



Human-value-centric digital transformation of money

With special thanks to Charles Moore, Rajinder Jhol and Oksana Lozitskaya.

Executive summary

The current financial system, being built historically, is overcomplex and broken. This legacy system has many artificial and natural barriers which prevent flow of value from one Actor (Human, Business and Government) to another Actor. Knowing that flow of value is a fundamental activity in any modern society, ideally, value must flow with the following characteristics:

- privately, inclusively, clearly, impartially,
- effortlessly, freely, instantaneously,
- legally, securely, equitably,
- face-to-face and remotely,
- in retail, wholesale, and cross-border transactions,
- with and without access to the Internet,
- within a Currency Area and between different Currency Areas.

Thus, the current financial system must be rearchitected and digitally transformed. A nexus of pandemic, ecology difficulties, digital transformation and economy failures has nullified many old dogmas. A set of human-value-centric principles is proposed to govern such rearchitected and digital transformation with the goal of the revitalisation of the financial system and economy recovery.

The core innovation is a Digital Coin as a digital bearer financial asset anchored with intrinsic value, issued by the Currency Area Authority as a legal tender. The Digital Coin is an enabler for the target system of moneys, the target system of payments and other systems. The Digital Coin is an archetype for creation of various Digital Currencies.

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1 This is a digital transformation

This document is aimed to present the logic and initial results of systemic digital transformation of the system of moneys, the system of payments and other related systems. All of them together will form a unique environment which enables economy recovery and revitalisation of the world financial system.

As well known, digital transformation of something (an entity, a system, an enterprise, a practice, a region, a country, etc.) obliterates some existing artificial and natural barriers associated with or ingrained in this thing. Typical barriers are distance, time, languages, cost, culture misunderstandings, etc. For example, Skype and WhatsApp removed natural and artificial barriers to freely connect all people from the planet. Skype and WhatsApp eliminated the distance and cost barriers. Adding automatic translation will eliminate the language barrier as well.

Considering that money has been invented to ease value transfer from one Actor (Human, Business and Government) to another Actor, the current financial system established many barriers for flow of value. For example, those barriers contribute to fees (loss of value for Actors) for cross-border money transfer (e.g., as remittances) which can be 7-10% of the transferred value.

This article outlines only some parts of the desired target system. The known so far complexity of this system is presented below:

- System of moneys
- System of payments
- System of financial assets
- System of financial events
- System of financial processes
- Systems of financial audit procedures
- System of investments
- Humans' moneys

Please note that each of the mentioned above systems is named as a set of its primary object, i.e., "system of payments" not "payment system", because an individual payment may be split into a few payments, or a few events may be considered together as an important event.

The audience (i.e., typology of Actors) of the system of moneys and the system of payments is straightforward: Humans, Business, Governments, Central Banks, Commercial Banks and BigTech with banking licensing. For simplicity, only main stakeholders are listed above. However, the primary beneficiaries are Humans and Business because they enable the real sectors of economy.

Any overcomplex and broken legacy system cannot be replaced overnight by a perfect target system, especially in the case of socio-technological systems. One of the systems heuristics¹ says: "In introducing technological and social changes, how you do it is often more important than what you do". A digital transformation of a socio-technological system from a current "as-is" state to a target "to-be" state (in

¹ "The Art of systems architecting", Mark Maier and Eberhardt Rechtin, 2000.

which the digital transformation becomes “new normal”) is usually more complex than the target system. Such digital transformation must be carried out step-by-step while the current and target systems peacefully co-exist for some time.

It will be normal when the target system is reconsidered as more knowledge and experience have obtained. This is the principle of **protopia**² as illustrated in Figure 1.

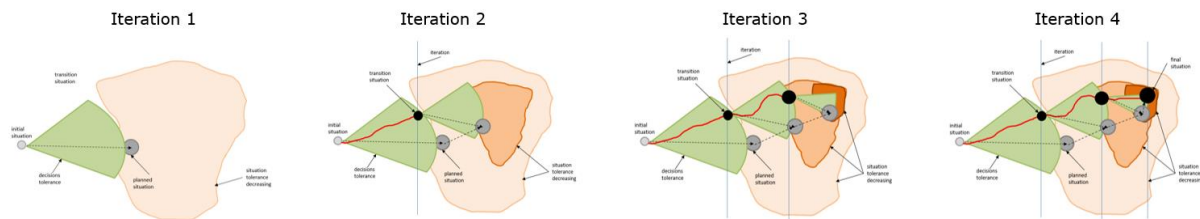


Figure 1 Principle of protopia

This article is only about the first iteration. Further iterations are yet “unknown unknowns” however the second iteration will become known during the first iteration.

2 Human-value-centric principles

The human-value-centric principles, which are described in this chapter, emphasize the supremacy of Human (as the primary beneficiary) and the supremacy of value (i.e., the value must flow).

The extreme importance of good, right, and successful system of moneys and the system of payments has been publicly recognised for many years. The fragment of the law³ of Commune de Paris (see Figure 2) says: “Likewise, money is the blood of the social body” and “Life among the people depends on the circulation of money” (or as one says right now, flow of value).

SÉANCE DU 1^{er} MAI 1871 11

UN MEMBRE. — Je demande la lecture de l'article. C'est de toute justice pour que la Commune puisse juger. (*Oui!*)

PYAT. — Je demande à lire l'article. Vous verrez que c'est un article purement philosophique.

UN PROJET DE DÉCRET

*Le sang est de la chair liquide, dit la physiologie.
Suivant cette science moderne, c'est le fluide nourricier, l'élément et l'aliment des solides, l'agent réparateur et créateur des tissus du corps humain.
De même, l'argent est le sang du corps social.
Le mot de circulation en français et de currency¹ en anglais prouve bien que la physiologie politique voit dans l'argent ou tout autre signe monétaire représentatif de la richesse, du produit commun, l'analogie² de la force vitale dans l'homme, l'agent de formation et d'entretien des organes et des fonctions, le globule sanguin, vraie pièce d'or, circulant dans les artères et les veines de la nation.
La vie dans l'homme, c'est l'ABC de la science, dépend de la circulation du sang.
La vie dans le peuple dépend de la circulation de l'argent.*

Figure 2 A fragment of the law of Commune de Paris

² The word “protopia” was coined in a 2011 blog post by Wired’s founding editor Kevin Kelly, see <https://kk.org/>

³ Source: <https://archivesautonomies.org/IMG/pdf/commune/communedeparis/proces-verbaux/seance-1871-05-01.pdf>

Human-value-centric principle 1 Money, currency and, ideally, payment means are **public goods** thus an integral part of the society lifestyle. All public goods are governed by **civic society**, managed by **public institutions**, and operated by **business entities** (leveraging Private-Public Partnership).

Human-value-centric principle 2 The physical cash, i.e., banknotes and coins, is a **financial bearer asset**. This feature of cash is attractive for Humans and Business because such an asset is fully controlled by its owner without any intermediaries. In any digital evolution of the system of moneys there must be digital currencies with all good (for primary beneficiaries, i.e., Humans and Business) features of cash. Also, all bad features of cash should be eliminated by digital currencies.

Human-value-centric principle 3 Governments introduce national laws (about “legal tender”) that payments in national currency (currency in form physical cash, i.e., banknotes and coins) are **free of charge** and have **immediate legal finality** without any trade contract.

Human-value-centric principle 4 **Currency Area** (a country, a region, a community of interest, a project, an industry, business, a union of countries and the whole planet Earth etc.) is a formal or informal authority for currency circulation under governance of a **Currency Area Authority**. Currency areas may overlap, e.g., bitcoin’s Currency Area is the whole planet. The Currency Area Authority decides about circulation of overlapping currencies. Each Currency Area can choose its own path and its own pace for introduction of digital currencies.

Human-value-centric principle 5 The current reality is that there are many digital and traditional currencies (from various Currency Areas) which must co-exist for some time. Although digital currencies will prevail, the various cryptocurrencies, CBDC, stablecoins, electronic money, etc. will compete and the **best type of digital currency will be chosen by the primary beneficiaries**, i.e., Humans and Business.

Human-value-centric principle 6 Value must flow (between Actors) with the following characteristics:

- privately, inclusively, clearly, impartially,
- effortlessly, freely, instantaneously,
- legally, securely, equitably,
- face-to-face and remotely,
- in retail, wholesale, and cross-border transactions,
- with and without access to the Internet,
- within a Currency Area and between different Currency Areas.

Human-value-centric principle 7 The main systemic characteristic of the system of moneys and the system of payments is **simplicity**. A good example of simplicity is the financial system at the time of the Musketeers: it was sufficient to throw a couple of coins (“louis-d’or”, a metallic-cash-coin) on the table in a tavern to pay for lunch. Also, the amount of gold in those coins (“louis-d’or”) can be checked independently of the government which issued those coins. Of course, the natural barriers of the usage of cash must be overcome at the time of Internet. However, no “smart” things at this level, please.

3 System of moneys

3.1 Basics of moneys

Money is an old humanity invention to simplify the trade of Commodities (any goods/services that are produced for sale on the market, i.e., for the sake of exchange). The simplest form of such trade is a barter exchange, i.e., goods/services (Commodity "C1") for goods/services exchange (Commodity "C2") or schematically, $C1 \leftrightarrow C2$. A classic barter trade is shown in Figure 3.

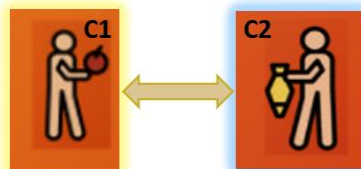


Figure 3 Immediate trade without Money

The first simplification of a trade was to use money as an abstract relative measure (thus unlimited) **unit-of-account** for pricing different Commodities. Exchange value of any Commodity is subjectively expressed by its owner (function ValueX is personal) in some amount of Money. Thus, the trade $C1 \leftrightarrow C2$ is possible if $M1 = M2$ where $M1 = \text{Value1}(C1)$ and $M2 = \text{Value2}(C2)$. After such an exchange, Money is not necessary (see Figure 4).

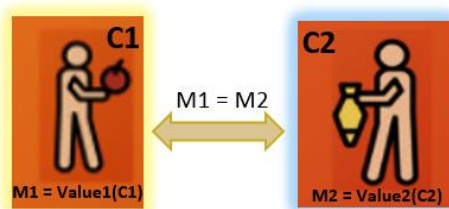


Figure 4 Immediate trade with pricing of Commodities in abstract Money

The second simplification of a trade was splitting the trade. Instead of exchanging apples for pots, apples can be exchanged for some Money that can be exchanged later for pots. If these two exchanges are separated in time and space, then it is called "deferred trade" and it requires some objective materialisation of money as a **medium of exchange**. **Currency** is another human invention as a materialisation of money within a local economy of a **Currency Area**. A **unit-of-currency** is a unit-of-account and medium of exchange (thus scarce).

An exchange value of a Commodity can be expressed in some amount of Currency. In case of a free market, the exchange value of any Commodity is set up by supply-demand balance on the market. Thus, this exchange value become objective, i.e., $\text{Value}(C1) \leftrightarrow Q$ and later $Q' \leftrightarrow \text{Value}(C2)$, where "Q" means Currency. See Figure 5.

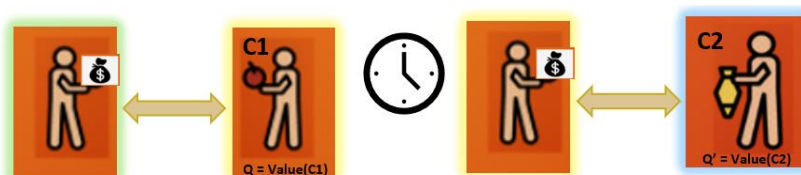


Figure 5 Deferred trade with Currency

The primary purpose of Currency is to transfer objective and stable value in time and space in deferred trades within a Currency Area. It is considered that Currency has some relatively stable value (at least in its Currency Area). Currency has some exchange value and the **price** of any Commodity is expressed in unit-of-currency.

The Currency Area Authority (i.e., the government of a country) sets the first exchange value of a unit-of-currency. For example, in Switzerland, the unit-of-account is CHF, the medium-of-exchange is banknotes and coins, and the unit-of-currency is 1 CHF.

Currency has three types of value (expressed in the unit-of-currency).

- **"Intrinsic value"** or "use intrinsic value" or "value in use" which is decided by the price of the underlying commodity (e.g., metallic content).
- **"Face value"** defined by Currency Area Authority if Currency is available in various denominations. The face value is needed to achieve fungibility of currency. For example, 1\$ banknotes can be redeemed as 4 quarters or 10 dimes.
- **"Exchange value"** or "value in exchange" or "market value" (as objective exchange value) used in trade. Exchange value of a unit-of-currency is normally implied to be "objective", although it may be explicitly stated as "subjective" or "objective".

The Gresham's law (https://en.wikipedia.org/wiki/Gresham%27s_law) states the market value (objective exchange value) of a unit-of-currency will be always greater than its intrinsic value.

The Regression theorem (https://en.wikipedia.org/wiki/Regression_theorem) states that the value of currency can be traced back ("regressed") to its value as a commodity in trade. Regression theorem is the theorem by which Ludwig von Mises applies the subjective theory of value (Money) to the objective exchange value (Currency) within a deferred trade.

Let us emphasise that the intrinsic value is a universal (i.e., Currency Area independent) value therefore it is rather stable over the time. The face value is an invariant (i.e., fixed by the Currency Area Authority). The market value of unit-of-currency can fluctuate because it is linked to the state of real economy. For these reasons, Currency is not good for **store of value**.

Any Currency Area has associated:

- some **aggregate (total) Currency supply value** as the market value of all units-of-currency, and
- some **aggregate (total) Commodity value** (wealth) as total market value of all commodities.

Considering that Money and Currency exist only within trade in a Currency Area, the aggregate currency supply value is **directly proportional** to the **Gross Domestic Product** or **GDP** of the Currency Area. GDP is the total market value of the total finished goods and services produced within the domestic boundaries of the Currency Area during a given period.

Capital is a means (an asset or an instrument) with rather stable over time objective exchange value and high level of liquidity Areas (ability to be traded for Currencies)

between Currency. Capital is more stable than Currencies because Capital has some intrinsic value. Capital cannot be scared, as it is born from the continuous cycle of the economic production of people:

Capital (old) -> Currency -> Assets and Labour -> Economic production -> Commodity -> Currency -> Capital (new additional).

More information is available at "The laws of money"

<https://www.numeraire.work/the-laws-of-money>

3.2 Money and currency in the current financial system

As a rule, each country has its own unit-of-account and typical national currency right now is **fiat currency** because such currency is not backed by a commodity such as gold.

There are several forms of fiat currency. The national treasury department (on behalf of the national government as the Local Currency Authority) mints some coins which is **metallic-cash-currency** with some intrinsic value although it is considerably less than the face value of a coin. Rational of enormous difference between the face value and the intrinsic value is to avoid that those coins will be converted back into raw metal. The three values for Swiss 5 CHF metallic-cash-currency are the following:

1. The face value is 5 CHF.
2. The intrinsic value is 0.0924 CHF because Swiss 5 CHF coin has 13.2 g of "Cupronickel" alloy (75 % Cu, 25 % Ni) which costs 7 CHF per kg (at the moment of writing this document).
3. The exchange value is about 250 g of Swiss cheese, whether it is Appenzeller, Emmentaler or Tilsiter.

The country Central Bank issues some national banknotes which is **paper-cash-currency** that has no intrinsic value. However, paper-cash-currency is redeemable to metallic-cash-currency. Rational of paper-cash-currency is that paper-cash-currency is cheaper and easier to handle than metallic-cash-currency.

The three values for Swiss 10 CHF paper-cash-currency are the following:

1. The face value of 10 CHF, e.g., it is redeemable into 2 x 5 CHF coins.
2. The intrinsic value is 0 CHF.
3. The exchange value is about 500 g of Swiss cheese, whether it is Appenzeller, Emmentaler or Tilsiter.

Although paper-cash-currency is redeemable into metallic-cash-currency per their face values, there is no Central Bank guarantee for such convertibility. Because, usually, the total face value of all printed banknotes is greater than the total face value of all minted coins, e.g., Switzerland has a ratio of 27 to 1. Therefore, paper-cash-currency has an **attached liability claim** (i.e., a limited convertibility to metallic-cash-currency) which is an artificial barrier for flow of value. On the contrary, metallic-cash-currency has no attached liability claims, e.g., interest-rate or rent extraction. Formally, following "IAS.32" financial standard from <https://www.ifrs.org/>, paper-cash-currency is a financial instrument and metallic-cash-currency is a financial asset.

The paper-cash-currency and metallic-cash-currency are usually the **legal tender** thus they can be used in payments without prior contracts and such payments have **immediate legal finality**.

Commercial Banks attract (under some interest) its clients (Humans, Business and Government) monetary resources to personal **saving accounts**. Actually, those clients transfer their monetary resources to a Commercial Bank which contractually becomes the owner of those resources. And the Commercial Bank supplies a contractual (i.e., legal) claim on **Commercial Bank ledger-money** which only exists as accounting electronic records in ledgers in the Commercial Bank. Rational of saving accounts in Commercial Banks is 1) acting as personal treasury for the clients of the Commercial Bank and 2) potential positive passive earning (interest) for cash-currency from the clients of the Commercial Bank.

Ledger-money is a financial instrument without the intrinsic value and the face value. It has some exchange value and may be used in payments only within some contractual agreements (e.g., a prior contract).

A Commercial Bank can lend to its clients some ledger-money which is created from thin air under a simple condition: a Commercial Bank must put aside only 1/10 of its total loan liabilities as cash in the Commercial Bank or as a balance at the Commercial Bank **reserve account** at the country Central Bank. Reserve accounts are **Central Bank ledger-money**. This technique is called "**Fractional Reserve Banking (FRB)**". The country Central Bank must maintain the integrity of the FRB. Rational of FRB is to supply the clients of the Commercial Bank "cheap" and quick loans.

All these forms of money and currency creates a rather complicated and asymmetric "currency inverted pyramid" as shown in Figure 6.

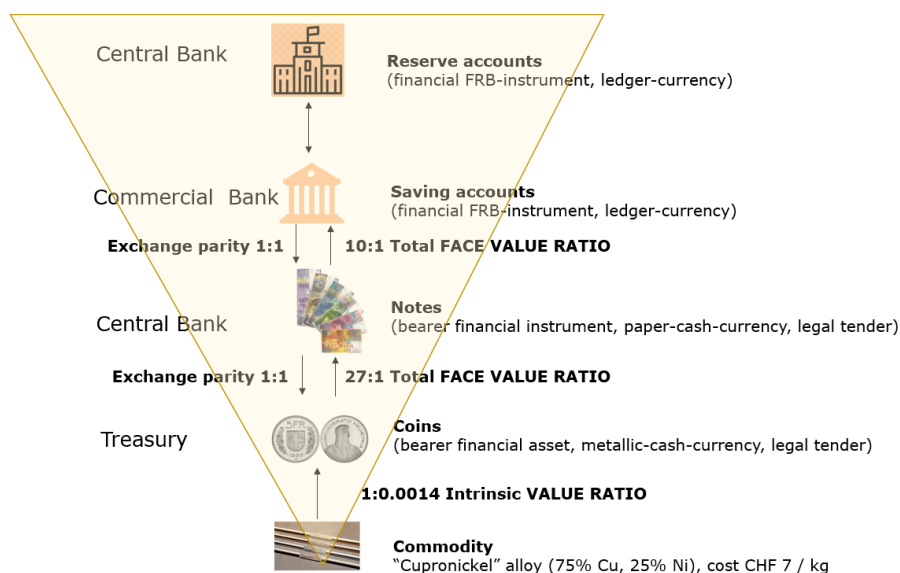


Figure 6 Currency inverted pyramid

Obviously, each layer in this currency inverted pyramid creates its own artificial barriers between a human and value (see Figure 7), as well as for flows of value.

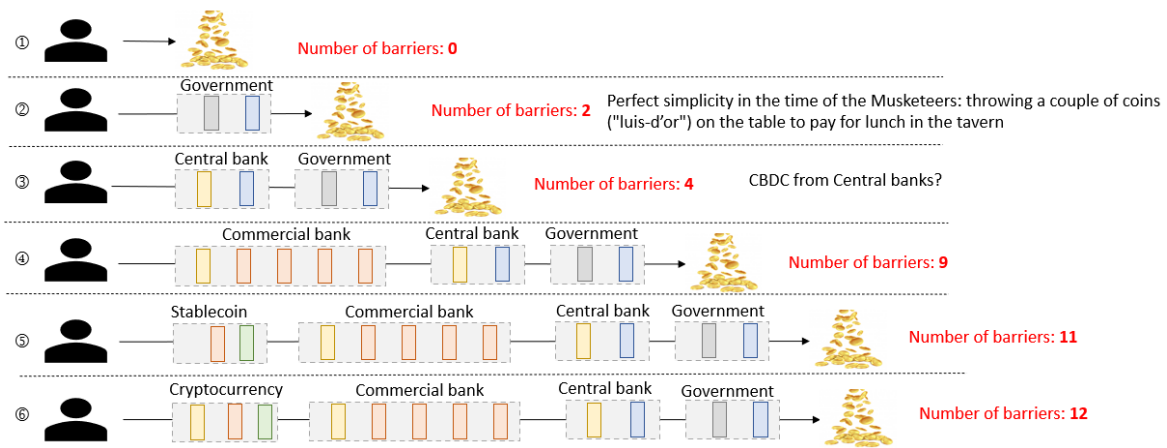


Figure 7 Artificial barriers in the current financial system

3.3 A target system of moneys

Knowing that the current financial system has been evolving under various historical events, the proposed system of moneys is architected from human-value-centric principles with minimum complexity. The core of this architecture is only one archetype of digital money – the **Digital Coin as digital bearer financial asset, anchored with intrinsic value** to be used for issuing **Local Currency Unit (LCU)** by the Currency Area Authority **as legal tender**. Additionally, the Digital Coin is implemented as a specialised public service which is governed by the civil society, managed by a governmental institution and operated by a business entity under PPP. Any country may issue its own variant of Digital Coin under the full sovereign control.

Obviously, the Digital Coin eliminates the necessity for cash (i.e., **paper-cash-currency** and **metallic-cash-currency**) while the Digital Coin keeps the valuable properties of cash and eliminates bad properties of cash (see Figure 8).



NN	Characteristic	National cash currency	Importance	Digital Coin
1	legal tender	YES	Mandatory	YES
2	legal finality of transactions	YES	Mandatory	YES
3	no interest	YES	Mandatory	YES
4	bearer financial asset	YES	Mandatory	YES
5	central bank direct claim	YES	Mandatory	YES
6	anonymous	YES	Critical	YES*
7	censorship-free	YES	Critical	YES
8	zero transaction fees	YES	Mandatory	YES
9	accessible	YES	Critical	YES**
10	autonomous payment	YES	Critical	YES**
11	instantaneous payment	YES	Mandatory	YES
12	retail payments	YES	Mandatory	YES
13	RTGS payments	NO	To be improved	YES***
14	cross-border payments	NO	To be improved	YES****
15	payment in the same place	mandatory	To be improved	anywhere
16	payment at the same time	mandatory	To be improved	anytime
17	risk to be stolen	high	To be improved	low
18	risk to be lost	medium	To be improved	low
19	risk to be counterfeited	high	To be improved	zero
20	AML conformance	low	To be improved	high
21	AML support	NO	To be improved	YES
22	programmable	NO	To be improved	YES*****
23	face value	fixed	To be improved	flexible
24	cost of minting	high	To be improved	zero
25	cost of burning	high	To be improved	zero
26	cost of maintenance	high	To be improved	low
27	public good	YES	Mandatory	YES
28	nature of money	Fiat	For information	Sound money
29	parity to M0 (cash in circulation)	1:1	Mandatory	1:1
30	parity to M1-M0 (CB reserves)	NO	To be considered	free market or 1:1
31	parity to M2-M1 (banks deposits)	1:1 limited	To be considered	free market or 1:1
32	parity to M3-M2	NO	To be considered	free market or 1:1
34	chase in possession	YES	Mandatory	YES

- disclose is possible under a court decision
- ** different applications to implement accessibility and autonomy can be developed on top of the Digital Coin infrastructure
- *** no RTGS systems are necessary
- **** an international version of Digital Coin is necessary
- ***** (programmable is considered as linking money-generated events with some actions executed by code) via APIs and events of the Digital Coin infrastructure

Figure 8 Comparison of national cash currency and Digital Coin

The Digital Coin eliminates another barrier – **usage of banknotes and coins with standardised face values**. There is no need to issue a million separate Digital Coins with the face value 1 CHF. In principle, an Actor may have only one Digital Coin with its unique face value. If necessary, such a Digital Coin can be split into two ones or, reversely, two Digital Coins may be merged into one.

These operations (split and merge) eliminates yet another barrier – **returning the “change”** (some amount of cash-currency given back when a customer hands over more than the exact price of a purchased item). Imagine that an amount of value required for a particular payment is chopped from a big amount of value.

Any LCU is bound (encapsulated) by a Currency Area and any Currency Area Authority has sovereignty over its LCU. Because the aggregate (total) currency supply value of the LCU is proportional to the GDP of a Currency Area there is no need for the Fractional Reserve Banking, Central Bank ledger-money and Commercial Bank ledger-money. **All loans are issued with security on equity.** Humans, Business, Governments and Banks use the LCU without interest-rate. Thus, Digital Coin **eliminates the whole "currency inverted pyramid"**.

It is recommended that that the aggregate (total) currency supply value of the LCU is GDP/12 and the annual GDP growth is 2.4 %

The three values of the LCU are the following:

1. The face value is 1 unit of national currency.
2. The intrinsic value is a tiny value of a commodity, e.g., gold.
3. The exchange value is proportional to the GDP of the Currency Area.

Holding (keeping currency without move) of the LCU is not economically logical because the exchange value may change, and any surplus of the LCU would be better to convert into Capital or invest it in the local industry to get more value. This also helps to improve liquidity of LCU, because there always will be some local economic agents which want to convert surplus of LCU into Capital.

There is no **inflation** of LCU because the amount of LCU in circulation depends on the GDP of the Currency Area.

These features of the LCU (and some other parameters of the target system of payments) make it is the **most liquid financial asset** in its Currency Area.

Obviously, the LCU **makes redundant any stablecoin** pegged to the national currency. For comparison, the three values of any stablecoin are the following:

1. The face value is 1 unit of the national currency.
2. The intrinsic value is 0.
3. The exchange value equals to 1 unit of national currency.

Also, the LCU is **more stable than any cryptocurrency**. For comparison, the three values of 1 BTC are the following:

1. The face value is 1 BTC.
2. The intrinsic value is 0.
3. The exchange value is the cost of the last sale of BTC.

For comparison, the three values of a unit-of-**CBDC** (as designed by Central Banks) are the following:

1. The face value is 1 unit of national currency.
2. The intrinsic value is 0.
3. The exchange value equals to 1 unit of national currency.

Such CBDC looks like a national "stablecoin" which is issued by the Central Bank (thus pegging this "stablecoin" to the national currency is trivial internal consideration within the Central Bank). Naturally, there are rules for the regulator, i.e., the Central Bank and there are rules for regulated, i.e., Commercial Banks. Certainly, such CBDC will be eclipsed by the LCU as well.

The LCU can co-exist with a national fiat currency. For example, for testing purposes Geneva canton can create and issue its own LCU (let us call it CHF-GE) which is nominated in CHF (Swiss national unit-of-account). CHF can be exchanged to CHF-GE at the parity 1:1. However, CHF-GE cannot be exchanged to CHF at the same parity because in this case CHF-GE will become counterfeiting. So, CHF-GE can be exchanged to CHF using a **money-market** on which CHF-GE is traded as a commodity. The citizens of Geneva Canton will prefer using CHF-GE for all local purchases to keep value on the "soil" of Geneva Canton. Thus, the exchange value of 1 unit-of-CHF-GE will be higher than the exchange value of 1 CHF. So, CHF-GE will be the most liquid ~~commodity~~ currency on the territory of Geneva canton.

Shall **digital currency be programmable**? The answer is simple: programmability of digital currency may break their fungibility. This will lead to several "black" markets for exchange between non-fungible money. Such weakness and complexity are not desirable for the target system of moneys.

4 System of payments

4.1 Basics of payments

There are two important legal concepts from national property laws which are important for payments (see Figure 9):

- **"chose in possession"** which means "direct ownership" and
- **"chose in action"** which means "indirect ownership".

Payments **without a prior contract** (typically used by Humans and Business) are legally bound to a national legal procedure (called "legal tender" as verb). This legal procedure defines payment as: 1) tendering (offering) some currency from the payer to the payee and 2) cancelling a dept of the payer. This legal procedure also defines payment "legal finality" of settlement which is immediate. **Only currency which is "chose in possession" is accepted in this legal procedure.** Such currency is called "legal tender" (as noun).

Payments with a prior contract may also use Currency which is "chose in action" (subject to the local legislation). Each contract has its own payment processes and legal finality of such payments is often not clear. For example, credit cards have about 30 days period for reporting irregularities.

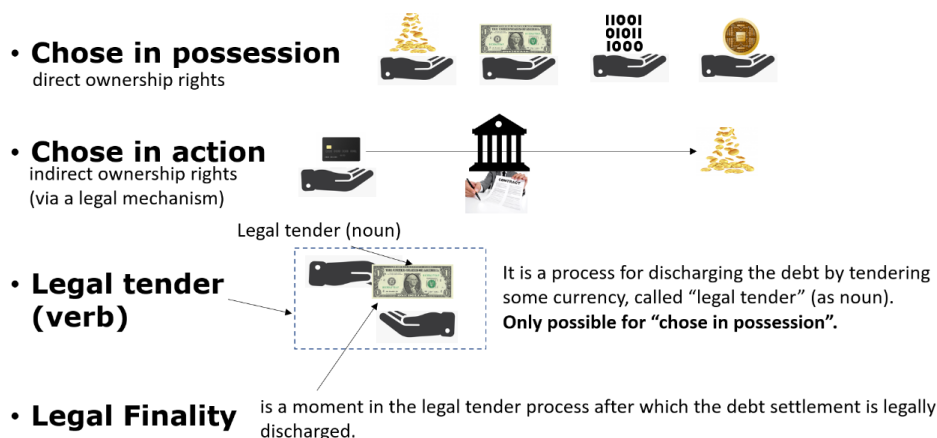


Figure 9 Basic of payments

This means that it is legally impossible to give “legal tender” status to any cryptocurrency and stablecoins because they are not “choses in possession” by design.

4.2 The current payment system

Direct payments can be carried out only in cash-currency (banknotes and coins). Such payments are simple and extremely attractive for Humans and Business (see Figure 10). Their legal finality is immediate and there is no need for any contracts. (Key: solid line means value transfer and dashed line means electronic messages.)



Figure 10 Payment by cash-currency

Indirect payments (i.e., via some certified intermediaries) can be carried out in ledger-money. Figure 11 shows a flow of Commercial Bank ledger-money between a Human and a shop (Business) if they use the same Commercial Bank (i.e., have contracts with this Commercial Bank).

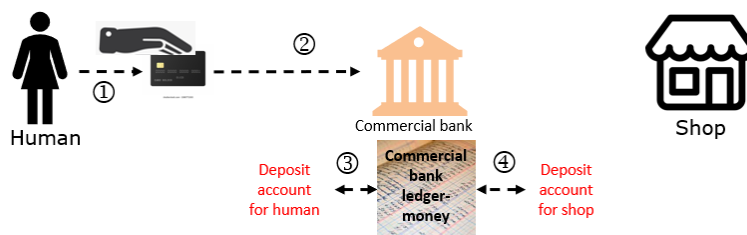


Figure 11 Payment by ledger-money of the same Commercial Bank

When ledger-money from different Commercial Banks is used by a Human and a shop (Business), the Central Bank must participate in the settlement of such transactions as show in Figure 12. The legal finality of such payments is usually unknown because any saving account is a legal claim.

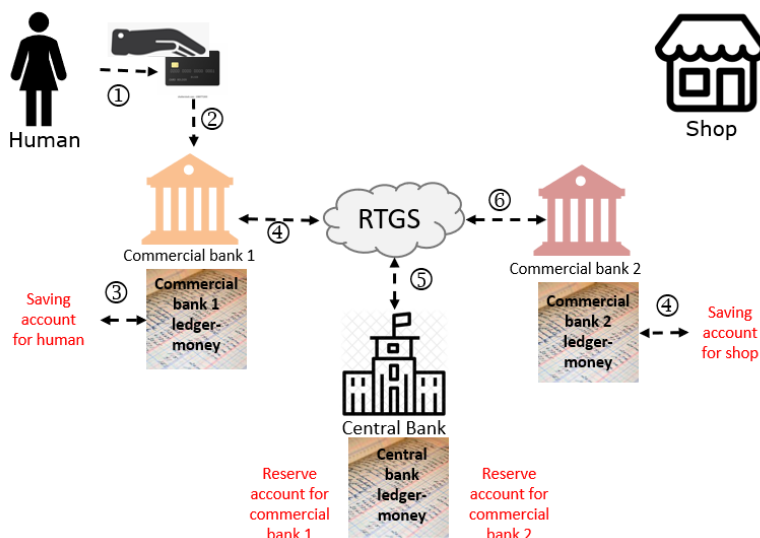


Figure 12 Payment by ledger-money from different Commercial Banks

RTGS stands for Real-Time Gross Settlement. National RTGS systems support fractional reserve banking, i.e., reserve accounts of Commercial Banks in the Central Bank.

When ledger-money from different Commercial Banks from different countries is used by a Human and a shop (Business) then two Central Banks must participate in the settlement of such transactions as shown in Figure 13. The legal finality of such payments is usually unknown.

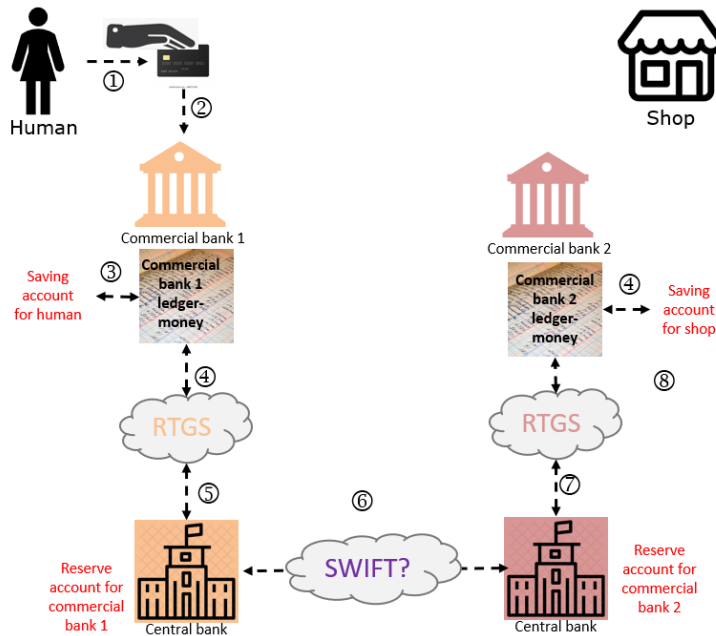


Figure 13 Cross-border payment by ledger-money

SWIFT stands for Society for Worldwide Interbank Financial Telecommunications. This system does not transfer value but messages.

CBDC for on-line retail transactions, which is the Central Bank stablecoin (pegged to central bank ledger-money), is straightforward (see Figure 14).

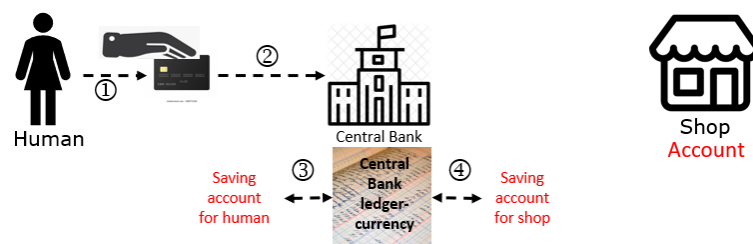


Figure 14 CBDC for on-line retail transactions

CBDC for off-line retail transactions, which is the Central Bank stablecoin (pegged to central bank ledger-money), can be requested from the Central bank for off-line (without the Internet) payment (see Figure 15). This creates an illusion of cash-money but such a stablecoin cannot be legal tender because this stablecoin is still ledger-money. The legal finality of such payments is usually unknown.

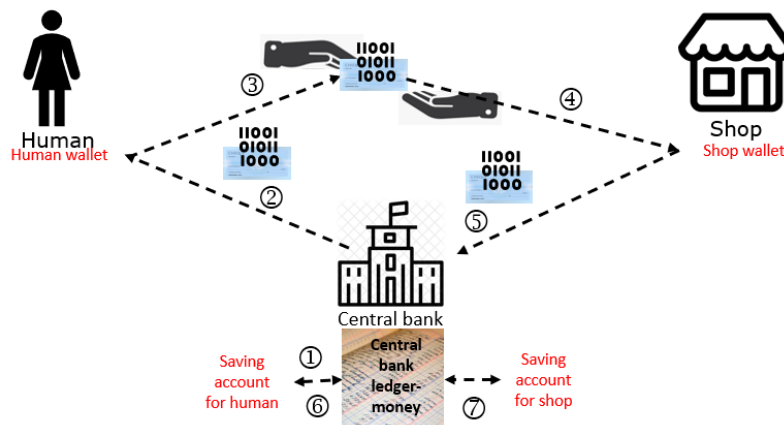


Figure 15 CBDC for off-line retail transactions

Use of CBDC for wholesale and cross-border transaction is still under development. The usage of cryptocurrencies and stablecoins in the current system of payments is still ad-hoc and not yet systemic.

4.3 Absurdity of current payment systems

At present, small amount payments are costly for a payee and a payer because such payments are not attractive for current payment systems based on Commercial Banks and Central Banks.

Large amount payments are profitable for a payee and a payer because Commercial Banks and Central Banks can earn some value by keeping (even for brief time) currencies used in such payments.

At the result, many beneficiaries are suffering:

- 1) Commercial Banks are losing "small money", e.g., 10 USD from a million Citizens or micropayments in Business.
- 2) "Small money" is attracted by "Ponzi scheme" fraud.
- 3) "Big money" is not supported by "small money".

This is a typical barrier against the "**money must work**" maxim or, in other words, velocity of money.

Cross-border payments have many problems, especially, execution time (hours or days) and transaction cost which can be up to 7-10% of the transaction value. Other barrier is a limited list of national currencies which are used as reserve currencies for currency exchange.

Based upon the theory of purchasing power parity, the notion that in the long run exchange rates should move towards the rate that would equalise the value (via local prices) of an identical basket of goods and services (in this case, a burger) in any two countries. However, most currencies are undervalued against the most popular reserve currency (see Figure 16).



Figure 16 Undervalued and overvalued currencies

4.4 The target system of payments

All payments with the Digital Coin have the following parameters:

- 0 time.
- 0 spread.
- 0 fee.
- 0 value loss, and
- the target LCU is the most liquid currency in its Currency Area.

Retail and wholesale payments are simple with the LCU – just move some LCU from one Actor (e.g., a Human) to another Actor (e.g., a Business) as shown in Figure 17. DFMI stands for Digital Financial Market Infrastructure.

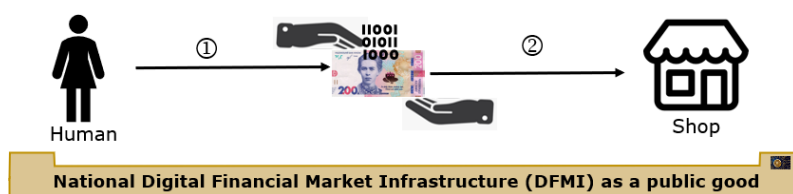


Figure 17 Retail and wholesale payments with the LCU

Cross-border payments with the Digital Coin requires an additional supra-national Digital Coin WCU-LT (based on digitised gold). Because any LCU is valid only in its Currency Area, this supra-national currency is valid on the whole planet thus it can be used for cross-border payments in two steps:

- 1) convert the source LCU to the supra-national currency WCU-LT (which is the most liquid currency in its Currency Area) and
- 2) convert the supra-national currency WCU-LT to the target LCU (which is the most liquid currency in its Currency Area).

All these conversions are using a money-market with rates for gold-to- LCU pairs. See Figure 18.

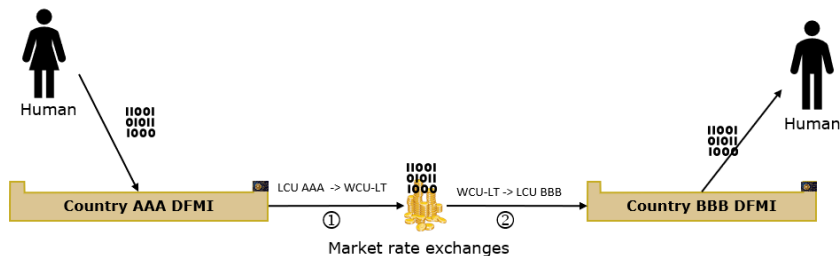


Figure 18 Cross-border payment in national currencies

The same payment may be presented in more details as shown in Figure 19.

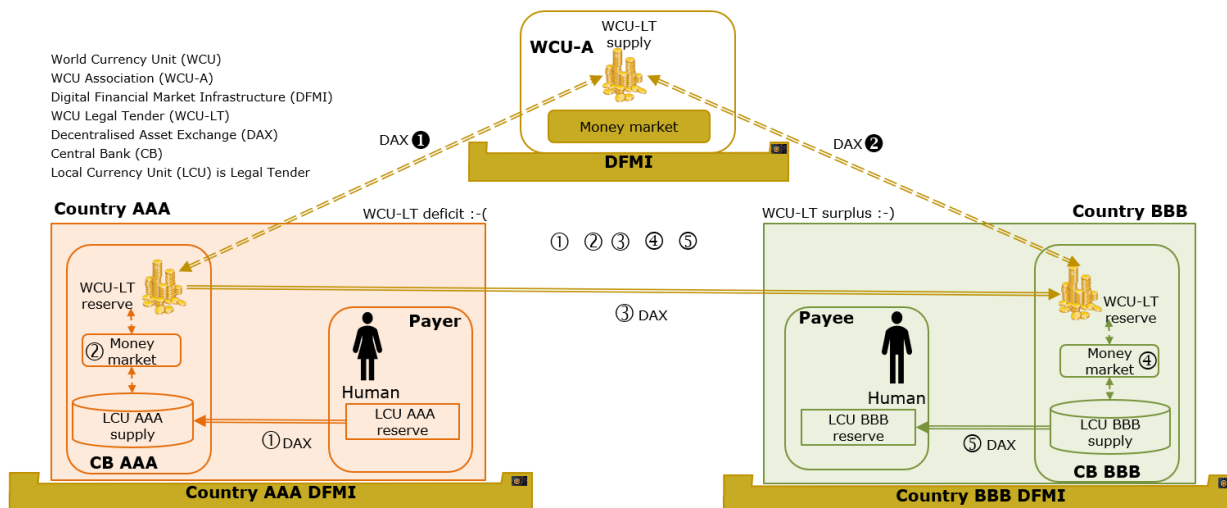


Figure 19 Cross-border payment in national LCU AAA and LCU BBB

The sequence of activities is the following:

1. The Payer transfers (via DAX) the agreed amount of LCU AAA to be paid to the CB of the Payer country AAA.
2. The CB AAA converts (via Money market) this amount of LCU AAA into WCU-LT.
3. The CB AAA transfers this amount of WCU-LT to the CB the Payee country BBB.
4. The CB BBB converts (via Money market) this amount WCU-LT into LCU BBB.
5. The CB BBB transfers (via DAX) this amount of LCU BBB to the Payee.

Two additional DAX "black 1" and DAX "black 2" are necessary to replenish WCU-LT reserves.

5 Digital Coin implementation

5.1 DFMI reference architecture

Architecture of the DFMI is platform-based. It means that each country may have its own instance of the DFMI because, this is a Commercial Off-The-Shelf (COTS) product. Also, some country-specific requirements can be implemented via API (see <https://eumarketplace.azurewebsites.net/Help>).

This DFMI provides a reference LCU solution as legal tender. If a country is not happy with some aspects of the reference LCU solution, then the country can extend and

customize without breaking underlying principles of the DFMI. Thus, the national DFMI is naturally integrated as the international (global) DFMI. Hence this architecture provides LCU interoperability by design.

The out-of-the-box DFMI capabilities, in addition to LCU, allows the following:

- payments, started by IoT devices,
- other legally codified digital financial bearer assets, such as securities, and
- certificates for supply-chains.

All stakeholders interact with the DFMI as shown Figure 20.

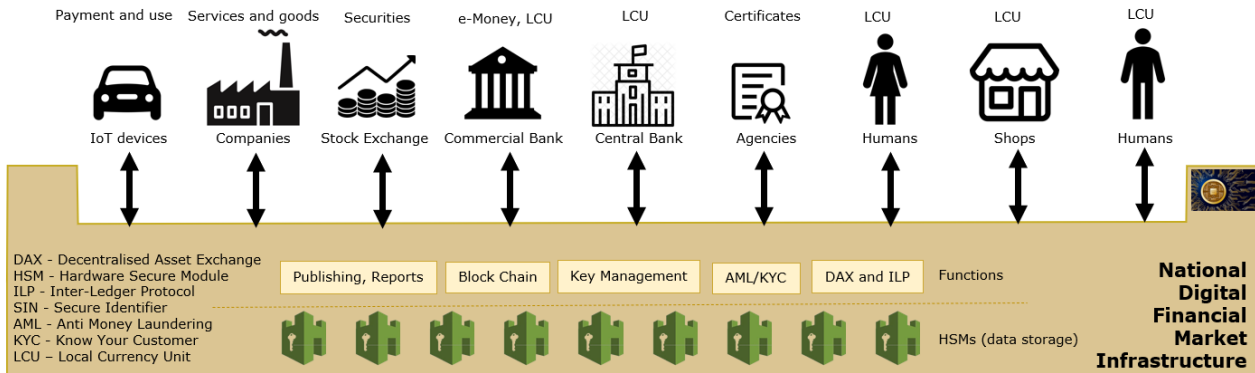


Figure 20 Digital Financial Market Infrastructure (DFMI)

This architecture enables fast (about 0.4 sec) and secure (thanks to HSM) peer-to-peer transactions.

5.2 Use case “retail payment with LCU”

This use case is straightforward. The seller (Shop) sends an invoice to the buyer (Human) who executes the requested payment. Figure 21 shows this payment from several points of view.

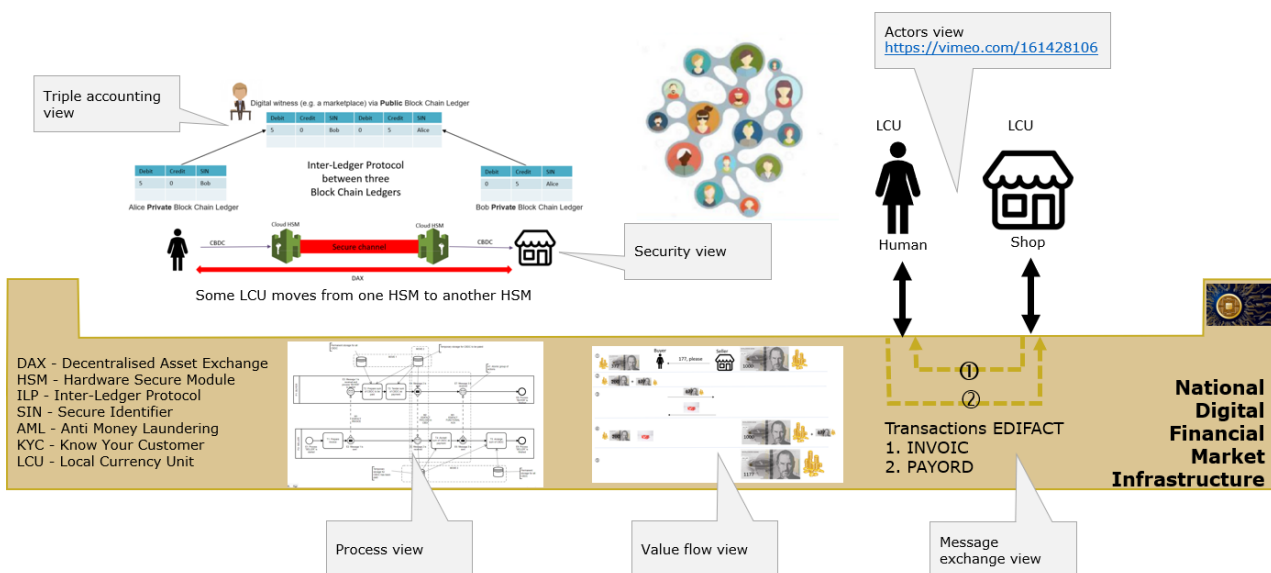


Figure 21 Retail payment in the DFMI

5.3 Use case “wholesale payment with LCU”

This use case is, surprisingly, the same the “retail LCU”. See Figure 22.

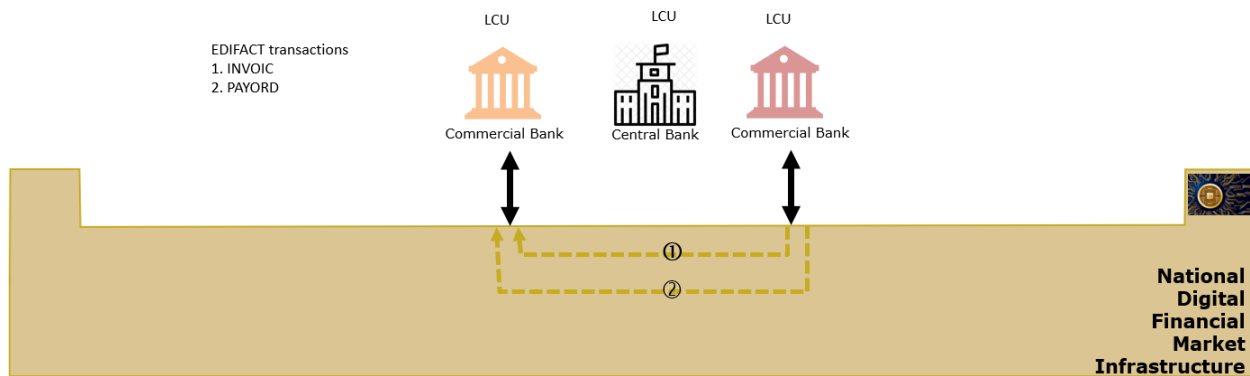


Figure 22 Wholesale payment in the DFMI

Benefits for participants (Commercial Banks and the Central Bank) of using the Digital Coin instead of their ledger-money are the following:

- Instantaneous because there is no need for modern RTGS systems. (The implementation cost of modern RGTS systems may vary from \$200 million to \$6 billion.)
- Legal finality (no RTGS systems guarantee legal finality)
- Free-of-charge payments

5.4 Other use cases

More use cases can be shown on demand:

- Use case "Cross-border payment in national LCU"
- Use case "Wholesale LCU without having retail LCU"
- Use case "Project" LCU which some protection against misuse"
- Use case "Delivery vs Payment" (DvP)
- Use case "Certificates"
- Use case "IoT pay-per-use"
- Use case "Cross-border payments in national currencies with national LCU"
- Use case "Cross-border payments in national currencies without national LCU"

6 Joining capital and payments for reviving local economy

In any financial system, a legal tender (or currency) as a bearer financial asset must co-exist with other types of assets (i.e., anything of value or a resource of value that can be converted into cash). Thus, in the digital world, a digital financial system must be able to manage several types of assets (e.g., securities, certificates, etc.). Usually, such assets are legally registered by authorised legal entities.

Figure 23 shows how to seamlessly link (within the DFMI) several types of Capital (see the left part in Figure 23) and various types of Digital Carriers (see the right part in Figure 23). Several types of Capital can be exchanged and converted to WCU-Capital which is a universal Capital based on gold. The WCU-Capital can be exchanged with WCU-LT which is used for Digital Currency exchanged. Having various digital assets within the single DFMI allows improve efficiency and security of some operations with them.

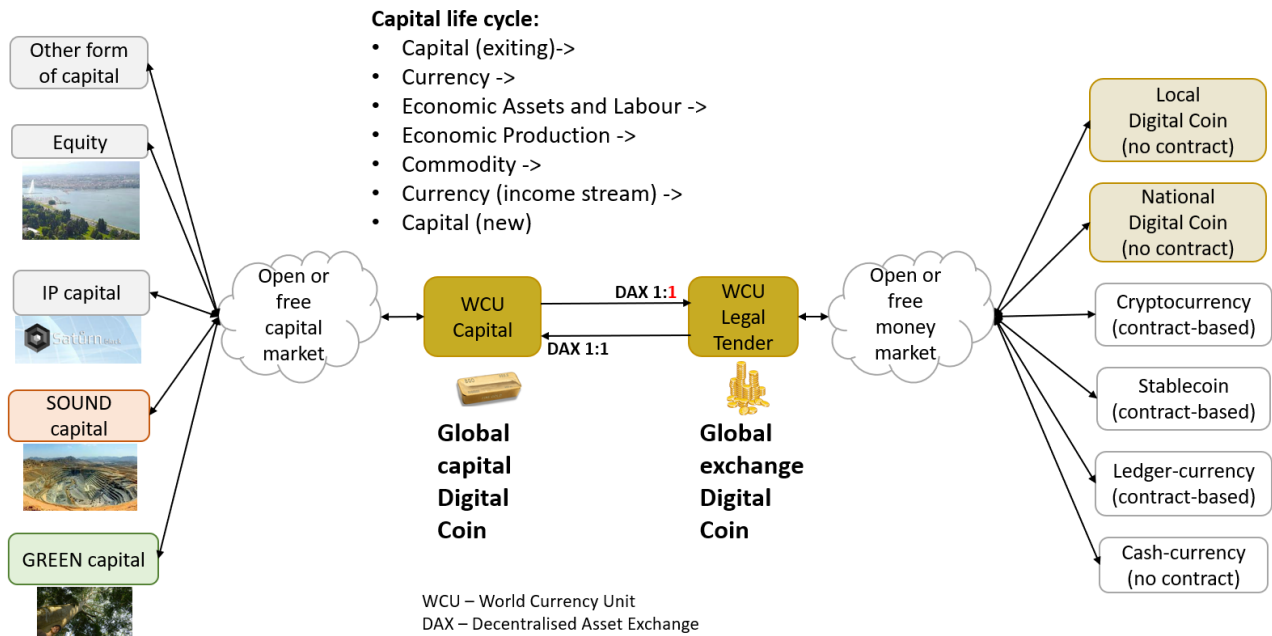


Figure 23 Flow of value between Capital and Currency

Such joining capital and payments enables reviving local economies by creating LCU in some villages, towns, regions, cantons, etc. The last paragraph in 3.3 gives an example of LCU for a canton.

LCU is an enabler for a local community to organise, manage and operate its own life. The community should establish some kind of internal agreements (as an example to consider):

- Self-organisation for common interest (no “let us solve together my problems and then you solve your problems along”)
- Anti-corruption mentality
- Sharing best practices and allowing experimentation
- “Do your little best”

The community should agree on some rules for internal economics:

- Local goods and services are cheaper in LCU
- Establish local distribution channels to neighbours and friends
- No payment but investment
- Compensation is either immediate or delayed
- Develop local production but
 - know local limits of growth
 - know local limits of integration
- At each moment either growth or integration

The community should agree on self-evolution:

- Creating local attractions
 - tourist island
 - specific market
 - gourmand restaurant with local wines
- Developing local events
 - motocross
 - Fête de village

The community should agree on external relationships:

- Easy flow in and flow out of other currencies
- External currencies and LCA are traded on the money market to avoid manipulations and attacks
- Easy flow of goods and services among other similar communities

Those are some rules for communities; additionally, FinTech and InvestTech methods should be employed.

7 Some systemic characteristics of Digital Currencies

7.1 Be understandable

The perfect simplicity of system of moneys and system of payments was at the time of the Musketeers: it was sufficient to throw a couple of coins ("louis-d'or") on the table in the tavern to pay for lunch. Also, the amount of gold in coins ("louis-d'or") can be checked independently of the state which issued those coins (i.e., France). Certainty, same simplicity must be achieved the at the time of Internet to eliminate the current complexity of the current financial system (see Figure 24).

The Advent of the Internet of Money

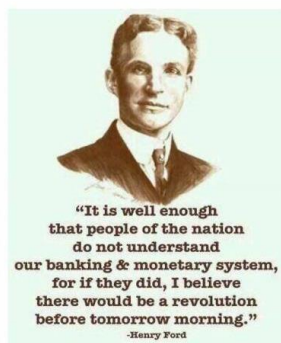


Figure 24 A sentence assigned to Henry Ford

7.2 Be systemic

The current financial system is overcomplex and broken. However, these systems are especially important for our civilisation because they are foundational. Not a secret that **confidence in money and payments is fundamental to financial stability** of any society.

The complexity of these systems is a typical case of systems being built incrementally by different people under different governance rules for evolving requirements. As the result, such systems accumulate increased barriers. Popular attempts to correct broken legacy systems with AI or by automating existing processes or by adding more complexity are making such systems even less manageable. Remember 737 MAX. There is only one reliable way to correct a broken legacy system is to **rearchitect it**.

However, some systemic guidance for rearchitecting must be explicitly said. Let us look at our civilisation as a hierarchical system with many levels (i.e., the system of

moneys and the system of payments are at the bottom of this hierarchy). For such a hierarchical system there is the follow law: "the growth of diversity at the top level of the hierarchical organization [AS: system] is ensured by the restriction of diversity at the previous levels, and vice versa - the growth of diversity at the lower level destroys the upper level of the organization [AS: system]"

http://ecsocman.hse.ru/data/149/386/1217/009_SEDOV.pdf

It means that if the system of moneys and the system of payments (and higher systems) are problematic (i.e., chaotic, complex, unpredictable, unstable, etc.) then the whole hierarchical system, i.e., our civilisation, is not stable. Hence the system of moneys and the system of payments must be as simple (structurally and behaviourally) as possible thus supplying confidence in moneys and payments.

7.3 Be digital

Without any doubts, digital currencies will "eat" non-digital currencies. National cash-currency (banknotes and coins) is not digital. Thus, each country must explicitly consider national digital currency. Ideally, national digital currency must preserve the good features of cash and remove bad features of cash.

7.4 Be transformational

An overcomplex and broken legacy system cannot be replaced by a new perfect system overnight. It will be too risky and too quickly for many Humans and Business. In this situation, the digital transformation of a socio-technological system from old to new is usually more complex than the new system. Figure 25 shows several potential transformational steps. Each country can choose its own path and its own pace.

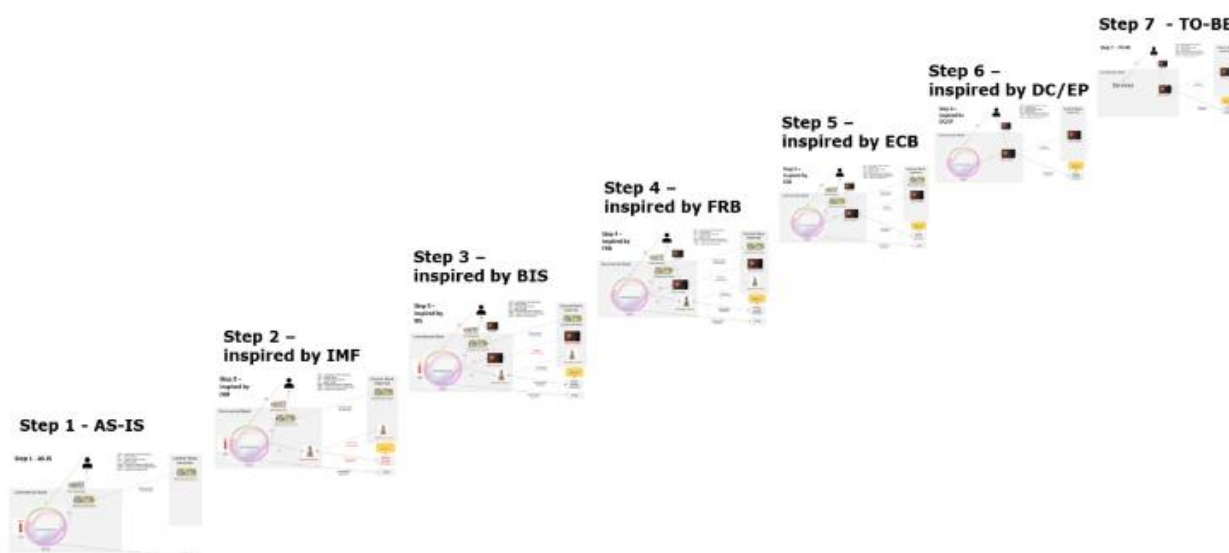


Figure 25 Potential transformational steps

7.4.1 What is the future role of Central Banks?

Let see how different currencies would answer to this question.

- Cash: Business as usual, please.
- Ledger-money: Support FRB.
- BTC: The Central Bank is not needed.
- Stablecoin: Business as usual, please.

- CBDC: The Central Bank and the regulator and the operator (which is a conflict of interest).
- Digital Coin: The Central Bank is only a regulator under civic-led governance.

7.4.2 What is the future role of Commercial Banks?

Let see how different currencies would answer to this question.

- Cash: Business as usual, please.
- Ledger-money: Support FRB.
- BTC: Commercial Banks are not needed.
- Stablecoin: Commercial Banks will be an engine room of innovations.
- CBDC: Commercial banks and FRB remain. Everything is as it was before.
- Digital Coin: The Central Bank is only a regulator under civic-led governance. Fractional reserve banking will disappear. Commercial banks become investment service centres.

7.4.3 What is the future of fiat?

Let see how different currencies would answer to this question.

- Cash: Business as usual, please.
- Ledger-money: Business as usual, please.
- BTC: Fiat is not needed.
- Stablecoin: Business as usual, please.
- CBDC: Fiat and FRB remain. Everything is as it was before.
- Digital Coin: The primary beneficiaries (e.g., Humans and Business) will choose the winner.

7.4.4 What will happen with the stability the current financial system?

Let see how different currencies would answer to this question.

- Cash: Business as usual, please.
- Ledger-money: Business as usual, please.
- BTC: Ha-ha.
- Stablecoin: Who knows? We use the current system by adding a digital layer on top of it.
- CBDC: Current design of these systems will be kept. However, the payments will be faster.
- Digital Coin: Various currencies will co-exist for stability; however, the primary beneficiaries (e.g., Humans and Business) will choose the winner.

7.5 Be competitive

As already mentioned, "good money must eat bad money" thus the winner among digital currencies must be defined by Humans and Business not by governmental decrees and bans. Figure 26 shows the ranking of some characteristics.

The table below shows the ranking of attributes of CBDCs based on responses from consumers.

ATTRIBUTE	RANKING
Privacy	1
Ease of use	2
No additional costs	3
Ability to use internationally	4
Ability to use without internet connection	5
Ability to use on smartphone and at payment terminals	6
More secure than other digital payments	7
Transaction completed instantaneously	8
Take the form of a dedicated physical device	9

Figure 26 Source: https://m.guardtime.com/files/CBDC_research.pdf

7.6 Be legal

7.6.1 Can a particular digital currency be named legal tender (as noun)?

Explanation: Any legal tender must possess some key features, primarily, be “chose in possession” to match existing property laws.

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: No. It is “chose in action”, being ledger-money, it can’t be declared as legal tender (as noun) without profound checking of country’s property laws. But El Salvador did.
- Stablecoin: No. It is “chose in action”.
- CBDC: Not sure.
- Digital Coin: Yes, by design. Because it is “chose in possession”.

7.6.2 What is about legal finality of payments with a particular digital currency?

Explanation: Cash, being a legal tender, can be used in payments and achieve immediate legal finality without any prior trade contract (because authority laws act in case of absence of trade contract).

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: What is it?
- Stablecoin: Let us talk about payment finality.
- CBDC: Let us talk about payment finality.
- Digital Coin: The same as for cash, i.e., immediate. By design.

7.6.3 Can a particular digital currency be considered as cash?

Explanation: Cash, being a legal tender, can be used in payments and achieve immediate legal finality without any prior trade contract (because authority laws act in case of absence of trade contract).

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: No.
- Stablecoin: No.
- CBDC: No.
- Digital Coin: Yes, by design.

7.7 Be valuable

The value must flow without any loss.

7.7.1 Can a particular digital currency be issued and destroyed?

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: Issue only through mining. Destruction – through the destruction of the key.
- Stablecoin: Maybe.
- CBDC: For now, copying fiat currency.
- Digital Coin: Issuing and destruction are normal operations.

7.8 Be sovereign

At what extent, the country authority exercises its sovereignty over its currency.

7.8.1 Is a particular digital currency supply a sovereign decision?

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: Who cares.
- Stablecoin: All depends what country.
- CBDC: No. All depends what country.
- Digital Coin: Yes, by design. The supply is proportional to the GDP.

7.8.2 May a particular digital currency be used outside its Currency Area?

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: Who cares.
- Stablecoin: All depends what country.
- CBDC: All depends what country.
- Digital Coin: No, by design.

7.9 Be explicit

The table below supplies a systemic and detailed way to compare various digital currencies by comparison many characteristics. In this section, it is used to compare cash and the Digital Coin.

The table below shows in its columns 2nd – 5th:

- 2) some characteristics of money (a characteristic is an abstraction of property, e.g., "colour" is a characteristic of cars and "red" is a property of some cars),
- 3) common properties of cash-currency, like a **benchmark**, although some national variations are possible,
- 4) level of importance of the characteristic, like a **demand side** with some national variations, and
- 5) properties of the Digital Coin implementation like a **supply side**.

The 4th column indicates that some characteristics (more options are possible):

- "Mandatory", i.e., any digital currency implementation must implement them exactly as physical cash.
- "Critical", i.e., any digital currency implementations may slightly vary on them and any differences between physical cash and the digital currency must be explicitly communicated,
- "To be improved", i.e., any digital currency implementation should be better than physical cash, and
- "For information".

The table can be used in the following ways.

- 1) Agree on the list of characteristics – drop columns 3rd, 4th and 5th.
- 2) Agree on the list of characteristics and physical cash properties – drop columns 4th and 5th.
- 3) Agree on the properties which are mandatory for the interoperability of various digital currency implementations – agree on the 4th column and agree on the column 5th.
- 4) Defining national requirements for digital currency – define the 4th column and drop the 5th column.
- 5) Comparison of several digital currency implementations – define the 4th column and provide several columns as the 5th, one per each particular digital currency implementations.

NN	Characteristic	National cash currency	Importance	Digital Coin
1	legal tender	YES	Mandatory	YES
2	legal finality of transactions	YES	Mandatory	YES
3	no interest	YES	Mandatory	YES
4	bearer financial asset	YES	Mandatory	YES
5	central bank direct claim	YES	Mandatory	YES
6	anonymous	YES	Critical	YES*
7	copyright-free	YES	Critical	YES
8	zero transaction fees	YES	Mandatory	YES
9	accessible	YES	Critical	YES**
10	autonomous payment	YES	Critical	YES**
11	instantaneous payment	YES	Mandatory	YES
12	retail payments	YES	Mandatory	YES
13	RTGS payments	NO	To be improved	YES***
14	cross-border payments	NO	To be improved	YES****
15	payment in the same place	mandatory	To be improved	anywhere
16	payment at the same time	mandatory	To be improved	anytime
17	risk to be stolen	high	To be improved	low
18	risk to be lost	medium	To be improved	low
19	risk to be counterfeited	high	To be improved	zero

NN	Characteristic	National cash currency	Importance	Digital Coin
20	AML conformance	low	To be improved	high
21	AML support	NO	To be improved	YES
22	programmable	NO	To be improved	YES*****
23	face value	fixed	To be improved	flexible
24	cost of minting	high	To be improved	zero
25	cost of burning	high	To be improved	zero
26	cost of maintenance	high	To be improved	low
27	public good	YES	Mandatory	YES
28	nature of money	Fiat	For information	Sound money
29	parity to M0 (cash in circulation)	1:1	Mandatory	1:1
30	parity to M1-M0 (CB reserves)	NO	To be considered	free market or 1:1
31	parity to M2-M1 (banks deposits)	1:1 limited	To be considered	free market or 1:1
32	parity to M3-M2	NO	To be considered	free market or 1:1
34	choses in possession	YES	Mandatory	YES

- disclose is possible under a court decision
- ** different applications to implement accessibility and autonomy can be developed on top of the Digital Coin infrastructure
- *** no RTGS systems are necessary
- **** an international version of Digital Coin is necessary
- ***** (programmable is considered as linking money-generated events with some actions executed by code) via APIs and events of the Digital Coin infrastructure

7.10Be ethical

7.10.1 Is a particular digital currency ethical?

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: Not applicable.
- Stablecoin: Not applicable.
- CBDC: Not applicable.
- Digital Coin: Yes, by design.

7.10.2 Is a particular digital currency created for quick payments, speculation, or economic recovery?

Let see how different currencies would answer to this question.

- Cash: Not applicable.
- Ledger-money: Not applicable.
- BTC: Speculation, of course.
- Stablecoin: Fast payments, of course.
- CBDC: Fast payments, of course.
- Digital Coin: The goal is to raise the economy and empower Humans.

7.11Be inclusive

Any digital currency must be inclusive. And some kind of "global identity" will be rather useful. KYC and AML are the must.

7.12 Be secure

7.12.1 Will it be possible for a bank or a state to lose somebody's digital currency?

Let see how different currencies would answer to this question.

- BTC: Good-level security until the FBI intervenes.
- Stablecoin: Security level unknown.
- CBDC: Security level unknown.
- Digital Coin: No. Secure by design.

7.12.2 Will it be possible for a bank or a state to take somebody's digital currency without owner knowledge?

Let see how different currencies would answer to this question.

- BTC: No. But the FBI can.
- Stablecoin: No, but some of our rules and regulations can do.
- CBDC: No, but some of our rules and regulations can do.
- Digital Coin: No. By design.

7.13 Be confidential

7.13.1 Can the identity of an Actor be disclosed?

Let see how different currencies would answer to this question.

- BTC: Top secret but the FBI can.
- CBDC: No comments.
- CBDC: No comments.
- Digital Coin: Disclosure of identity is possible only by a court decision.

7.14 Be interoperable

Digital currencies from different countries must be interoperable to enable seamless cross-border payments and exchange. In general, there are several layers of interoperability: technical, syntactical, semantic, behavioural, legal, etc. However, value must flow, not currencies. This is non-trivial and requires one or more reference architectures.

7.15 Be comprehensive

Ideally, digital currency should be an integral part of a Digital Financial Market Infrastructure.

7.16 Be affordable

Considering that only a few countries will be able to develop their own comprehensive digital currency implementation, many commercial off-the-shelf digital currency implementations are expected.

7.17 Be eco-friendly

Any digital currency at large scale must use reasonable amount of energy.

8 Abbreviations

AML - Anti Money Laundering

DAX – Decentralised Asset Exchange

CB – Central Bank

CBDC – Central Bank Digital Currency

DFMI – Digital Financial Market Infrastructure

FBI – Federal Bureau of Investigation

GDP – Gross Domestic Product

HSM – Hardware Secure Module

IAS – International Accounting Standards

ILP - Inter-Ledger Protocol

KYC - Know Your Customer

LCU – Local Currency Unit

RTGS – Real-Time Gross Settlement

SIN – Secure Identifier

SWIFT – Society for Worldwide Interbank Financial Telecommunications

WCU – World Currency Unit

WCU-LT – WCU-Legal Tender

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