Hyperledger Public Sector Special Interest Group

CBDC Rationale, Design and Challenges
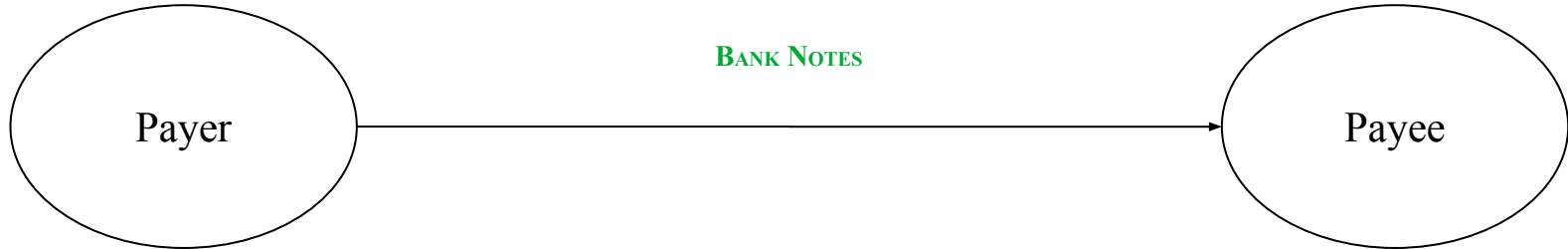
Vipin Bharathan, dlt.nyc

2020-12-04

Agenda

1. Rationale- illustrate with use case
2. Taxonomy
3. Design Choices
4. Challenges & Risks
5. Efforts and a Roadmap

LIABILITY OF CENTRAL BANK

- LEGAL TENDER
- PEER-TO-PEER
- NO INTEREST
- ANONYMOUS
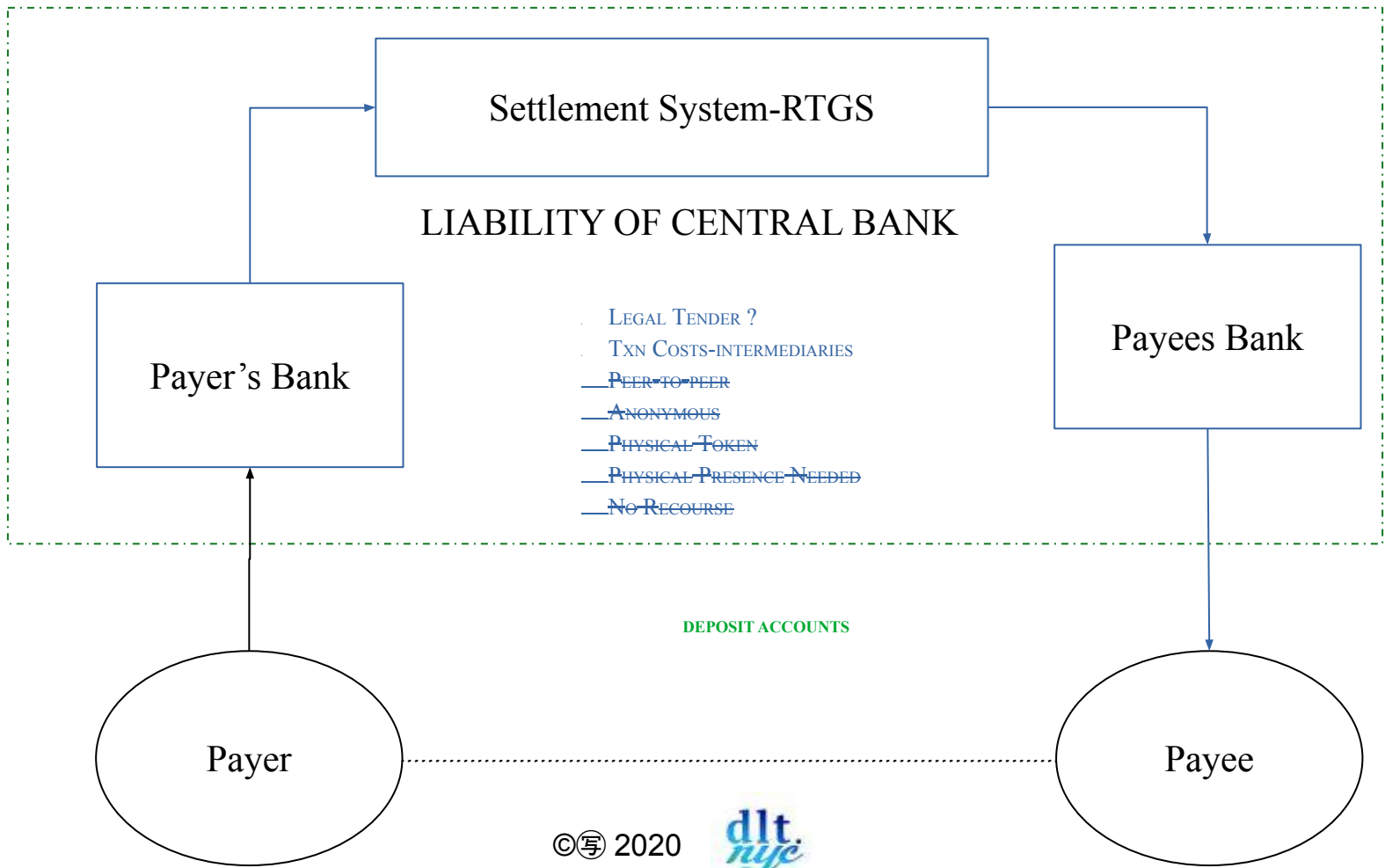- PHYSICAL TOKEN
- PHYSICAL PRESENCE NEEDED
- NO RECOURSE

BANK NOTES

Payer → Payee

Settlement System-RTGS

LIABILITY OF CENTRAL BANK

- L~EGAL~ T~ENDER~ ?
- T~XN~ C~OSTS~-~INTERMEDIARIES~
- ~P~EER~-~TO~-~PEER~
- ~A~NONYMOUS~
- ~P~HYSICAL~ T~OKEN~
- ~P~HYSICAL~ P~RESENCE~ N~EEDED~
- ~N~O~ R~ECOURSE~

Payer's Bank

Payees Bank

DEPOSIT ACCOUNTS

Payer

Payee

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Figure 1. Relevant markets in the card-payment value chain

central bank

Settlement market

card networks

Card services market

commercial banks

System market

Issuing market

Acquiring market

customers

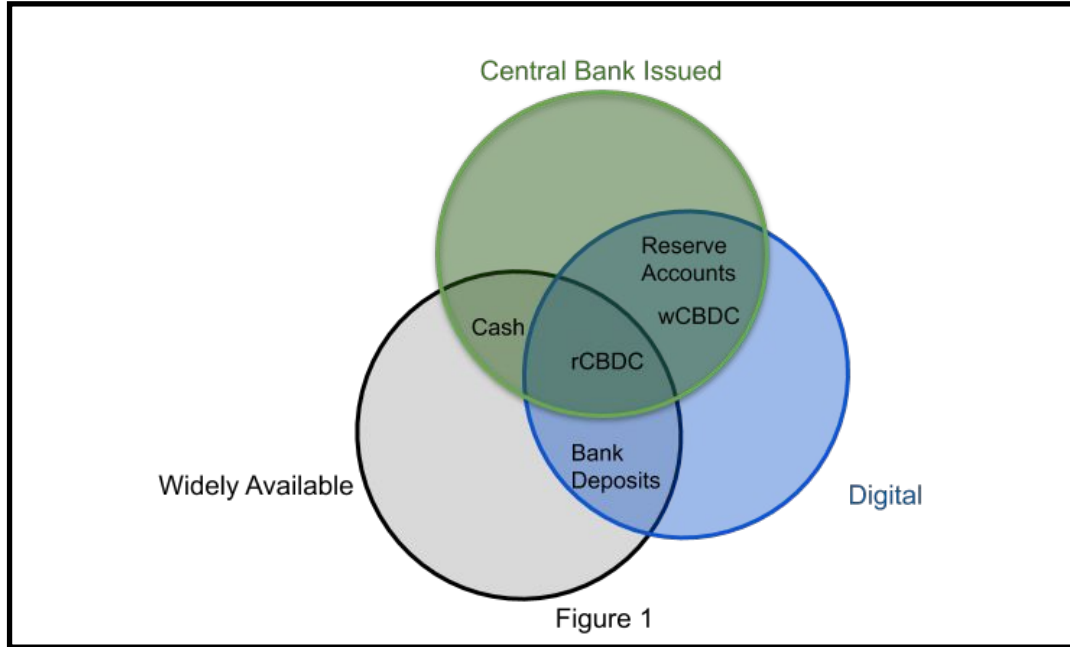merchants
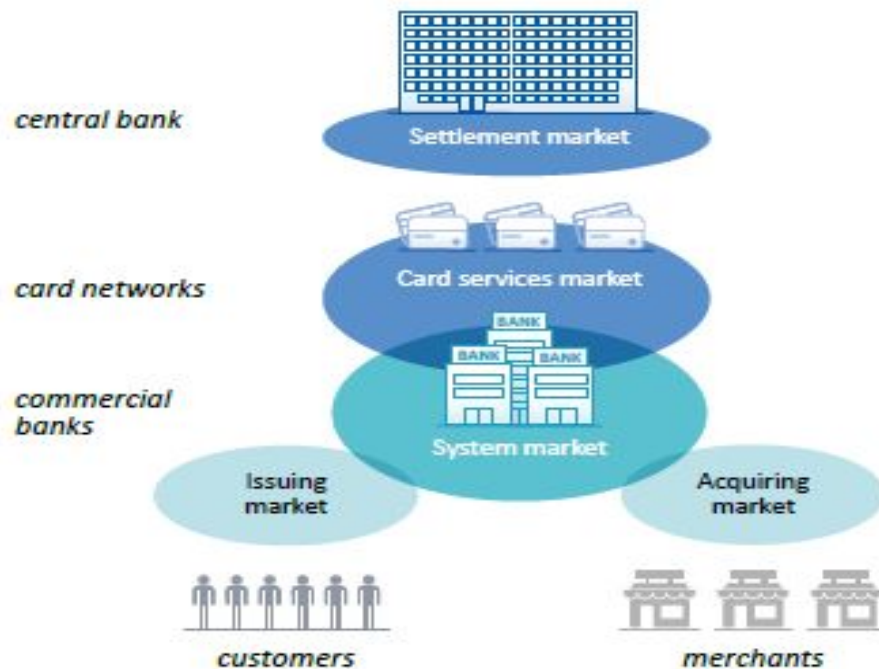
LIABILITY OF CENTRAL BANK

- LEGAL TENDER - CLARIFY
- PEER-TO-PEER - TOKEN OR OTHERWISE
- ~~NO REMUNERATION~~
- ANONYMOUS ?
- ~~PHYSICAL TOKEN~~
- ~~PHYSICAL PRESENCE NEEDED~~
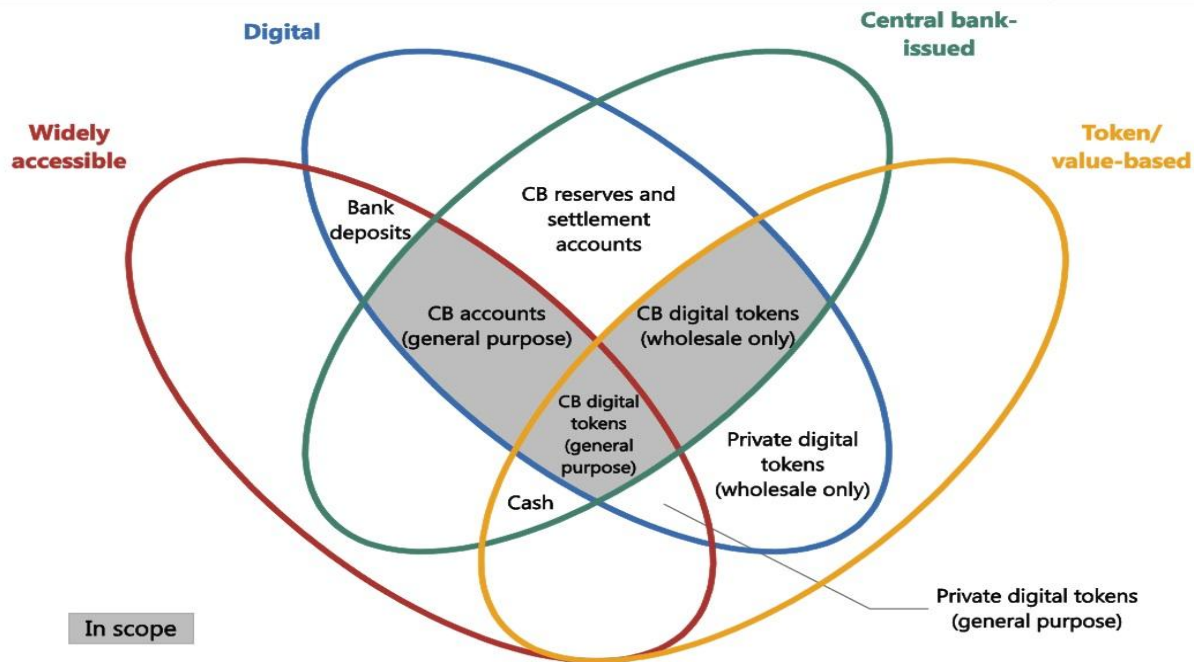- NO RECOURSE

CBDC

Payer → Payee

Rationale

1. Twin of cash
2. Payment system as national infrastructure
3. Payment diversity (multiple paths for payments)
4. QE to the people (UBI, Social security FedAccounts)
5. Regain control of monetary policy
6. Financial inclusion
7. Cross border payments
8. Reduce costs of issuance compared to cash

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Taxonomy-1

Figure 1

The money flower: a taxonomy of money

Graph 1

Digital

Central bank-issued

Widely accessible

Token/value-based

Bank deposits

CB reserves and settlement accounts

CB accounts (general purpose)

CB digital tokens (wholesale only)

CB digital tokens (general purpose)

Private digital tokens (wholesale only)

Cash

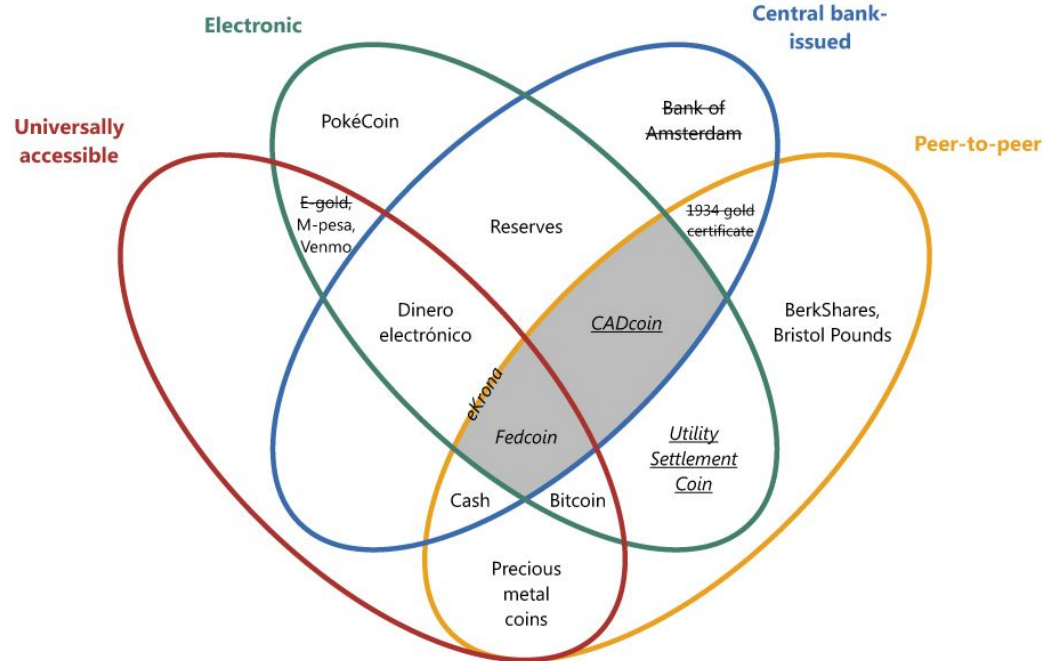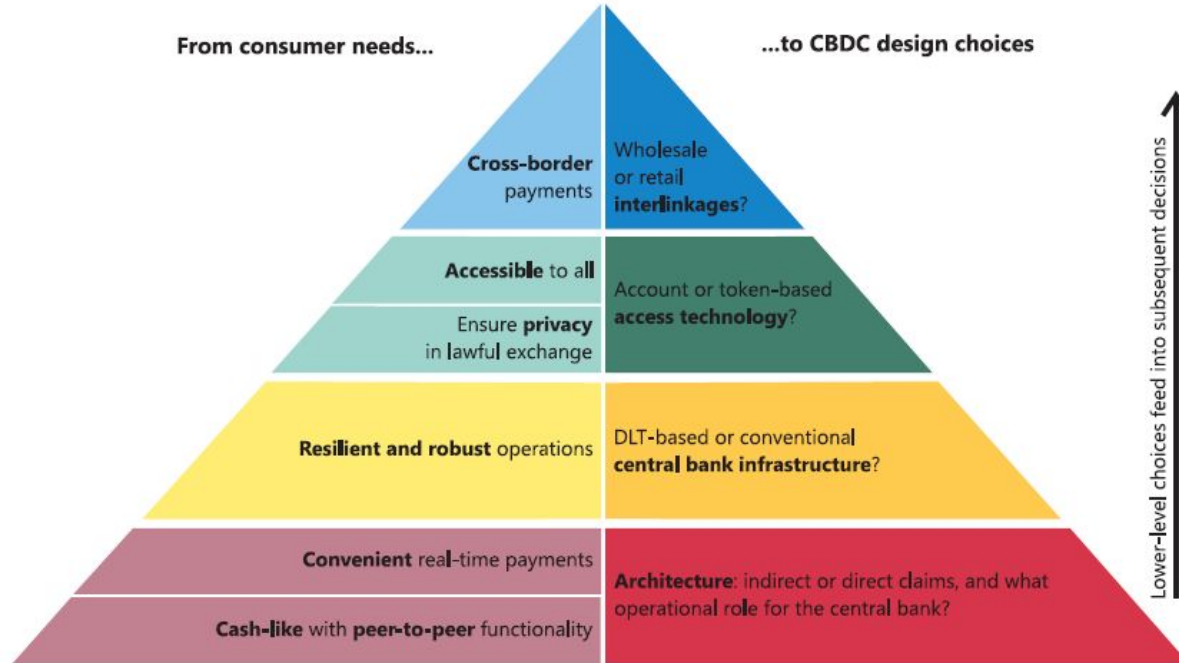Private digital tokens (general purpose)

In scope

The Venn diagram illustrates the four key properties of money: *issuer* (central bank or not); *form* (digital or physical); *accessibility* (widely or restricted); and *technology* (account-based or token-based). CB = central bank. *Private digital tokens (general purpose)* include cryptocurrencies, such as Bitcoin. For examples of how other forms of money may fit in the diagram, please refer to the source.

Sources: CPMI-MC (2018); Bech and Garratt (2017).

Electronic

Central bank-issued

Universally accessible

Peer-to-peer

PokéCoin

~~Bank of Amsterdam~~

~~E-gold, M-pesa, Venmo~~

Reserves

~~1934 gold certificate~~

Dinero electrónico

CADcoin

BerkShares, Bristol Pounds

ekrona

Fedcoin

Utility Settlement Coin

Cash

Bitcoin

Precious metal coins

A standard font indicates that a system is in operation; an *italic* font indicates a proposal; an *italic and underlined* font indicates experimentation; a ~~strikethrough~~ font indicates a defunct company or an abandoned project.

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The CBDC pyramid

Graph 1

From consumer needs... ...**to CBDC design choices**

Cross-border payments — Wholesale or retail **interlinkages?**

Accessible to all — Account or token-based **access technology?**

Ensure **privacy** in lawful exchange

Resilient and robust operations — DLT-based or conventional **central bank infrastructure?**

Convenient real-time payments — **Architecture**: indirect or direct claims, and what operational role for the central bank?

Cash-like with **peer-to-peer** functionality

Lower-level choices feed into subsequent decisions

The CBDC pyramid maps consumer needs (left-hand side) onto the associated design choices for the central bank (right-hand side). The four layers of the right-hand side form a hierarchy in which the lower layers represent design choices that feed into subsequent, higher-level decisions.

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An overview of potential retail CBDC architectures

Graph 2
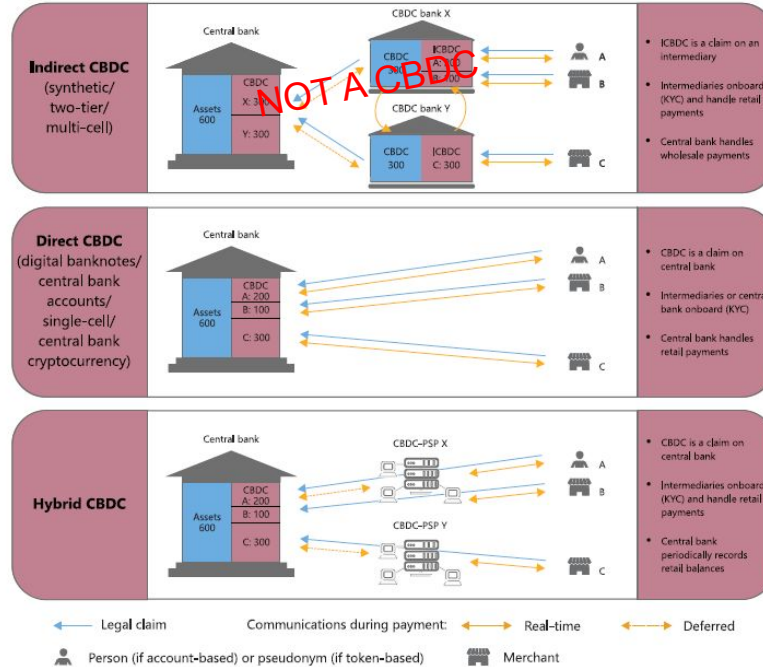
In all three architectures, the CBDC is issued only by the central bank. In the indirect CBDC architecture (top panel), this is done indirectly, and an ICBDC in the hands of consumers represents a claim on an intermediary. In the other two architectures, consumers have a direct claim on the central bank. In the direct CBDC model (centre panel), the central bank handles all payments in real time and thus keeps a record of all retail holdings. The hybrid CBDC model (bottom panel) is an intermediate solution providing for direct claims on the central bank while real-time payments are handled by intermediaries. In this architecture, the central bank retains a copy of all retail CBDC holdings, allowing it to transfer holdings from one payment service provider to another in the event of a technical failure. All three architectures allow for either account- or token-based access.

Source: Authors' elaboration.

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Notes on Design

CBDC design elements

- Records of transfers and holdings, Value-based vs. account-based, **Value-based**
- Programmability, Eligible scope for smart contracts, **Yes**
- Transfer mechanism, Peer to peer vs. use of intermediaries, **Peer to peer** (TBD)
- Level of transparency, Degree of anonymity for CBDC payments, TBD
- Availability, 24/7/365 vs. restricted hours, **24/7/365**
- Fungibility, Restrictions of converting central bank or commercial bank money: no/restricted/unrestricted, TBD
- Interest-bearing functionality, CBDC dedicated/general/no interest rate,TBD
- Offline functionality,Yes/No,**Yes**
- Integration with existing platforms (via APIs),Yes/No,**Yes**

eThaler- A Sample PoC

- Issued by Fed
- Issued only to Institutions with Fed accounts- Dealer Banks
- Constitutes a prepaid value (electronic money) without interest
- Used by commercial banks to pay each other (peer to peer)
- Redeemable at Central bank and increases reserves
- Not used by retail consumers
- Account Based
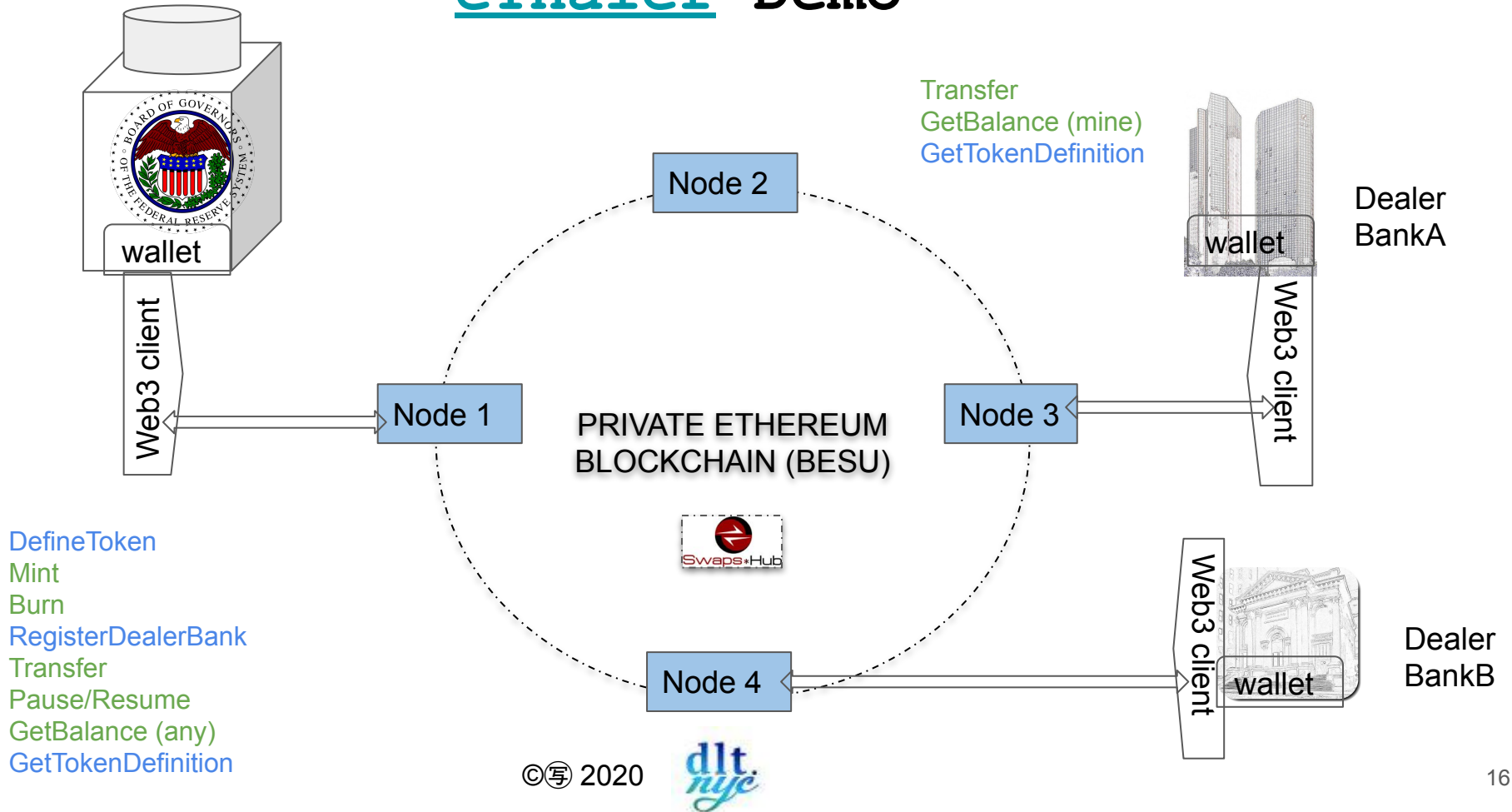- Upto 4 decimals
- Held through a digital wallet

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Using TTF develop a Formula

Formula: "tF{d,t,p,c,SC}"

    Business Description: It is **fractional,** by setting the **Decimals** property on the **divisible** behavior. A token can be **minted** or **burned.** Before executing transfer, burn or mint operation check if they are within the **compliance** regulations. **Pausable** for possible freezing of movement and all other operations because of discovered bugs or upgrade.

    Business Example: Enables the issuance of regulated electronic money by the central bank (mintable and burnable only by Central bank) and its practical usage in real financial applications.

[eThaler](#) Demo

Transfer
GetBalance (mine)
GetTokenDefinition

Node 2

Dealer
BankA

wallet

Web3 client

Node 1

PRIVATE ETHEREUM
BLOCKCHAIN (BESU)

Swaps*Hub

Node 3

Web3 client

wallet

DefineToken
Mint
Burn
RegisterDealerBank
Transfer
Pause/Resume
GetBalance (any)
GetTokenDefinition

Web3 client

Node 4

Web3 client

wallet

Dealer
BankB

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Challenges & Risks

1. Risk to Commercial banks
2. Loss of Monetary Policy Control with ZLB
3. Surveillance vs. Privacy (tiered wallets)
4. Security concerns- hackability
5. Interoperability
6. Scale
7. Performance

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Some New Ideas

[Project Helvetia](#) BIS project to integrate tokenized assets with a payment rail

Use CBDC to spur Climate Change mitigation- Make direct CBDC payments to carbon credits
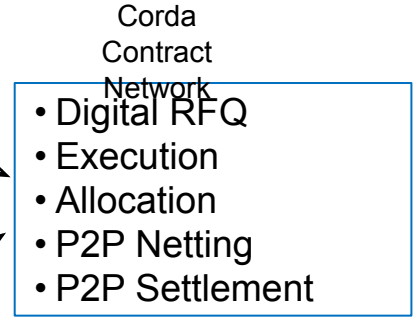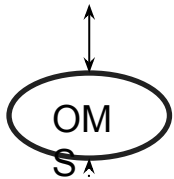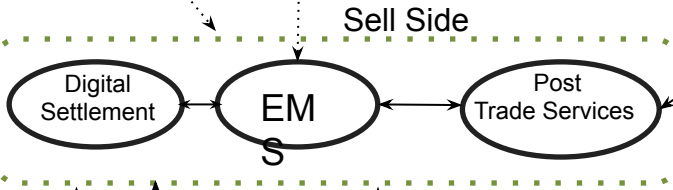
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Why do we need an Integrated CBDC ?

Retail

Buy Side

Institutional (Asset Mgrs, Hedge Funds, Insurance)
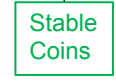Corporates, Wealth Mgmt firms/desks, Family offices

Corda Contract Network

We need a medium of exchange for all digital assets
- an integrated r/w/c CBDC
to facilitate RTGS, Prefunded/Deferred Netting

OMS

Post Trade Services

otc*Ledger

- Digital RFQ
- Execution
- Allocation
- P2P Netting
- P2P Settlement

ISDA CDM   **Layer 2**

Sell Side

Digital Settlement

EMS

Post Trade Services

Primary & Secondary Market Services

NASDAQ, Archax, SIX Digital ..

Institutional Digital Exchanges

Retail RTGS Exchanges, Interoperability platforms

Polkadot, Fnality.org clearmatics

Layer 1

Asset Network s

CBDC

Stable Coins

Cryptos

STOs

Cap. Mkt Tokens

Public Utility Tokens

USDC, Fnality, DAI, JPM/ Coin?

Securitize, Polymath, Investment Banks

Bank A&L tokens, Depository Receipts, Bonds, Loans etc. IoT, Industrial Token

Real Estate, Entertainmen t, Collectibles, Industrial

otcLedger components

Surveys of CBDC projects

[Four horses](#)
The data has been translated using Yandex (from an image) available in a [spreadsheet](#).
The spreadsheet contains 23 states as reported by Tsinghua University BC research. This is about 6+ months old as of 2020-05-08
The translation is literal.

[CBDC Tracker](#)
It is a tracker that is kept current. Research, Development, Pilot, Launched, Cancelled are the categories and there is a table. Seems slightly out of date on 2020-12-04- can be easily brought back to reflect reality.

[Taking Stock: Ongoing Retail CBDC Projects](#) A BIS study.

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Roadmap For CBDC

In the short term: 1-2 years Experimentation will continue, gathering momentum. China will issue some form of DC/EP and integrate with their national infrastructure. SOV and Bakong are out already although they cannot be really called CBDCs.

In the medium term: 2-5 years more integration into the system as issues get shaken out. More countries join.

In the long term: 5-10 years. Either it will become successful, widely used and not discussed anymore or it will be a failure and stop being adopted, digital central bank money will continue to engage the public sector.