BIS Innovation Hub

Projects Atlas, Mariana and the Technology of Decentralised Finance

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31 August 2023, Bank of Finland 21st Simulator Seminar, Helsinki

The expressed views are not necessarily those of the BIS

What is the relevance of DeFi to central banks and regulators?

- DeFi of interest beyond cryptoassets:
  - Algorithmic automation of financial activity
  - Composition of financial services – "Financial lego"
  - Enabling of new forms of openness
- However, comes with enormous technological and economic complexity, and many risks

➢ **What is DeFi, how does it work, and can we learn from it for centralized systems?**

- R Auer, B Haslhofer, S Kitzler, P Saggese and F Victor (2023), "The Technology of Decentralized Finance (DeFi)", BIS WP No 1066.

➢ **What are the use cases, risks of DeFi and its interaction with regulated finance?**

- Project Atlas
- Project Mariana

Technology of DeFi – “Tyvestä puuhun noustaan”

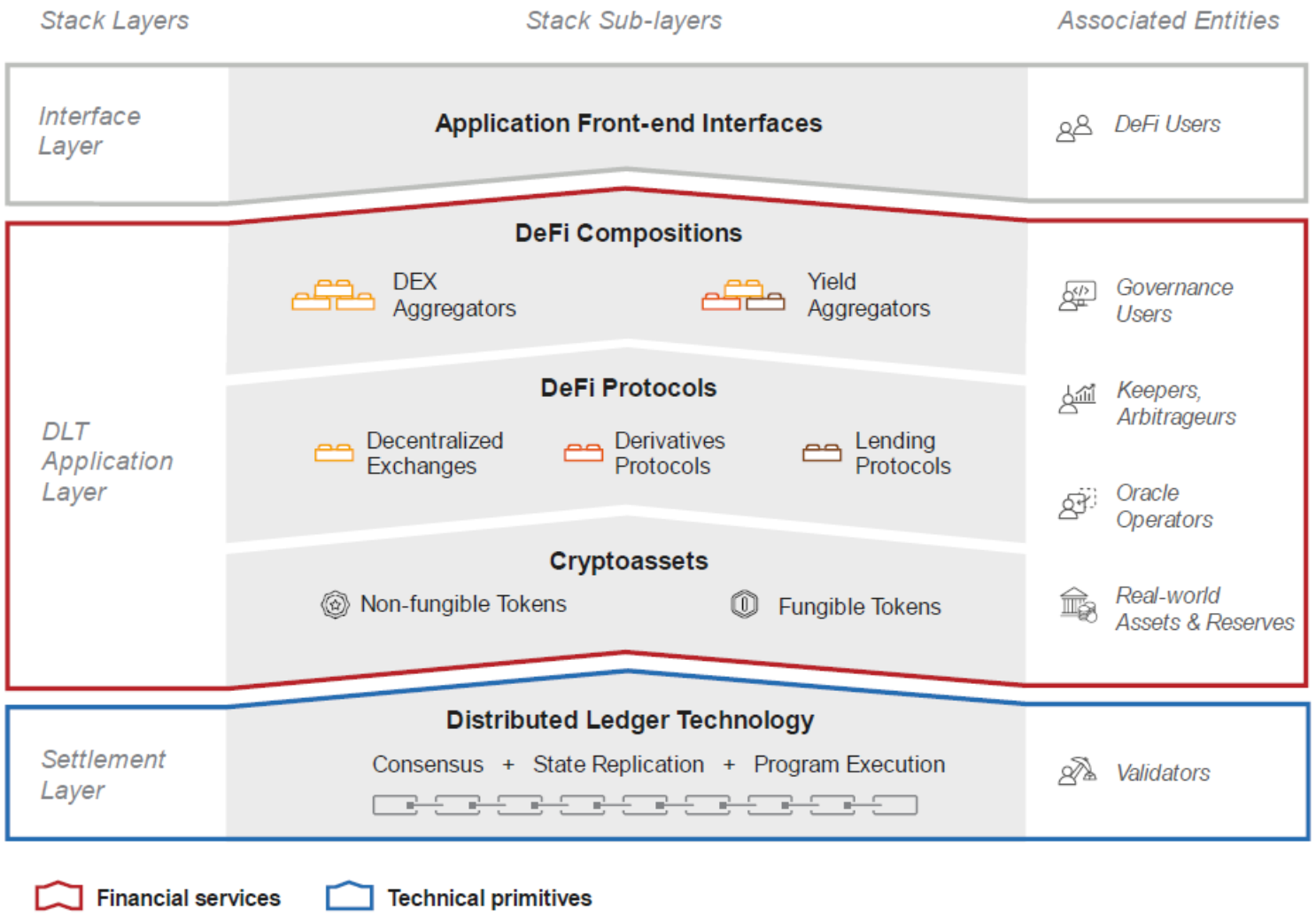
- We define Defi and draw on a DeFi Stack Reference Model (or DSR Model) to outline the *technical primitives*, i.e. the technology DeFi relies on
- We describe in a structured way the DeFi protocols, the *financial functions* they offer, and the *economic agents* involved
- We *generalize* the protocol incentive mechanisms in the *peer-to-pool model*
- We describe how *composability affects DeFi* and its ecosystem
- We discuss an *interdisciplinary research agenda*

Definition of DeFi

***DeFi** is a competitive, contestable, compostable and non-custodial financial ecosystem built on technology that does not require a central organization to operate and that has no safety net.*

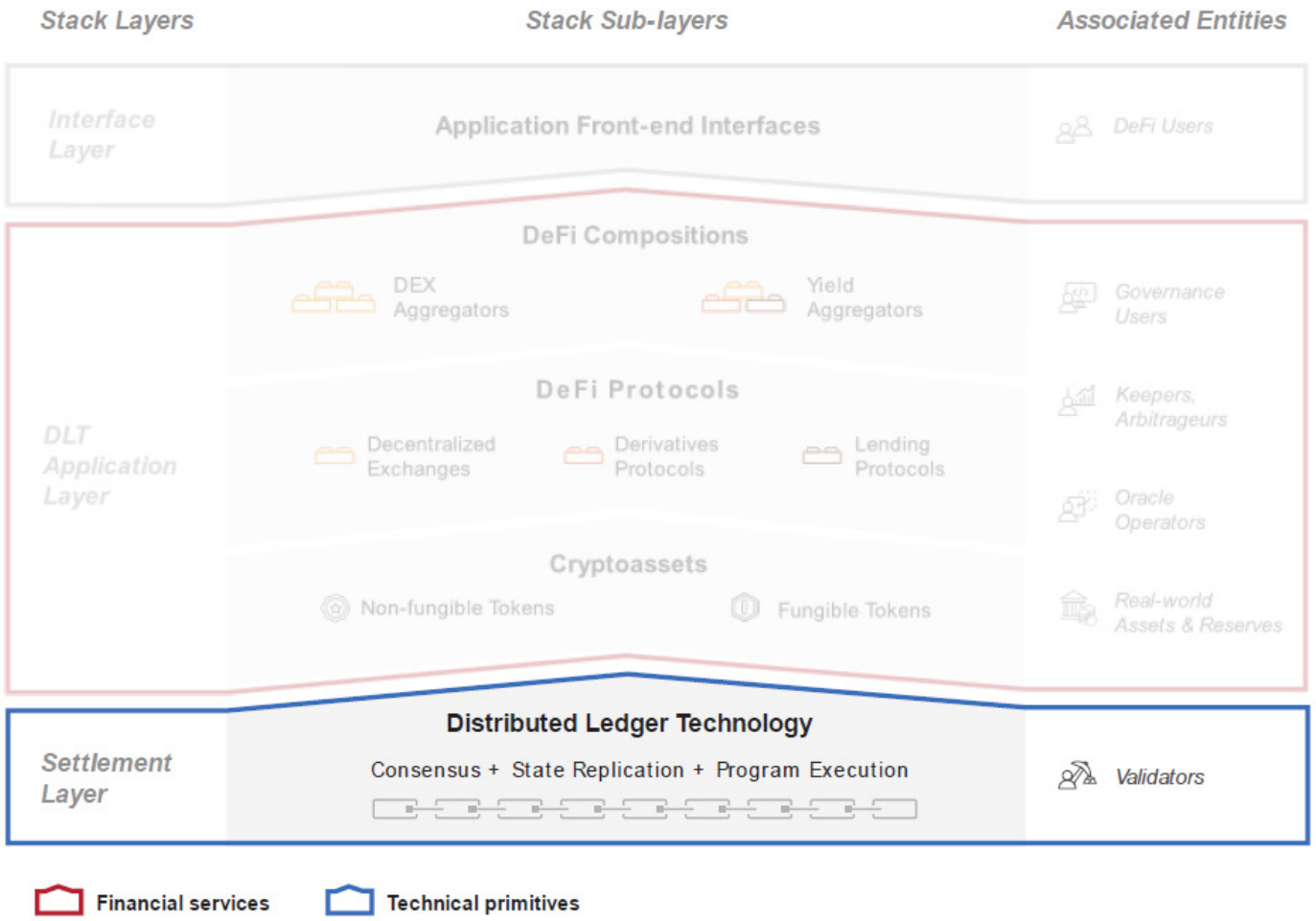
- Competitive - novel intermediaries (miners, validators) compete to settle transactions
- Contestable - anyone can enter the markets
- Composable - basic protocols can be assembled in complex services
- Non-custodial - users keep custody of their assets
- No safety net:
  - No KYC/AML
  - No investor protection
  - Lost funds cannot be recovered

The DeFi Stack Reference Model (DSR)



- **Interfaces** for consumers
- **Applications**:
  - composed into potentially complex financial products
  - called by protocols
  - assets
- **Settlements & finality**

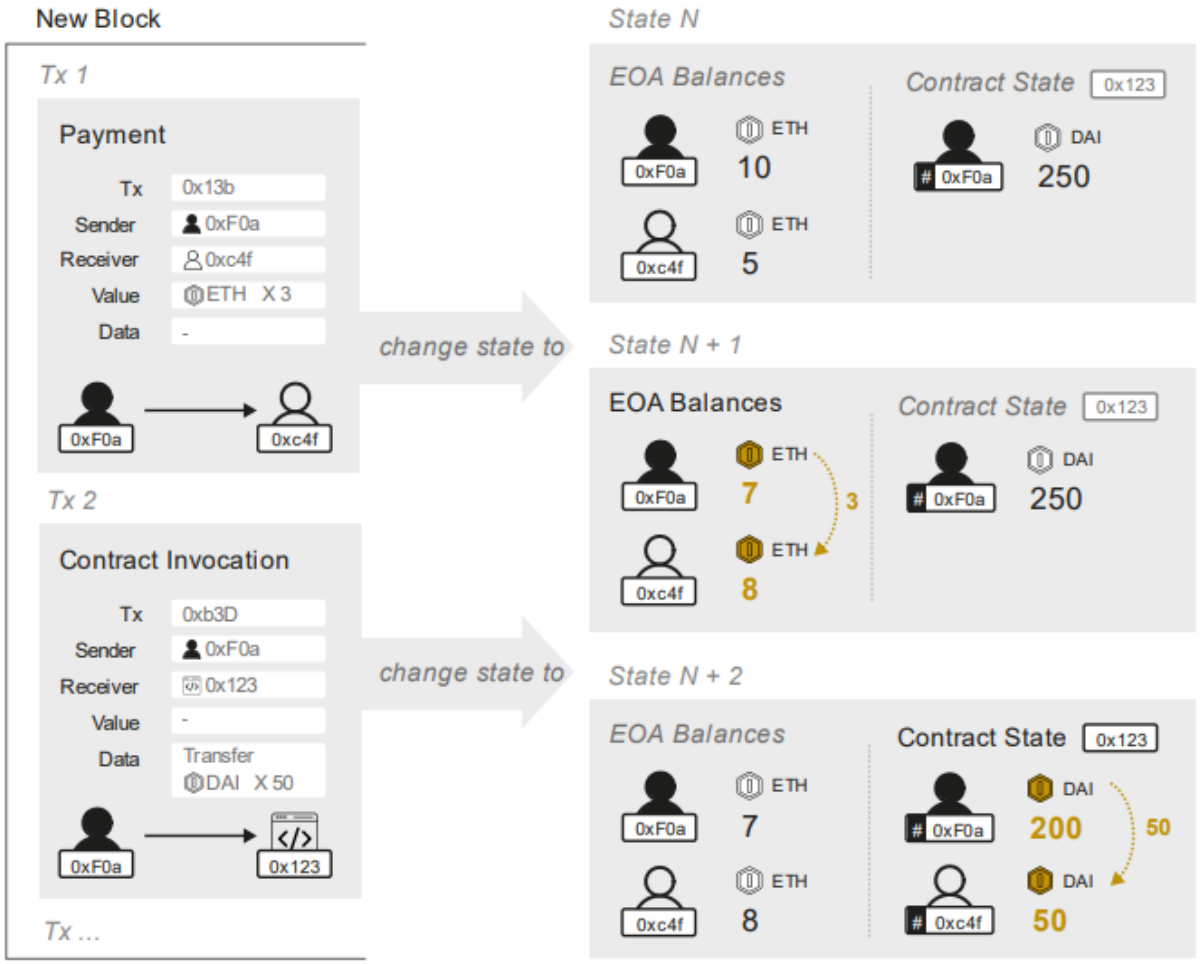
Settlement Layer | DLTs



Through **DLTs**, untrusted parties reach an agreement on the global state of the system, replicate it across the network, and execute smart contracts.

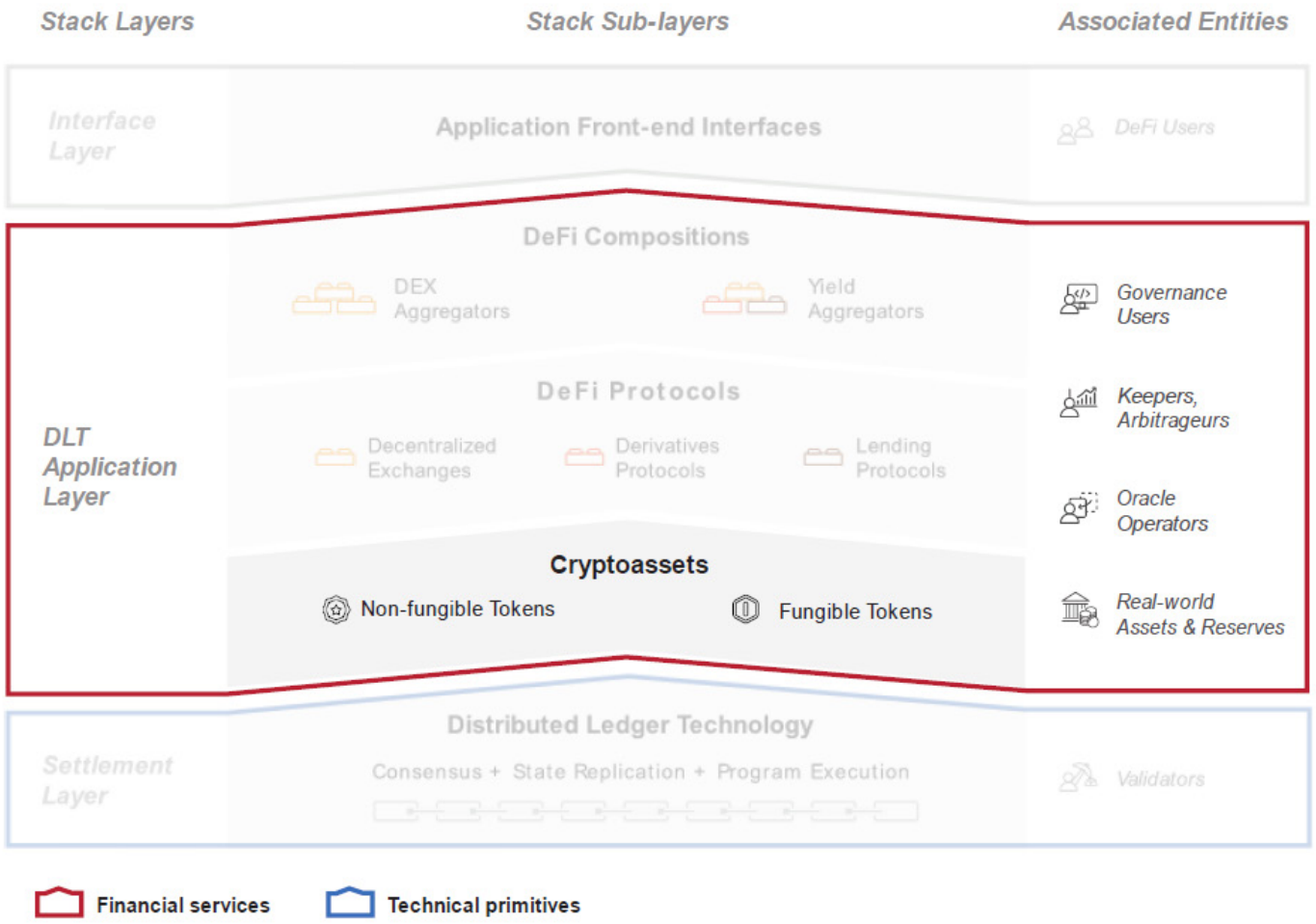
Nothing magical, centralised systems do something similar

DLT Settlement Layer | State changes



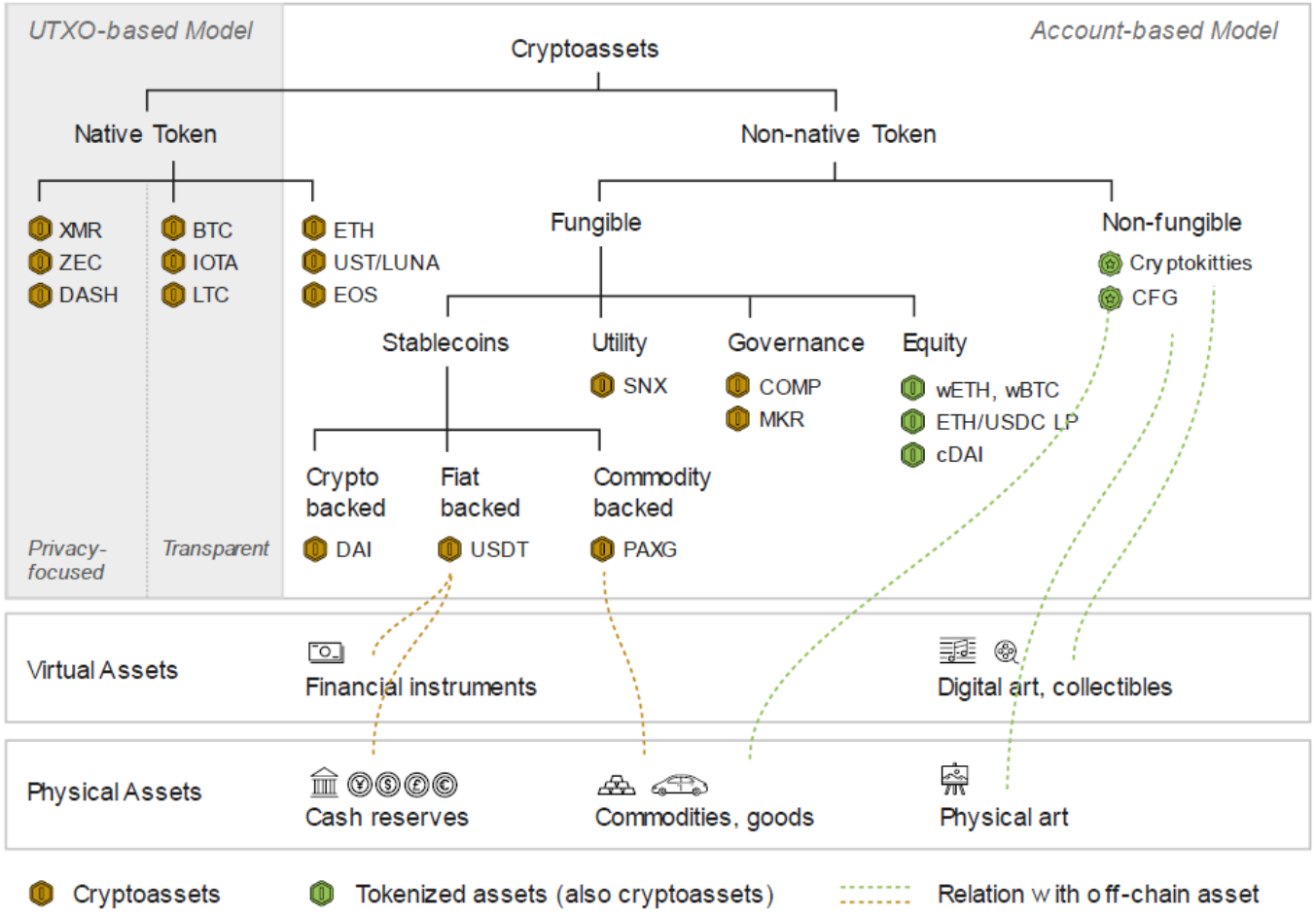
- State = at each point in time, who owns which funds, and which contracts are active?
- **New block records changes**:
  - Payments
  - New contracts
  - …
- **DLT no magic bullet** – just a file system to record all activities, updated in a distributed matter by miners (POW) or validators (POS)

DLT Application Layer | Cryptoassets



Cryptoassets are digital assets that utilise cryptography and distributed ledger technologies and represent some economic resource or value to someone.

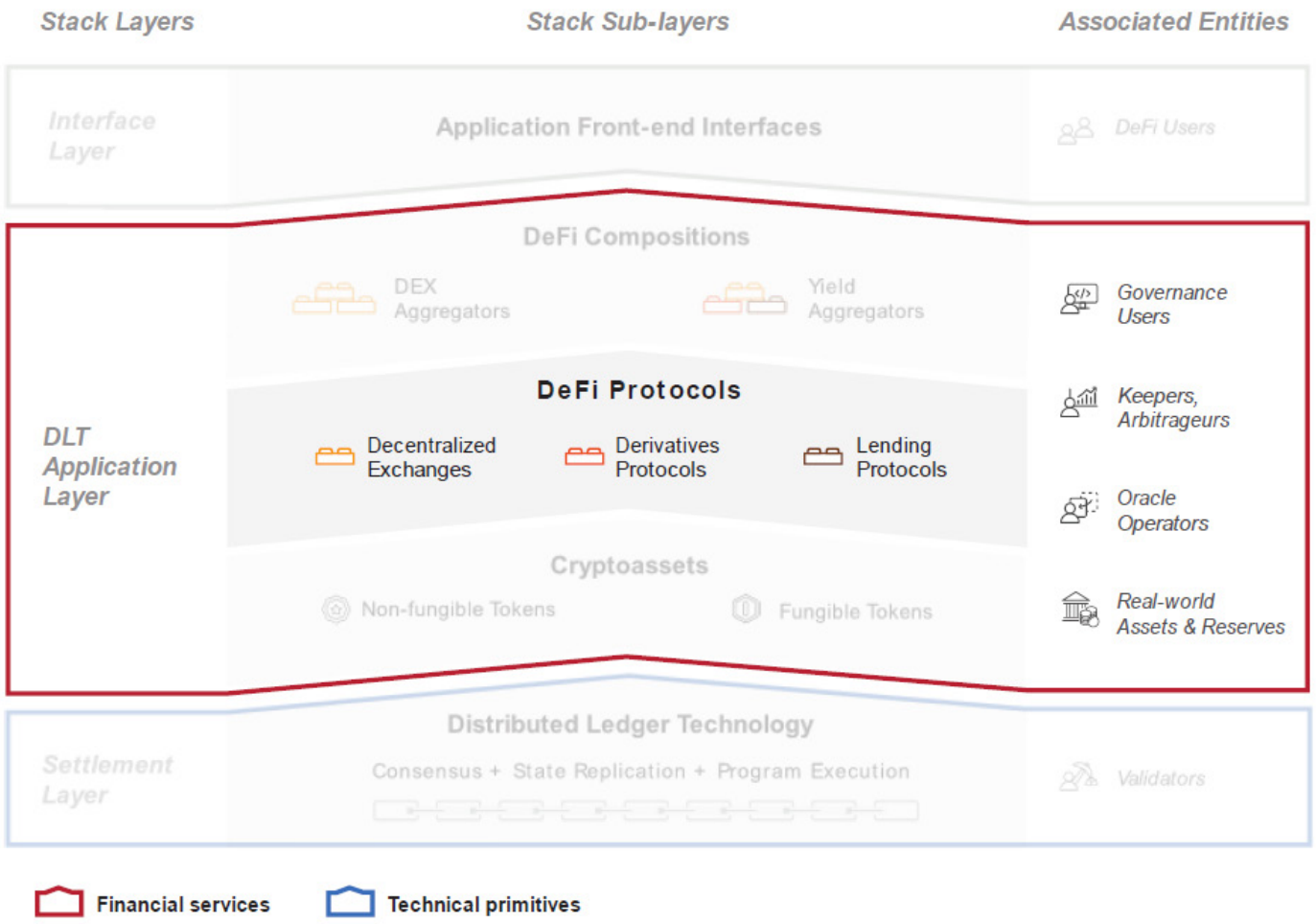
DLT Application Layer | Cryptoassets



- Crypto assets: Means of exchange, investment, or to access a good or service.

- Can be:
  - native/virtual (ETH, Uniswap token)
  - or represent real value (asset backed stablecoin, tokenized investment)
  - Latter only as good as the asset backing

DLT Application Layer | DeFi Protocols



A **DeFi protocol** provides financial services that are implemented as program functions by one or more smart contracts:

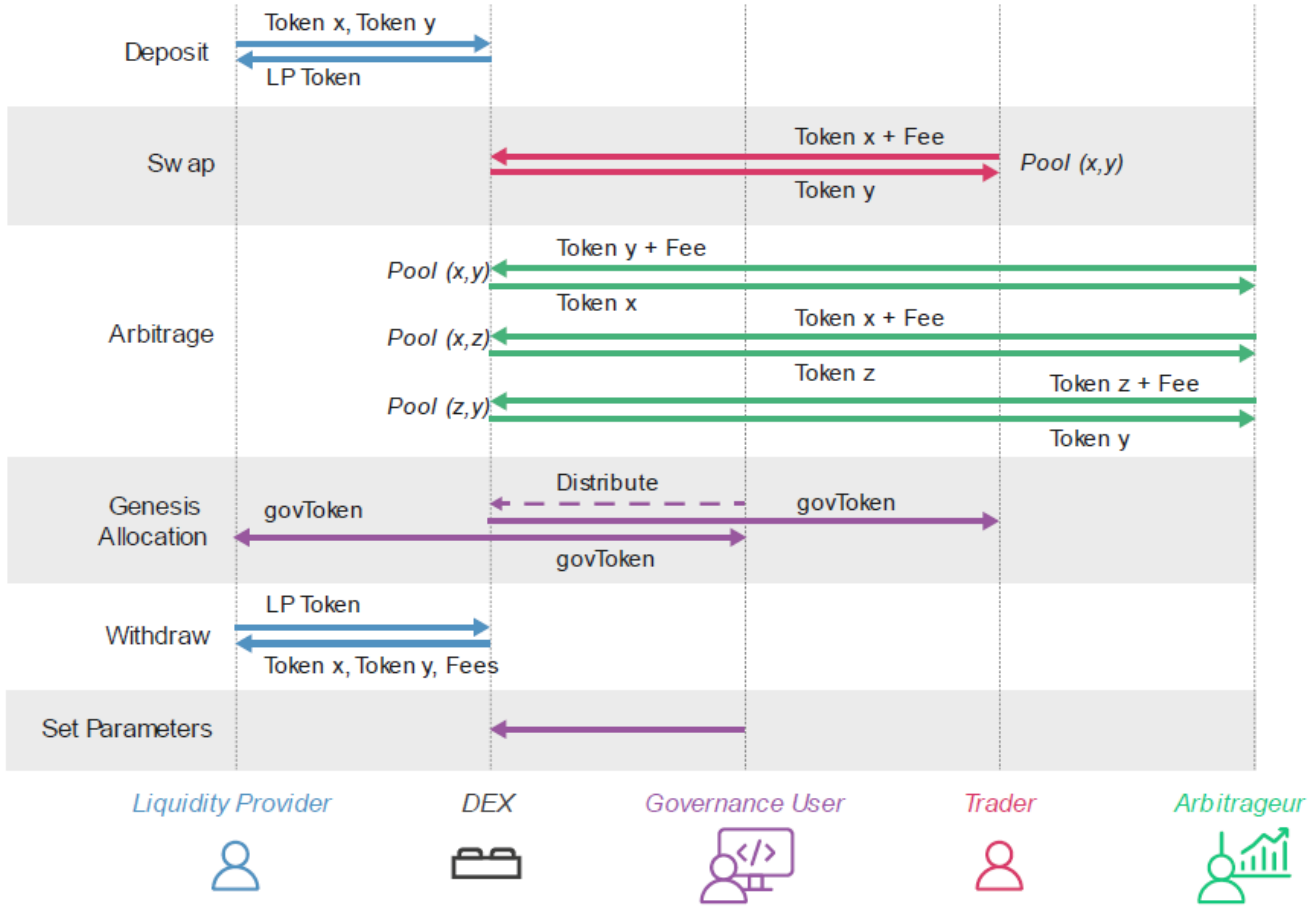
- DEX, AMM, lending, pooling, etc.

Definition DeFi protocol

DeFi protocol provides one or more financial services to economic agents. Financial services are implemented as program functions by one or more smart contracts.

- **Decentralized Exchanges** (DEXs): facilitate the exchange of cryptoassets
  → Uniswap, Curve Finance
- **Lending Protocols**: allow users to lend and borrow cryptoassets
  → Compound, MakerDAO
- **Derivatives Protocols**: issue and trade synthetic positions that track the value of underlying crypto or real-world assets
  → Synthetix , dYdX

DeFi protocols | DEX



→ *LPs*: provide liquidity into a pooling smart contract (AMM):

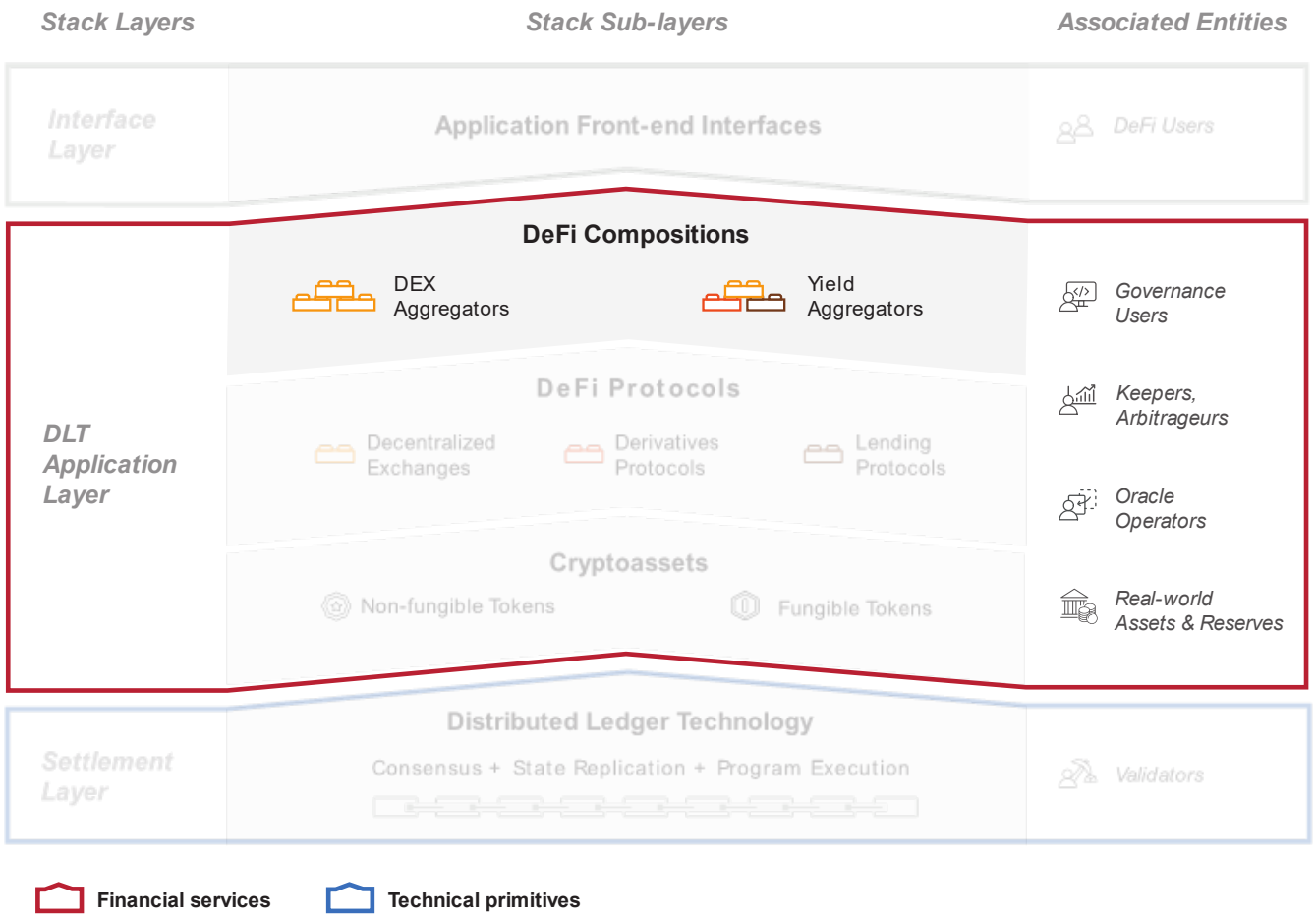
- Ie pool is X,Y with $LP_1(X,Y)$ outstanding

→ ***Traders*** **swap tokens, with prices guided by some formula such as X*Y=k**

- **Ie pay in y and get x such that X*Y=(X-x) *(Y-y)**

(*Arbitrageurs* rebalance pools for profit; *Governance* users have voting rights to set fees etc)

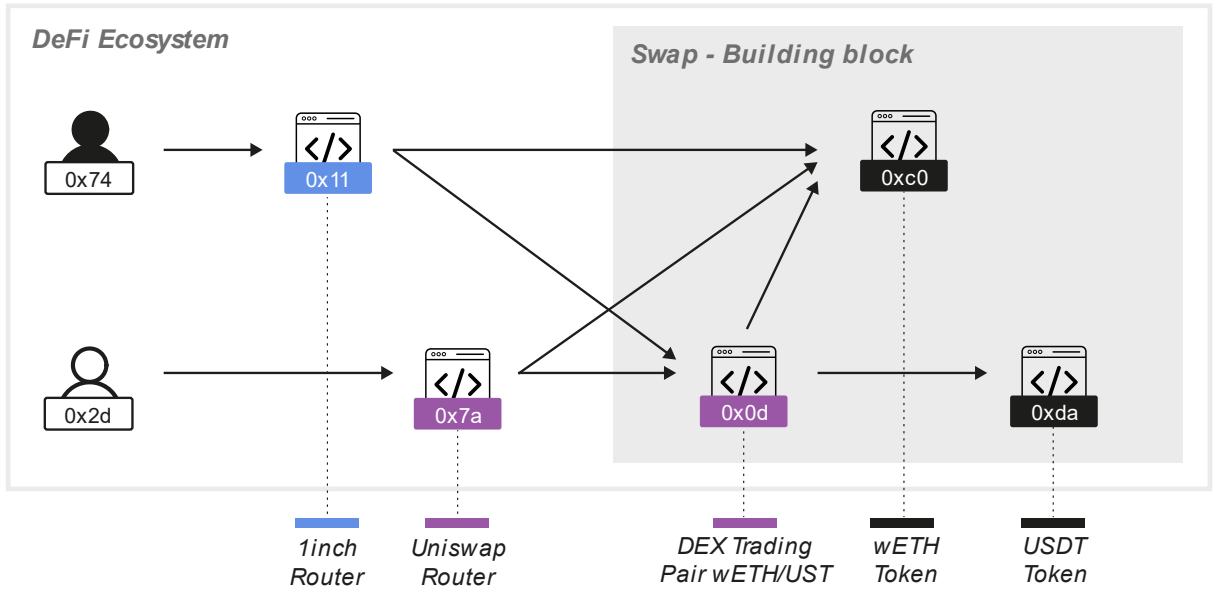
DLT Application Layer | Compositions



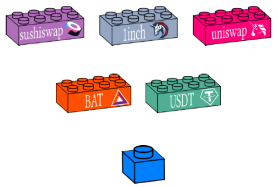
A DeFi composition combines other DeFi protocol within a single transaction to offer a new functionality.

- ie computer programs that call other programs, just like in C++, R, Matlab or Stata

Smart contracts can interact with smart contracts of other DeFi protocols

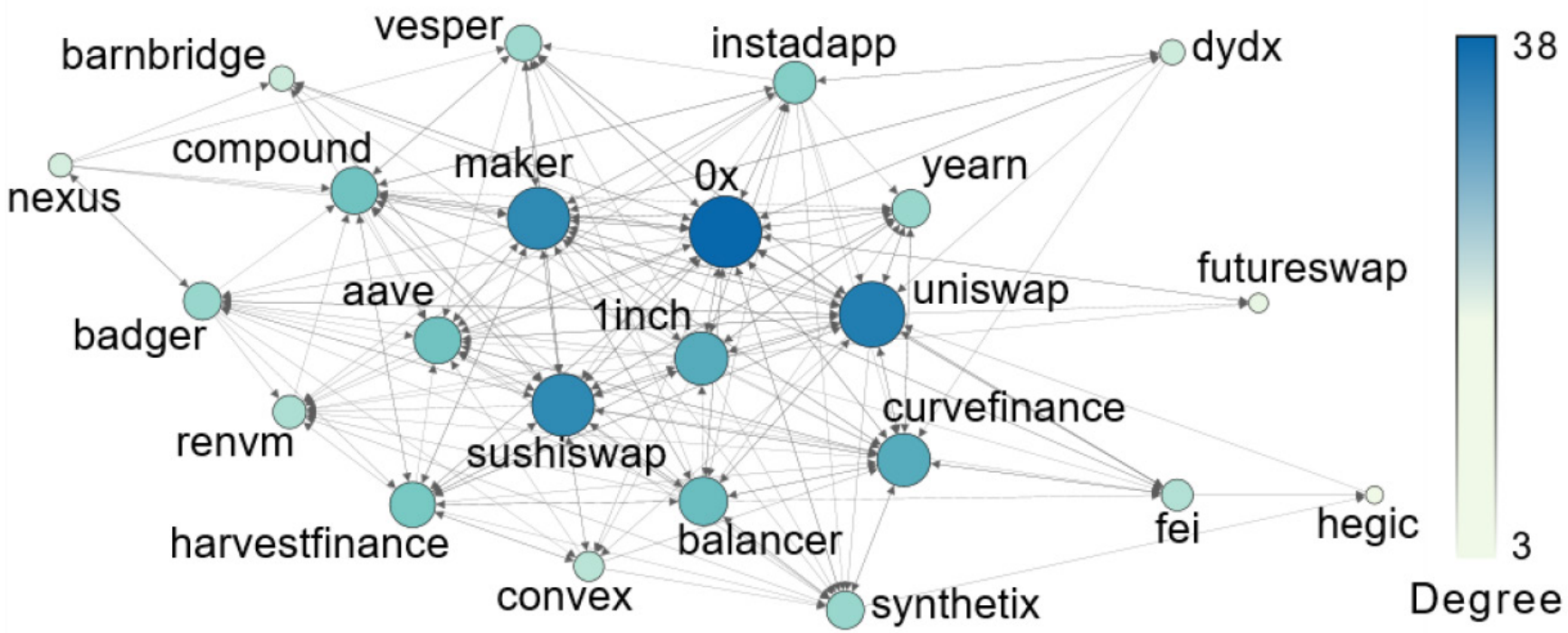


- DeFi protocols provide financial services
- On top of cryptoassets
- Implemented as smart contracts



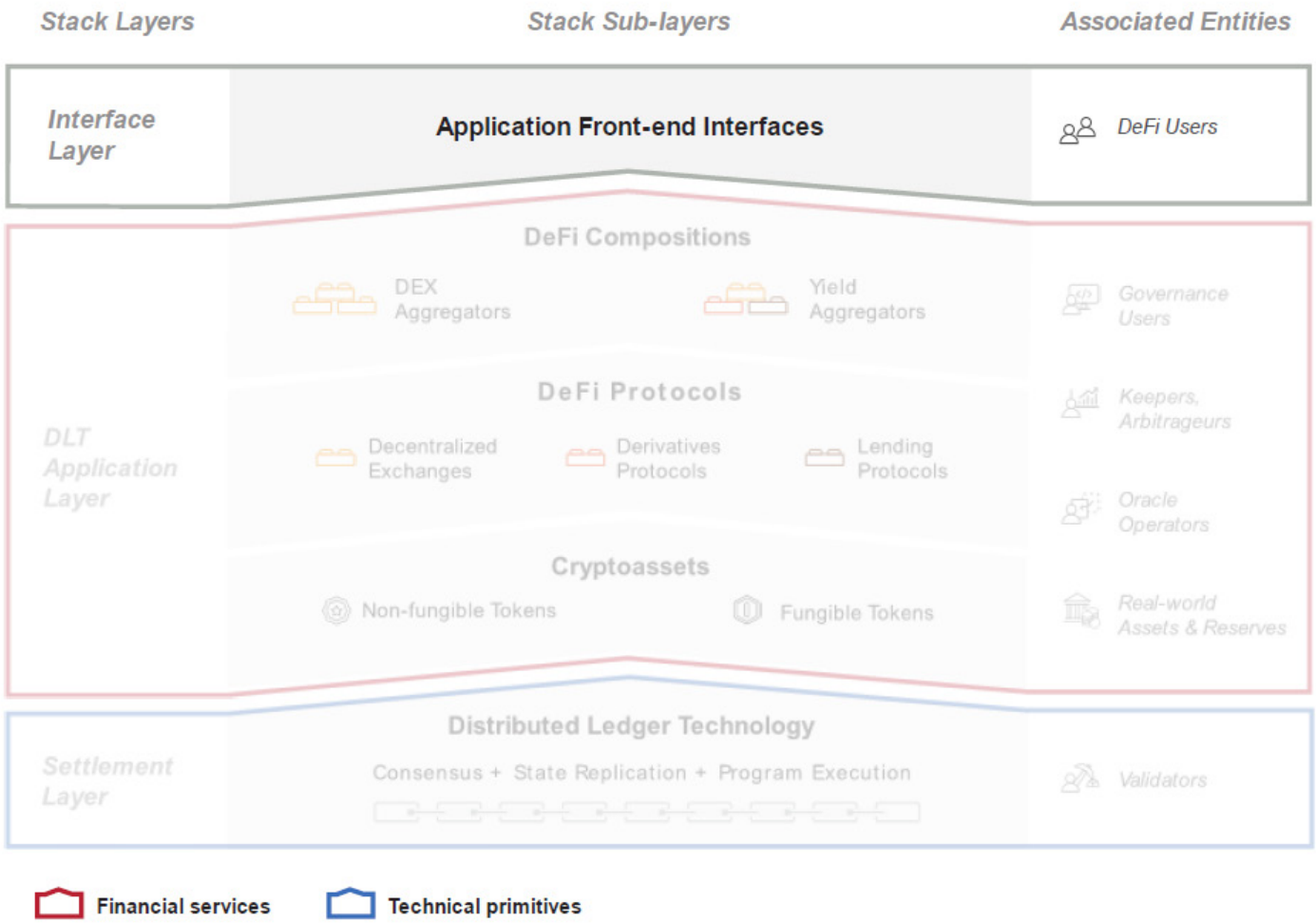
A **DeFi composition** combines other DeFi protocol within a single transaction to offer a new functionality.

The DeFi Protocol Network



The network is constructed from a dataset of external transactions directed to a set of smart contracts manually associated with 23 DeFi protocols between January and August 2021

End-user Layer | DeFi applications



DeFi interfaces facilitate the interactions with protocols. They provide a framework to enter parameter inputs to the DLT application layer.

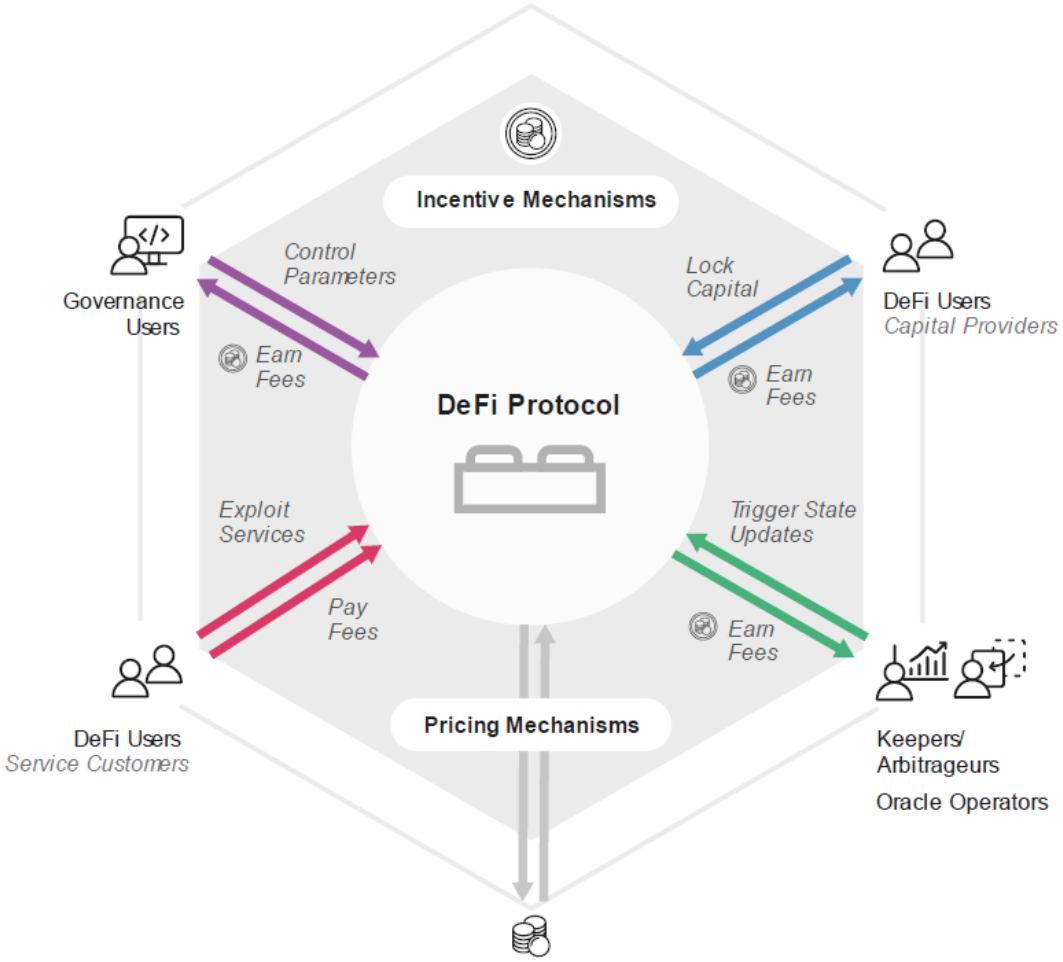
- Non-DLT applications
- Facilitate the interaction with the smart contract logic
- Framework to provide input parameters to the Application layer

Research agenda

- Settlement Layer:
  - Cross chain Interoperability
  - Transaction Reordering and Miner Extractable Value (MEV)

- DLT Application Layer:
  - Cryptoassets: SoK of derivatives like tokens
  - DeFi Protocols: governance and centralization, evolution of mechanism designs, and DeFi democratization to broader audiences
  - DeFi Compositions: understand risk more deeply, for instance analysing token flows and DeFi integration with traditional finance

The peer-to-pool ecosystem



→ Protocols provide services based on the ability to pool cryptoassets

→ Active users pay fees, capital providers earn fees

→ Other incentive mechanisms: Keepers, Arbitrageurs, Governance

Work agenda Eurosystem Centre

- Use mechanisms of DeFI space in traditional financial system
  - Project Mariana

- Close data gaps to assess the macroeconomic relevance of DeFi
  - Project Atlas

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Project Mariana

Cross-border exchange of wholesale CBDCs using automated market-makers

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BANQUE DE FRANCE
EUROSYSTÈME

MAS
Monetary Authority of Singapore

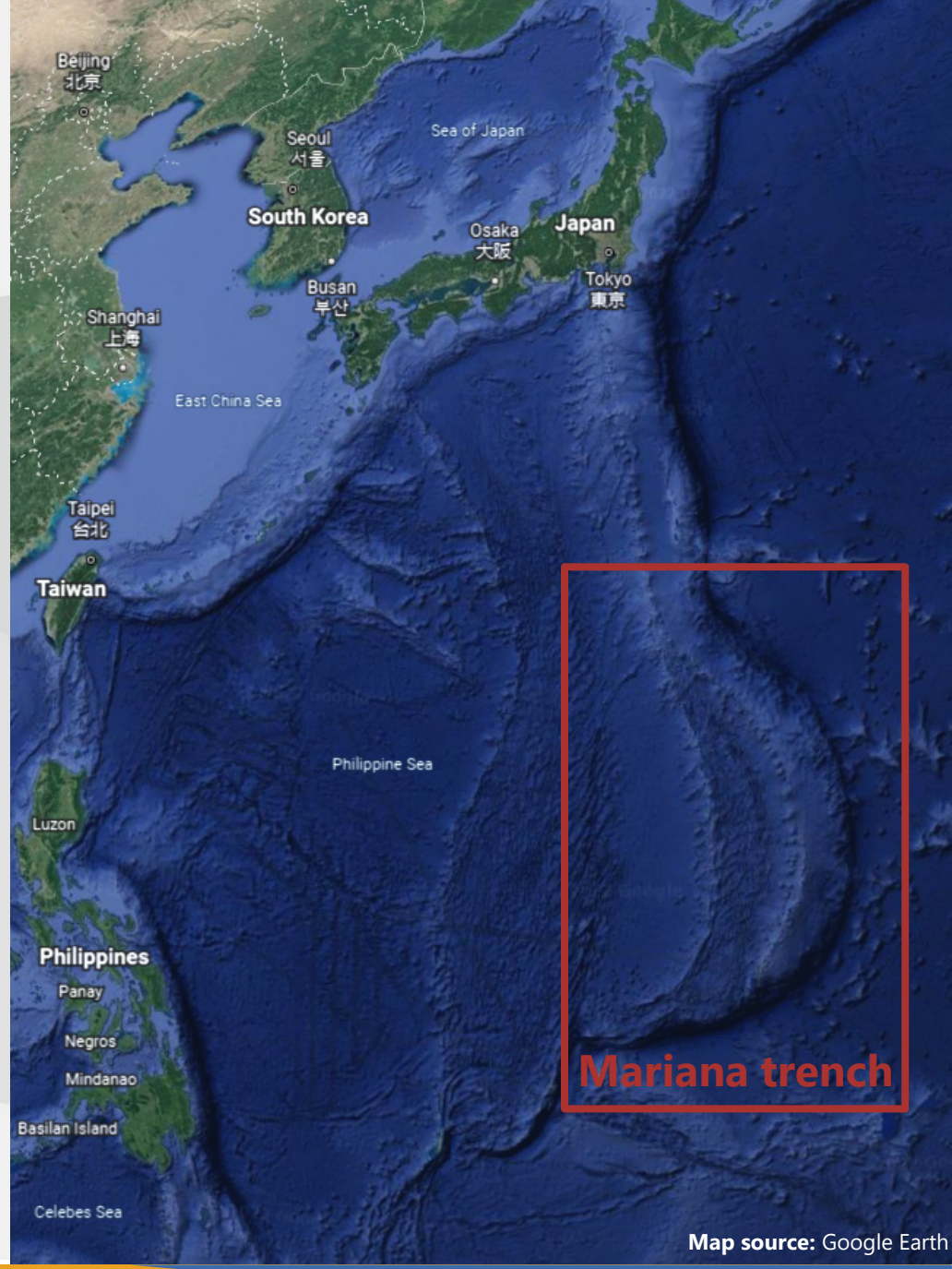
SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
BANCA NAZIONALE SVIZZERA
BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK

Project Mariana

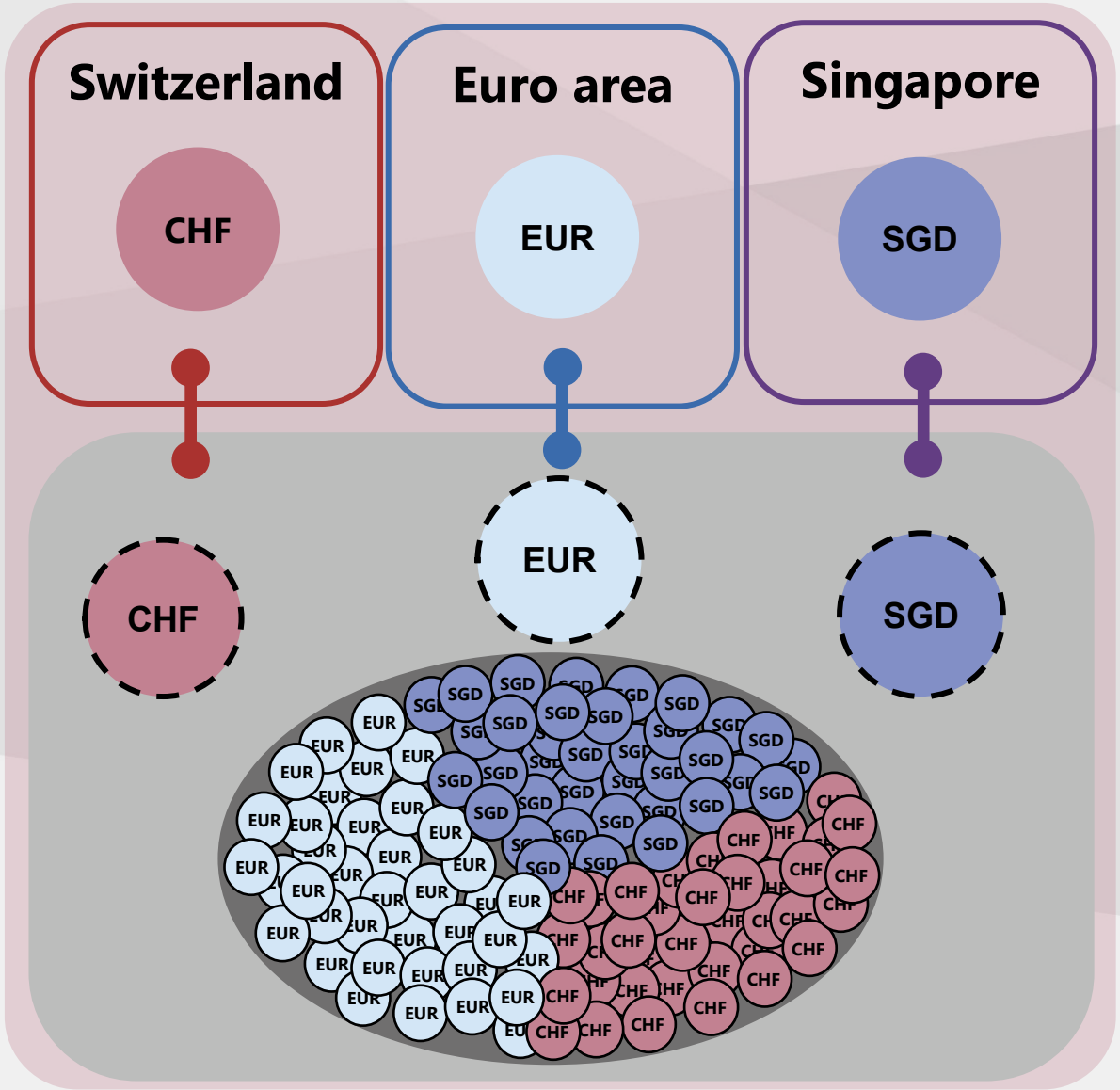
The future of tokenised FX trading and settlement?

Trading and settlement

International network for FX



Mariana high-level architecture



Three components

Bridges: Interoperability between domestic platforms and international network

CBDC

wCBDCs: Interoperability between currencies

EUR CHF SGD

AMM: Decentralised trading and settlement of wCBDCs

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Project Atlas

Cryptoanalytics for Central Banks

DeNederlandscheBank EUROSYSTEEM

DEUTSCHE BUNDESBANK EUROSYSTEM

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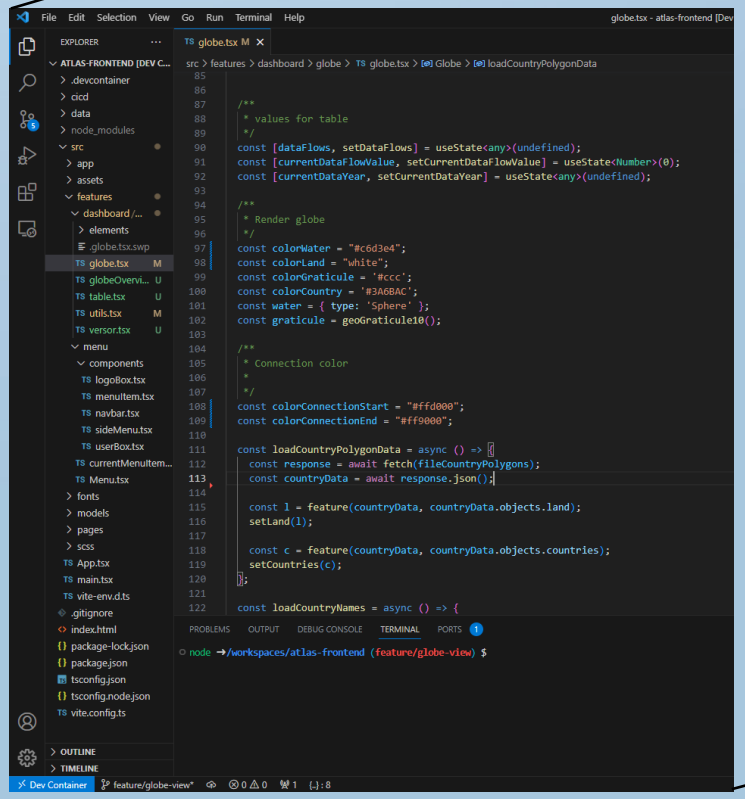
Atlas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data
node_modules
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features
dashboard /...
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sideMenu.tsx
userBox.tsx
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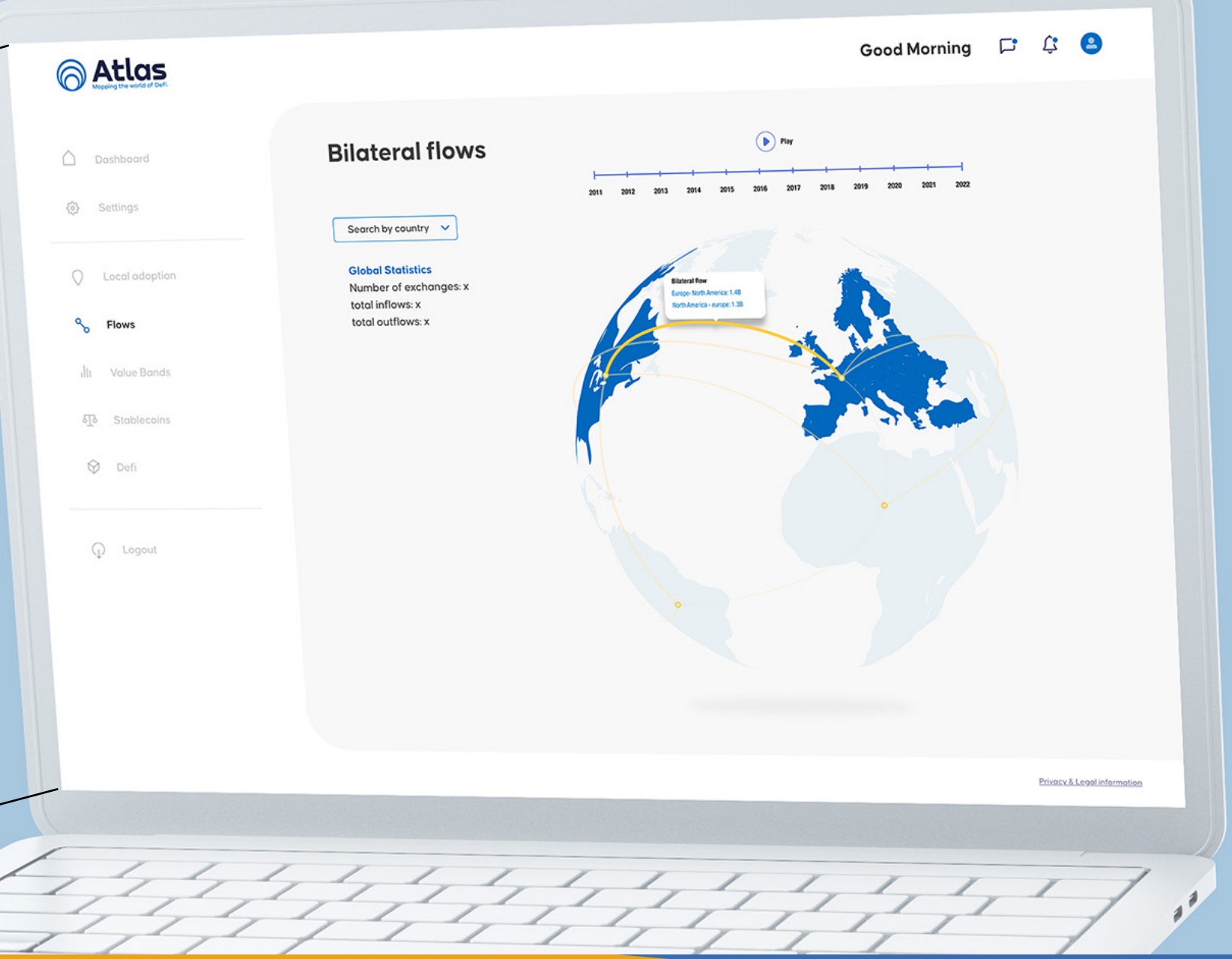
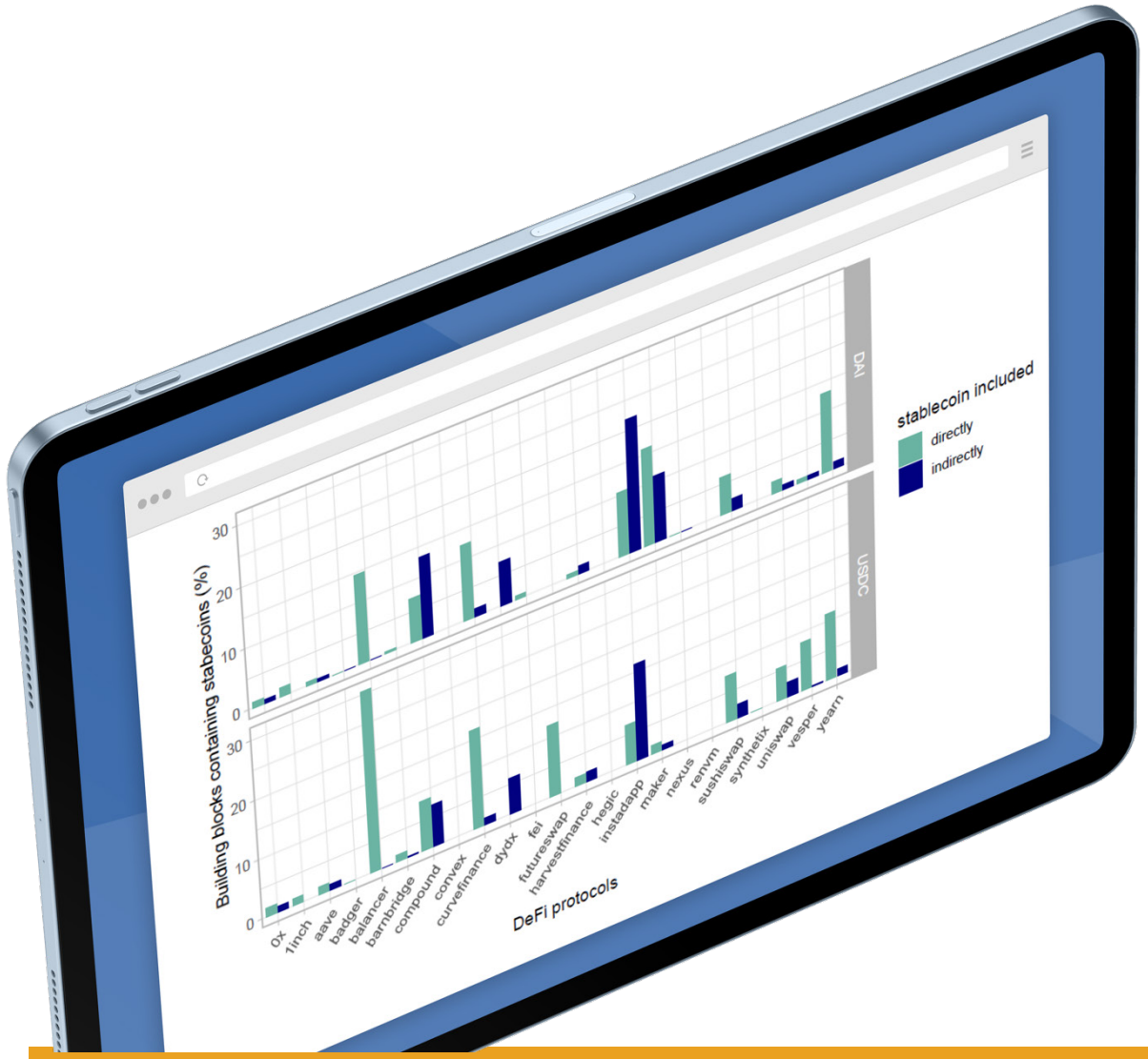
models
pages
scss
App.tsx
main.tsx
vite-env.d.ts
.gitignore
index.html
package-lock.json
package.json
tsconfig.json
tsconfig.node.json
vite.config.ts
OUTLINE
TIMELINE
src > features > dashboard > globe > globe.tsx > Globe > loadCountryPolygonData
/**
* values for table
*/
const [dataFlows, setDataFlows] = useState<any>(undefined);
const [currentDataFlowValue, setCurrentDataFlowValue] = useState<Number>(0);
const [currentDataYear, setCurrentDataYear] = useState<any>(undefined);
/**
* Render globe
*/
const colorWater = "#c6d3e4";
const colorLand = "white";
const colorGraticule = '#ccc';
const colorCountry = '#3A6BAC';
const water = { type: 'Sphere' };
const graticule = geoGraticule10();
/**
* Connection color
*
*/
const colorConnectionStart = "#ffd000";
const colorConnectionEnd = "#ff9000";
const loadCountryPolygonData = async () => {
const response = await fetch(fileCountryPolygons);
const countryData = await response.json();
const l = feature(countryData, countryData.objects.land);
setLand(l);
const c = feature(countryData, countryData.objects.countries);
setCountries(c);
};
const loadCountryNames = async () => {
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
node ➜ /workspaces/atlas-frontend (feature/globe-view) $
Dev Container
feature/globe-view*


Atlas
Mapping the world of DeFi
Good Morning
Dashboard
Settings
Local adoption
Flows
Value Bands
Stablecoins
Defi
Logout
Bilateral flows
Play
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Search by country
Global Statistics
Number of exchanges: x
total inflows: x
total outflows: x
Bilateral flow
Europe- North America: 1.48
North America - europe: 1.38
Privacy & Legal information

Thinking ahead: protocol exposure to stablecoin runs



What is the exposure of DeFi protocols to a stablecoin run?

Conclusion

Comprehensive understanding of DeFi and its layers combined with a sound understanding of the technology & data can improve informed decision-making concerning financial risks

- *What are the concepts?*
- *Are there use cases? (Mariana)*
- *How large is the industry and what are its risks? (Atlas)*

Learn on how we work at the Eurosystem Centre - Monday 4.9. 2 pm CET

BIS Innovation Hub Eurosystem Centre

Advisor Info Event

4th September

The **BIS Innovation Hub Eurosystem Centre** is offering the unique possibility to join its team and work at the forefront of financial and technological innovation. Ever wondered what its like to work at the BIS Innovation Hub? Join us for the Advisor Info Event on the 4th September to engage with **Raphael Auer, Centre Head and the teams Advisors,** where we will discuss all things Innovation Hub, Eurosystem Centre and our running projects. Join us to learn more about the opportunity to join this innovative and dynamic team.

Contact us at:
eurocentre@bisih.org

Registration link

Thank you very much!

Contact us at:
eurocentre@bisih.org