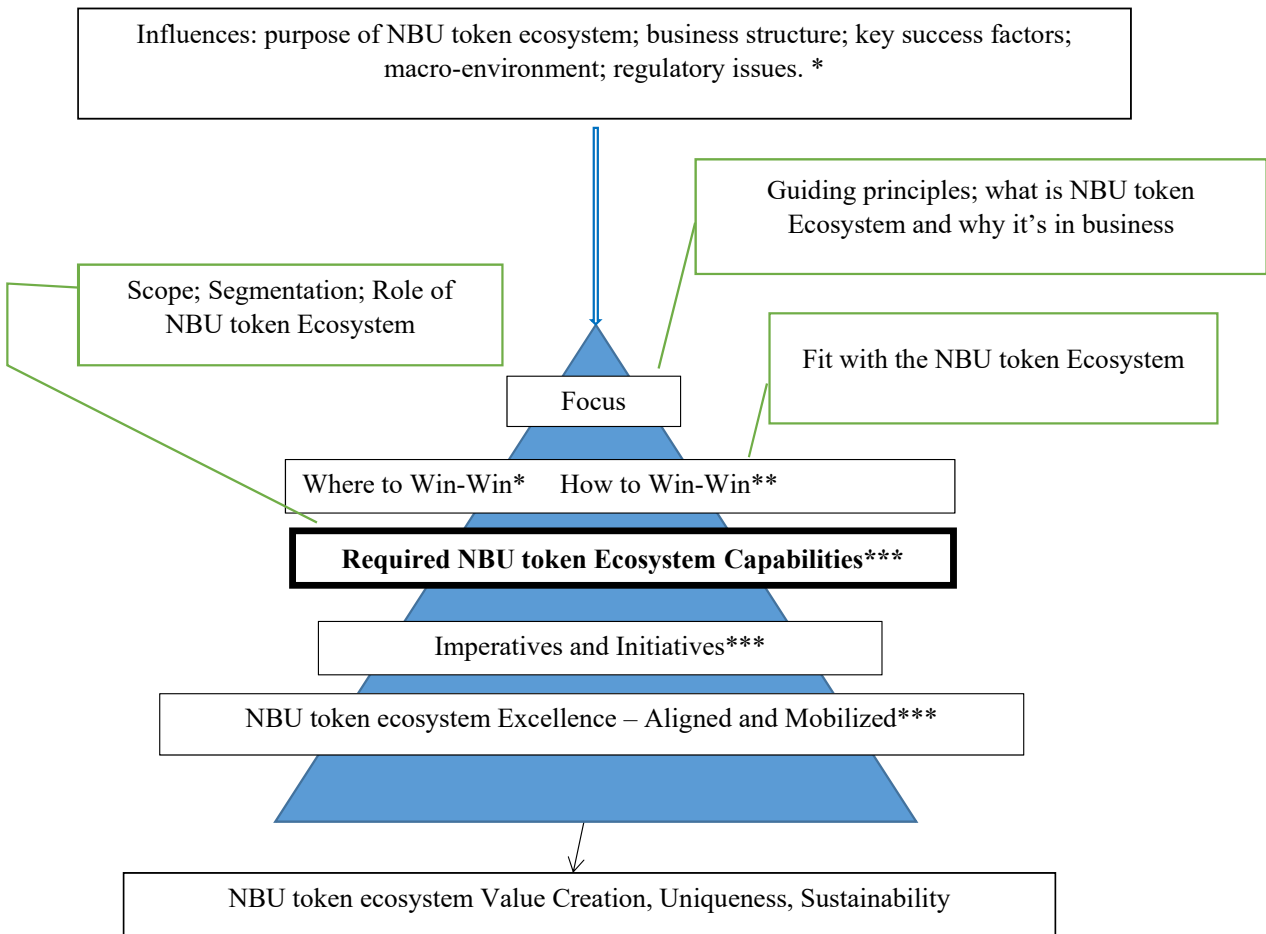


supported by a set of activities. The positioning denotes to a market space for servicing ecosystem stakeholders. The ecosystem activities are internal and include processes and circuits, formed to support loyalty programs' NBU tokens circulation. Thus we can further structure NBU CBDC ecosystem as follow (table 3).

Table 3

NBU token Ecosystem Stakeholders				
NBU CBDC Ecosystem Stakeholders				
NBU token Foundation	NBU token Vendor(s)	NBU token Merchant(s)	NBU token Customer(s)	NBU token Market Maker(s) – Marketplace

NBU token ecosystem ought to include win-win decision with collaborative approach that aims how to accommodate all stakeholders in order to maximize NBU CBDC ecosystem long term value. Where to win-win embraces choices on positions in markets and how to win-win includes approaches to ecosystem implementation. By itself ecosystem pursues operational scale on multiple geographic markets, and contribution for every NBU token ecosystem stakeholder precise service features. Also, each geographic market is referred to as unique actions to achieve desired outcomes. Thus we can formulate logic of unique structure for NBU token Ecosystem (Fig. 8).



**Fig. 8. Unique structure for NBU token Ecosystem**

Note: \* External Analysis; \*\* Internal Analysis; \*\*\* Implementation

Identifying a core challenge the NBU token ecosystem. Challenges identification avoids developing a model that is devoid of ecosystem authenticity. NBU token ecosystem challenges come from various places such as external threats, new market opportunities, or failures within an ecosystem such as poor ecosystem’ organizational design. The first major challenge is about building decentralized (or centralized as it tested up to date) platform with no central control (or with central control!) the process yet realizes the importance of stakeholders’ knowledge, actions, and decisions unencumbered by centralized authority. Second one is about determination ecosystem as viable, feasible, and sustainable. Third one is around diminishing risks by decreasing ecosystem inconsistency. What challenges we ought to expect:

- NBU token ecosystem challenges:*
- ✓ building decentralized (centralized) trustworthiness platform
  - ✓ determination ecosystem as viable, feasible, and sustainable
  - ✓ diminishing risks by decreasing ecosystem inconsistency

The positioning NBU token ecosystem must be unique and valuable to all stakeholders and the ecosystem has the capability to protect its positioning. Wherein the value in ecosystem delivered from contributors (stakeholders) of ecosystem and those contributors use correspondent resources for that purpose. Thus value proposition in NBU token ecosystem comes from specific contributors’ activities, which in own turn form individual cost base and cost structure. Should be noted, that value proposition appeared as materialized (monetized) in form of streamed revenue (tangible values), and as in no monetized form (intangible values) such as customer satisfaction with merchants as well as with new digital money brand. For now, we can structure NBU token ecosystem as following (table 4) and further more detailed functionality for “What/Who delivers” (table 5).

4. CBDC Marketplace Challenges to Be Prepared

Additional four fundamental queries of NBU digital currency ecosystem as well as business model resolves:

Table 4

**NBU token ecosystem formalized Unique Value Proposition structure**

What/Who delivers – ecosystem	Core Activities in Ecosystem	Unique Value Proposition	Customer Relationships	Customer Segmentation
1) merchant(s) 2) vendor(s) 3) operator(s) 4) foundation	What differentiates NBU token from other digital currencies?	}	In what form relationships accomplished?	What group(s) support generally relationships & channels? (mostly about targeting)
	Core Resources		Channels	
1) merchants 2) vendors 3) operators 4) foundation	What resources support core activities?	}	How revenue generates?	
Cost Structure		Revenue Structure		

Table 5

**Delivering the e-hryvna value proposition**

	<b>NBU token Foundation</b>	<b>NBU token Vendor(s)</b>	<b>NBU token Merchant(s)</b>	<b>NBU token Customer(s)</b>
<b>Role</b>	Ecosystem architect, emitent and holder e-hryvna	NBU token technology provider, node holder(s)	Tokens operator(s)	tokens user
<b>Responsibilities</b>	To issue guides, standards, criteria, etc., for different ecosystem players To develop network and client software and issue new releases of it	– to hold NBU token node – to integrate new Merchants NBU token – to support existing Merchants at technology, legal and accounting levels	To reserve NBU token with healthy equivalent in fiat, gold, etc.	Update the wallet regularly
<b>Power</b>	To accredit new Vendors and recall accreditation from those, who do not comply with Vendor acceptance criteria	To accredit new Merchants and recall accreditation from those Merchants, who do not comply with Merchant participation criteria	To agreed nominal price for NBU token.	To exchange one token to another within NBU token ecosystem
	Collects and distributes fees from transactions	Obtains reward for connected customers' activities	Obtains loyal customers and tokens of high liquidity	Pays commission for token transfer and exchange
	Provides access to external assets (fiat, crypto) via NBU token.			
<b>Typical profile</b>	Head office: R&D, Strategy, Technology, Legal, Accounting, Security Center of Competence on Token Loyalty	Software Vendor, who develops software for loyalty management or provides software as a service for Merchants	Retailer, ideally with e-commerce enabled. Consumes software or services from Vendors.	Anybody with e-hryvna wallet, who consumes goods or services from Merchants and who is granted with tokens from a Merchant
<b>Motivation</b>	Motivation is to earn from disruption of new digital currency management market	To earn on NBU token area development	Novel management, technology, better utilization of digital currency, new cheap traffic of customers	Self-determination of e-hryvna use. No cards in the pocket anymore – all vendors in one wallet.

1. How many market segments of the “new currency” ecosystem does serve and who are specific beneficiaries of NBU digital currency ecosystem?
2. How (in what method) relationships between beneficiaries built within NBU digital currency ecosystem?
3. What channel(s) NBU digital currency ecosystem uses to deliver value to beneficiaries in the future?
4. What the most efficient pathway to create CBDC marketplace

The answers on those questions need additional thoughtful research.

**Conclusions.** Modern centralized banking and financial systems experience rapid changes in external and internal business environment. Central banks more and more are involved in experiments with issuing own digital currencies. So far that early to say if new digital money will serve prosperity all participants of highly integrated financial market, or that is going to fix local or regional monetary problems. Generally, we ought to accept the result for evolution of central banks money and payments brings new prospects, along with new tasks. Powerful spin of non-cash use started with pandemic (covid-19) crisis and as for today the major trend is still there – central banks are exploring how they can continue to deliver their public policy objectives, ensuring liability for preserving monetary value for customers. Not all countries are at the same benchmark on that race to jump in “new money bandwagon”. Noticeably enough, countries with less advanced banking and financial systems make more efforts in the way of digitalized version money use, among those countries stays Ukraine with own version CBDC – e-hryvna; conducted research delivers the piece of confidence that NBU effort is going to deliver some advance to economic and financial country prosperity, obviously if respective job will be stranded on very compassionate, prudent and acumen up to day knowledge and practices some of them have been presented in this article.

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