

# Blockchain based Resource Governance for Decentralized Web Environments

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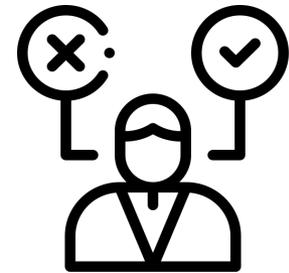
What do **companies** use your **data** for ?



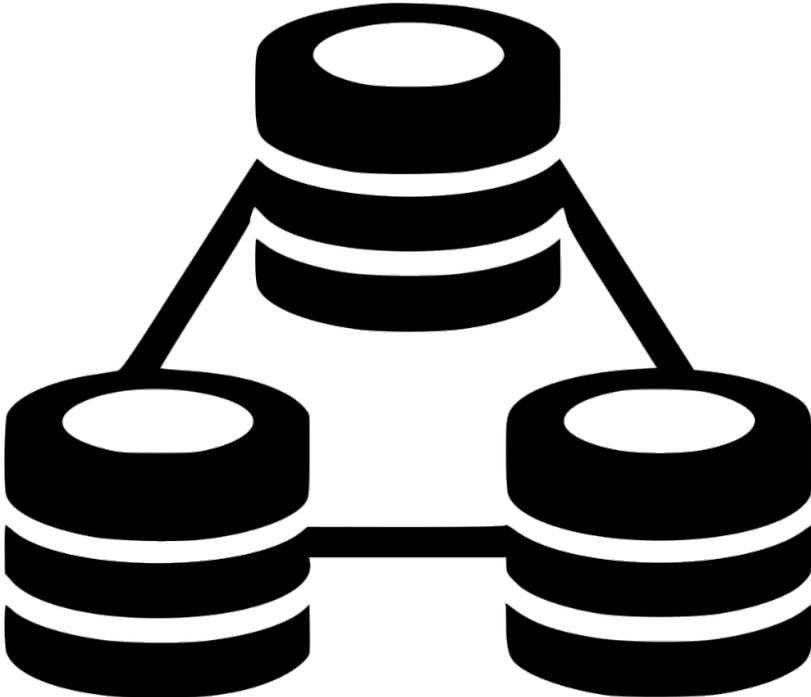
Behaviour insights



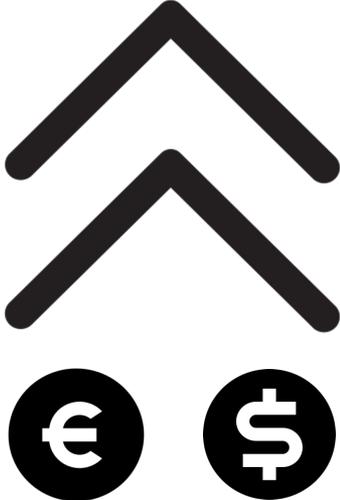
Targeted advertising



Decision making

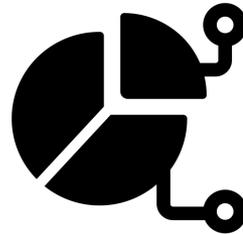
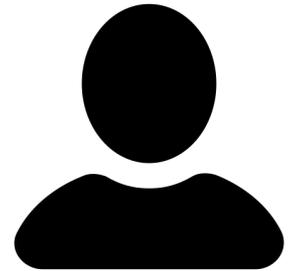


“The **big data** field’s revenue will reach \$ **273.4** billion in 2026”



# Data trading

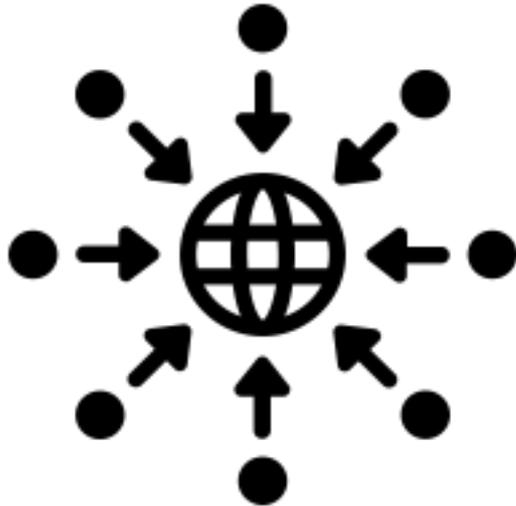
# Introduction



Data consumer

Data owner

## Centralization



Low degree of control  
on shared data

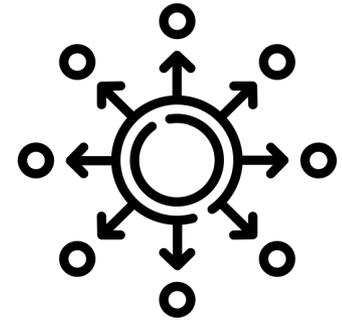


# Goals of DecentralTrading

## DecentralTrading



Full decentralization



Usage control  
inspired solution



Built upon  
existing Web  
standards



# Functionality

# DecentralTrading



Data Owner

Sets up a **personal online datastore**

Makes his resources available only for **medical** purposes

Gets a **remuneration** according to the **number of accesses**



# Functionality

# DecentralTrading



**Data Owner**

Sets up a **personal online datastore**

Makes his resources available only for **medical** purposes

Gets a **remuneration** according to the **number of accesses**



---

Asks the market for a **web reference** to access resources

**Contacts** the personal datastore

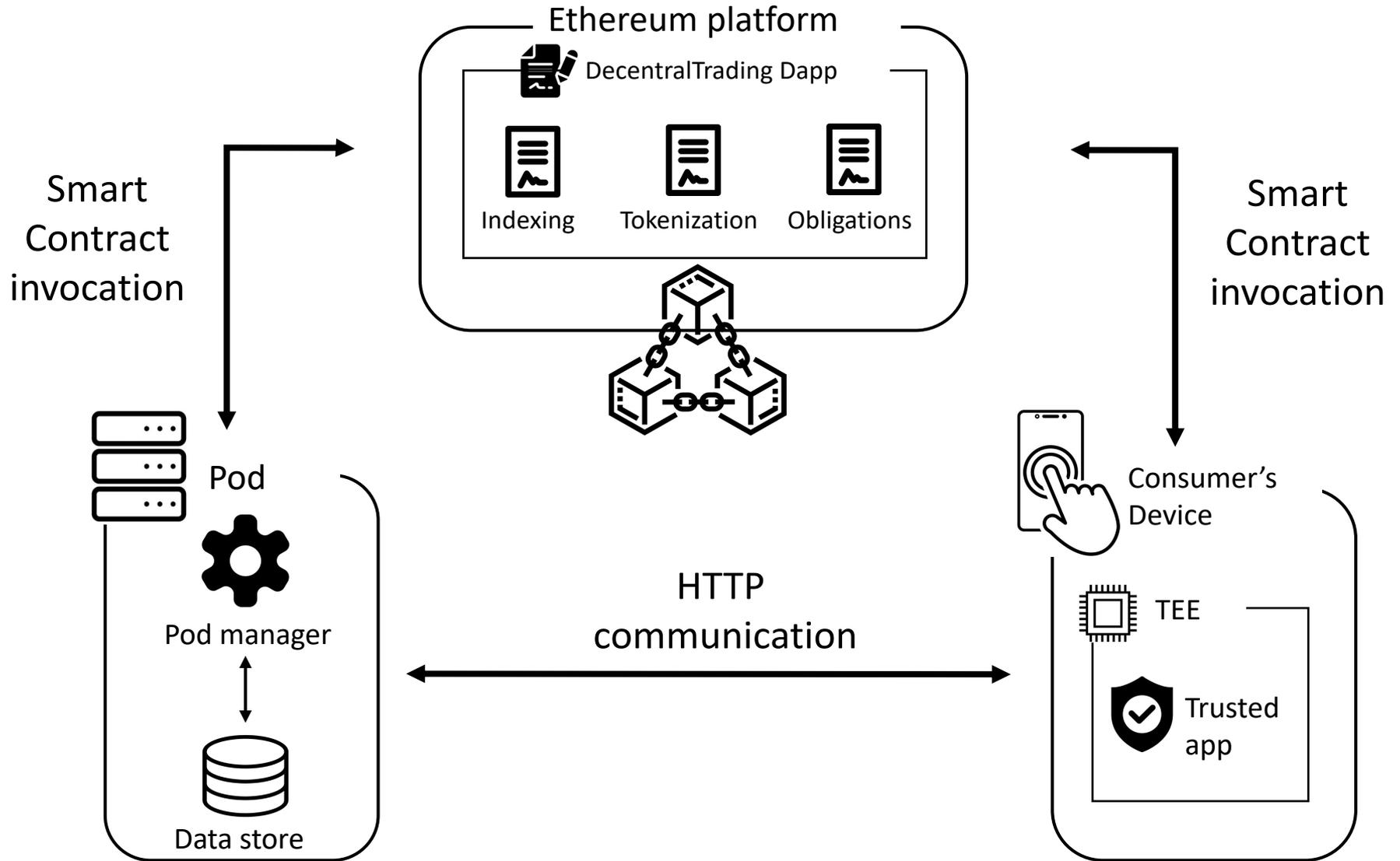
Uses the retrieved resources on her **trusted device**



**Data Consumer**

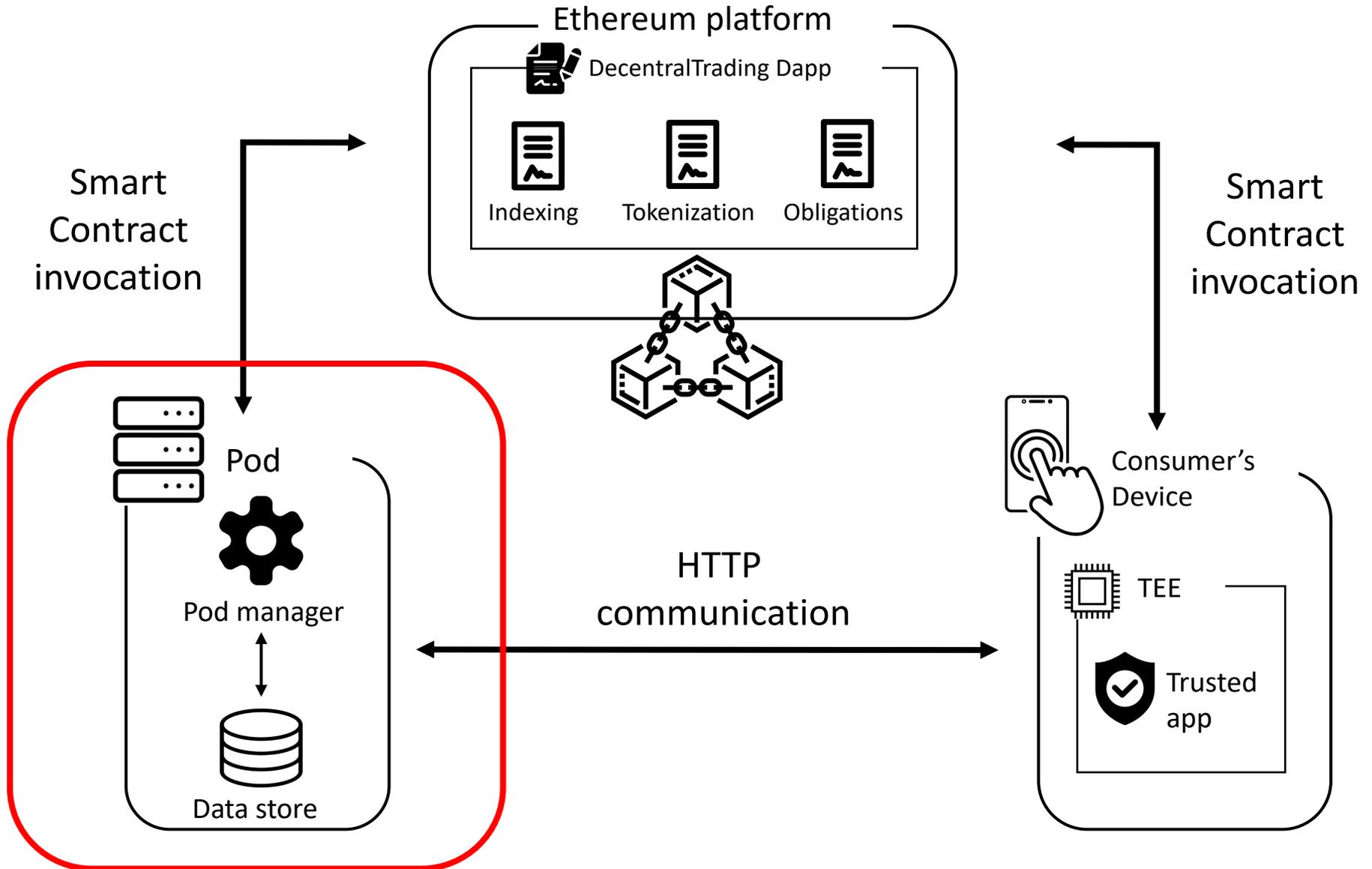
# Architecture

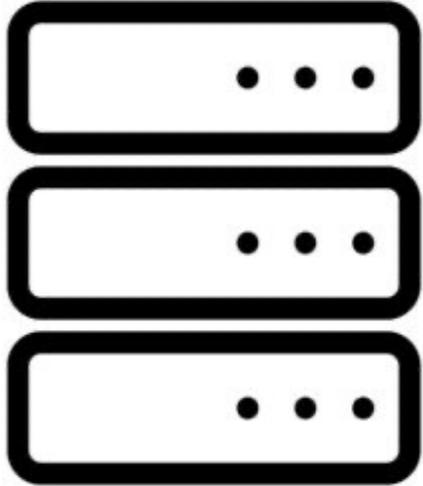
# DecentralTrading



# Architecture

# DecentralTrading





Data owners store shared resources in their **Personal Online Datastore**.

## Functionalities

Data storage



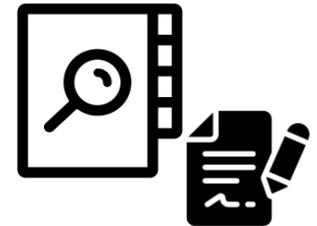
Pods initiation



Data provision

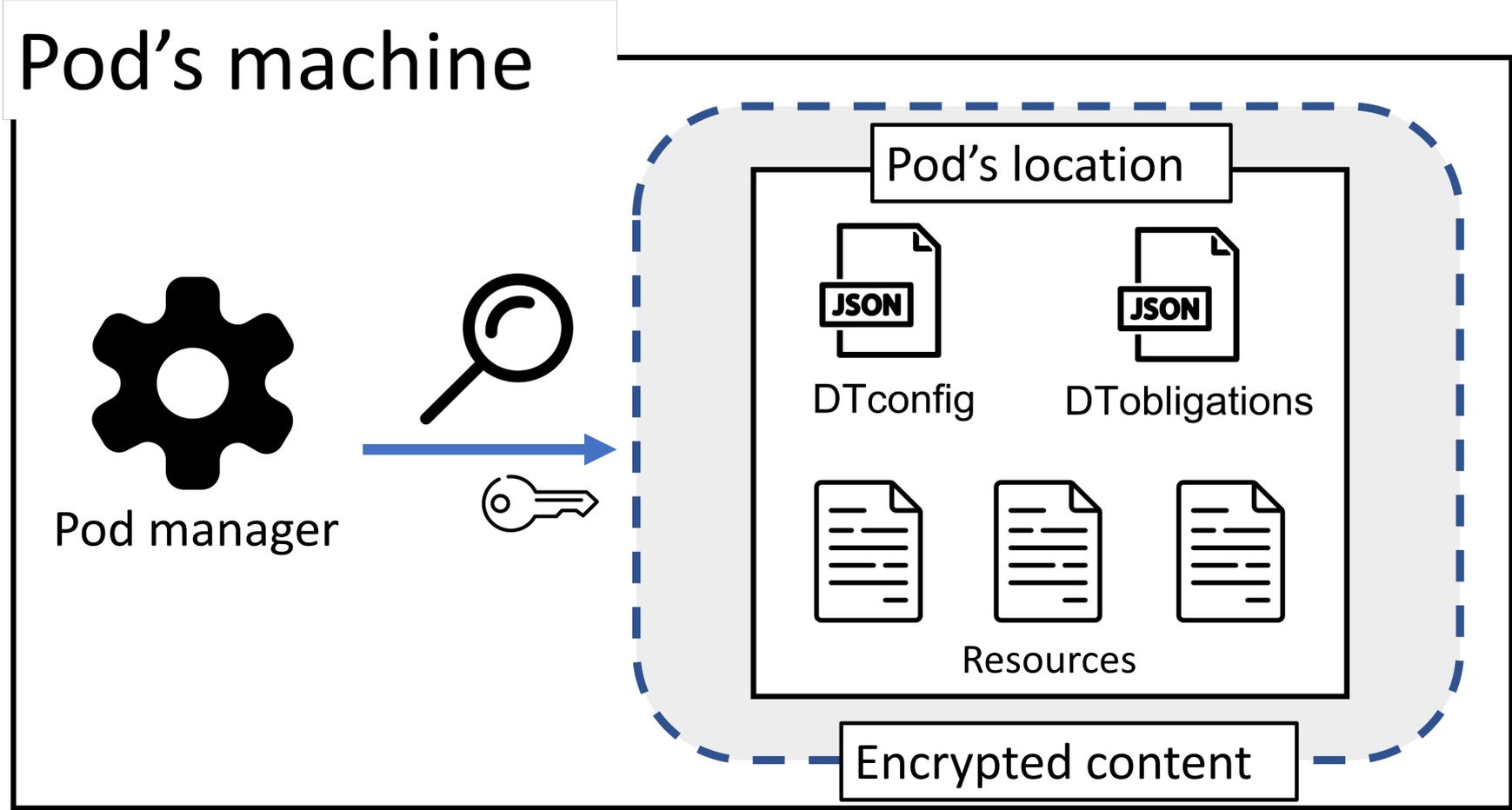


Resources initiation



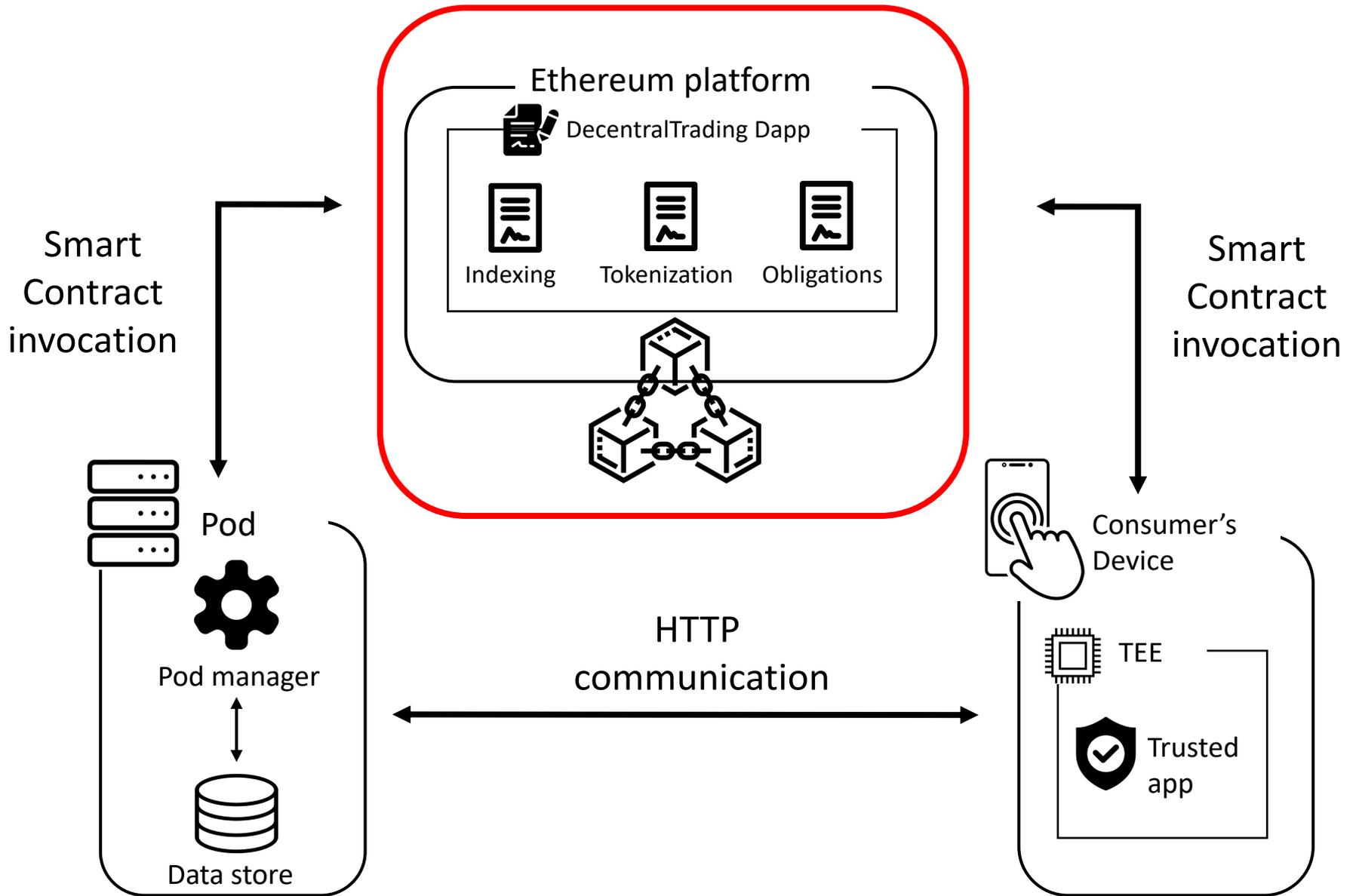
Obligations management





# Architecture

# DecentralTrading



### Ethereum blockchain



Runs DecentralTrading's  
**smart contracts**



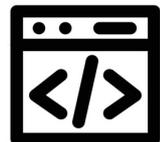
**Validates** and **supervises**  
exchange operations



Manages and verifies **user's**  
**rights**

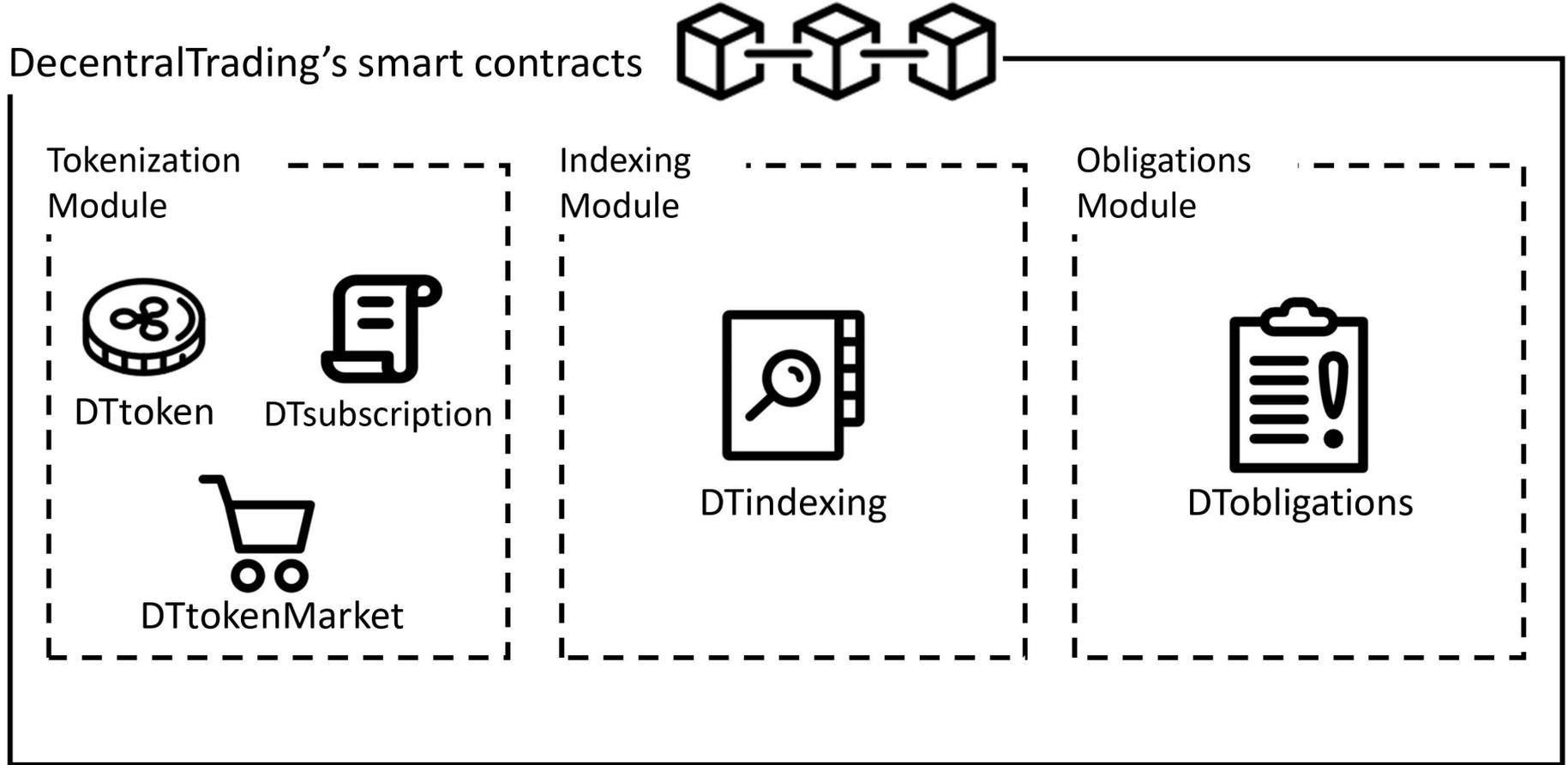


Records resources' **metadata**



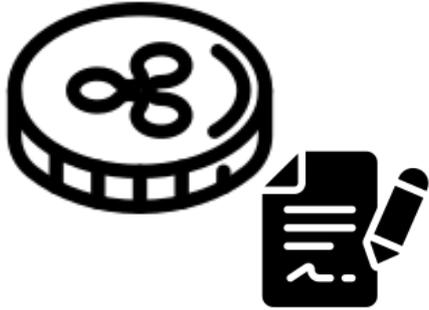
# Modules and smart contracts

## On-chain components



# DTtoken

## On-chain components



### Remarkable functions



```
balanceOf()  
transfer()  
mint()
```

```
burn()  
approve()  
transferFrom()
```

What is it ? → A smart contract that manages a fungible token

What is it used for ? → to buy market's subscriptions

How is it implemented ? → ERC20

# DTtokenMarket

## On-chain components

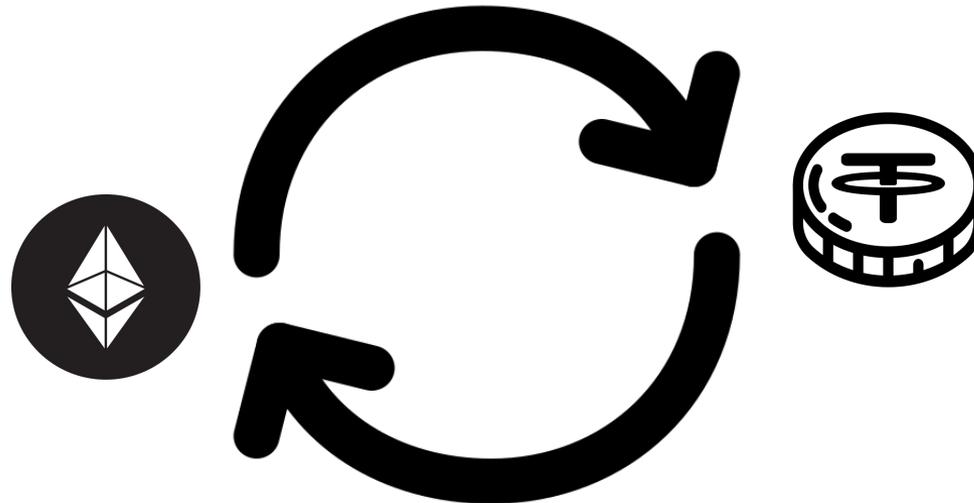


Remarkable function



```
buyTokens()
```

What is it ? → A smart contract to exchange ETH with DTtokens



# DTsubscription

## On-chain components



Remarkable function



```
purchaseSubscription()  
verifySubscription()
```

What is it ? → A smart contract that controls a non-fungible token

What is it used for ? → to represent the market membership

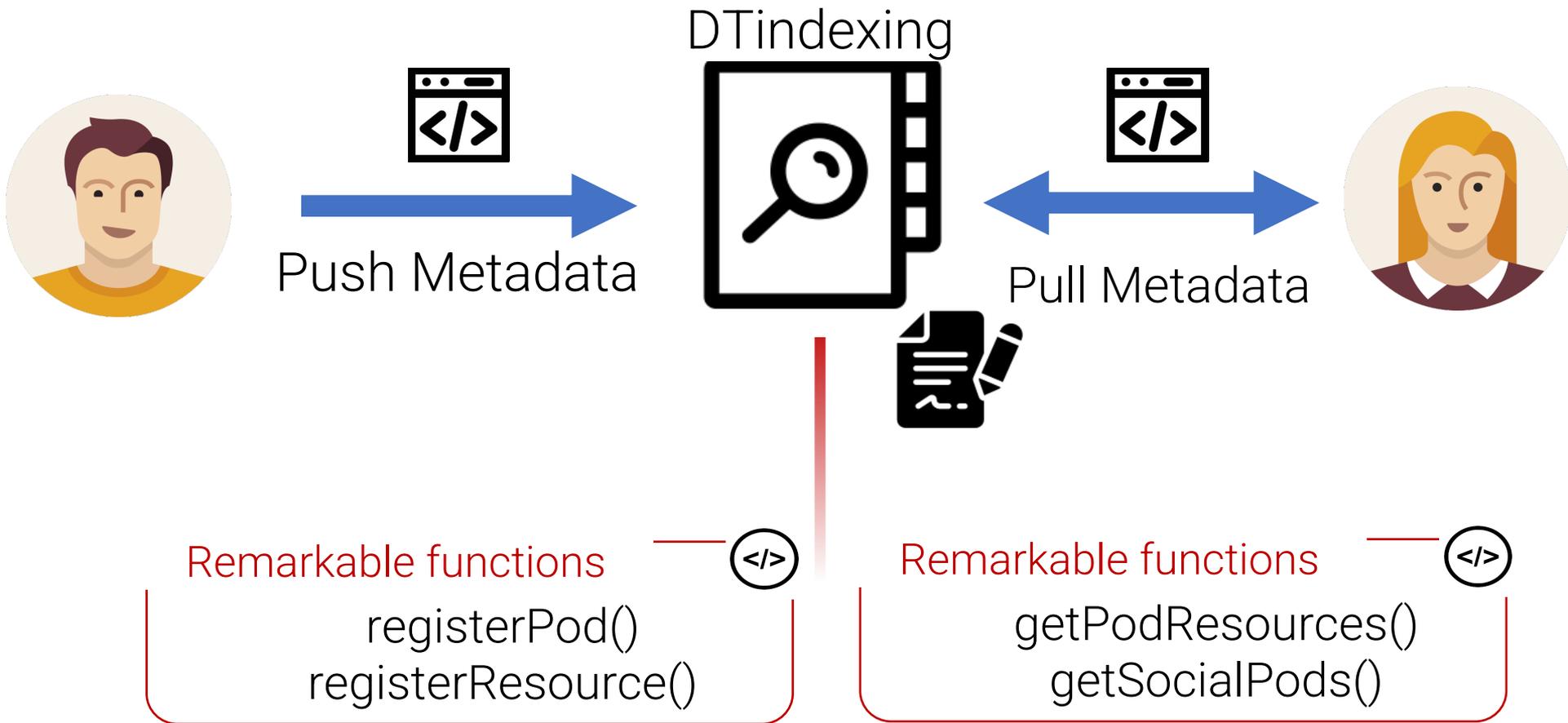
How is it implemented ? → ERC721

# DTindexing

## On-chain components

Data owners' side

Data consumers' side



# DTobligation

## On-chain components



The smart contract stores and represents **rules** concerning the **usage** of the resources

Remarkable functions



```
setDomainObligation()  
removeDomainObligation()
```

Access Counter obligation



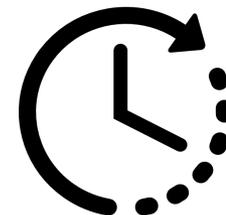
Country obligation



Domain obligation



Temporal obligation



# DTobligation instances

# On-chain components

DTobligation  
instance  
1



DTobligation  
instance  
2

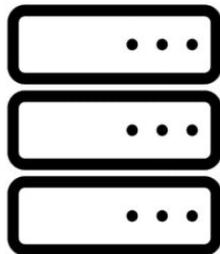


DTobligation  
instance  
3

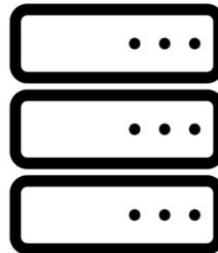


On-chain

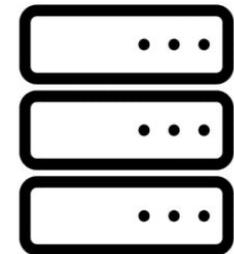
Off-chain



Pod 1



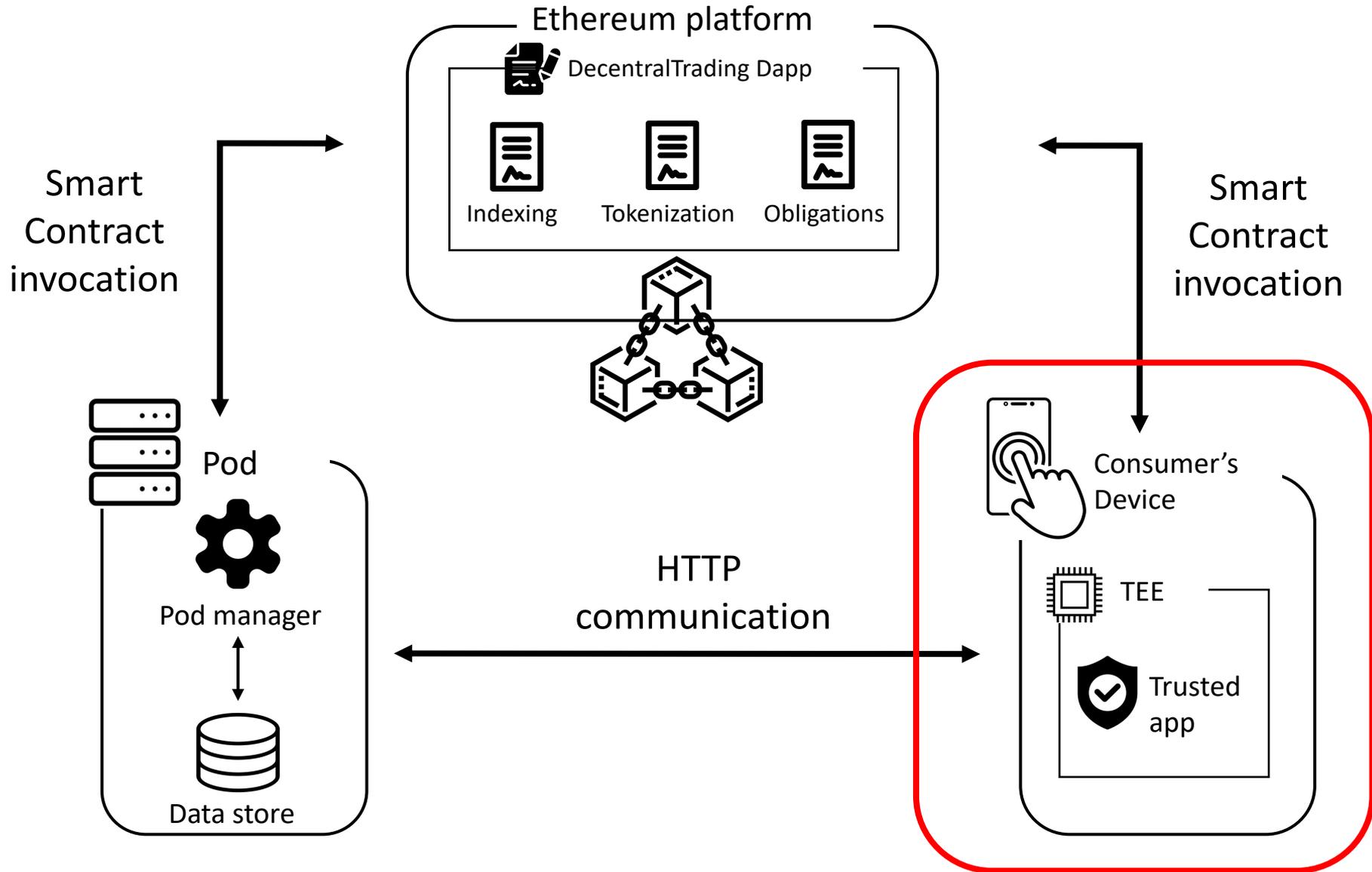
Pod 2

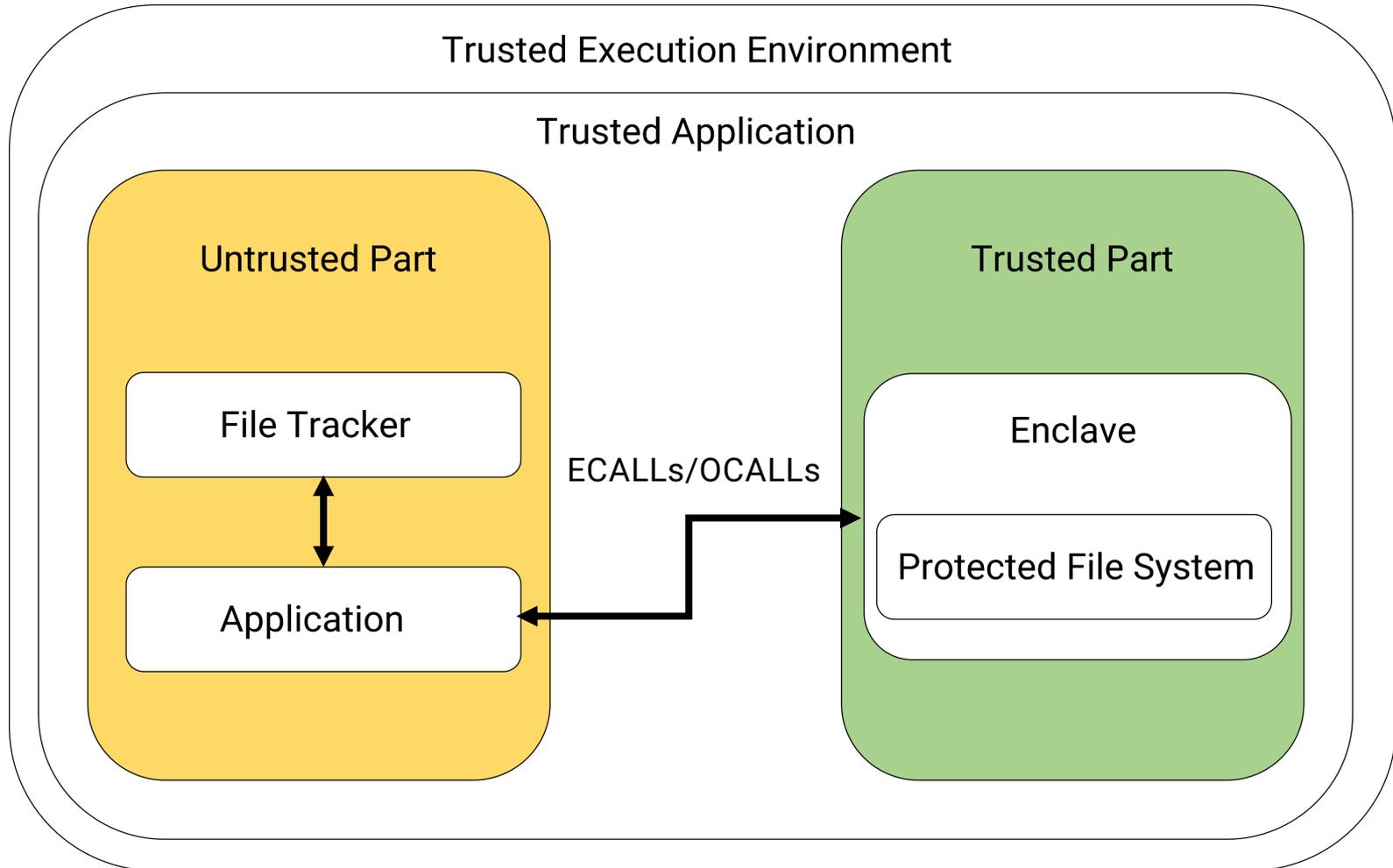


Pod 3

# Architecture

# DecentralTrading



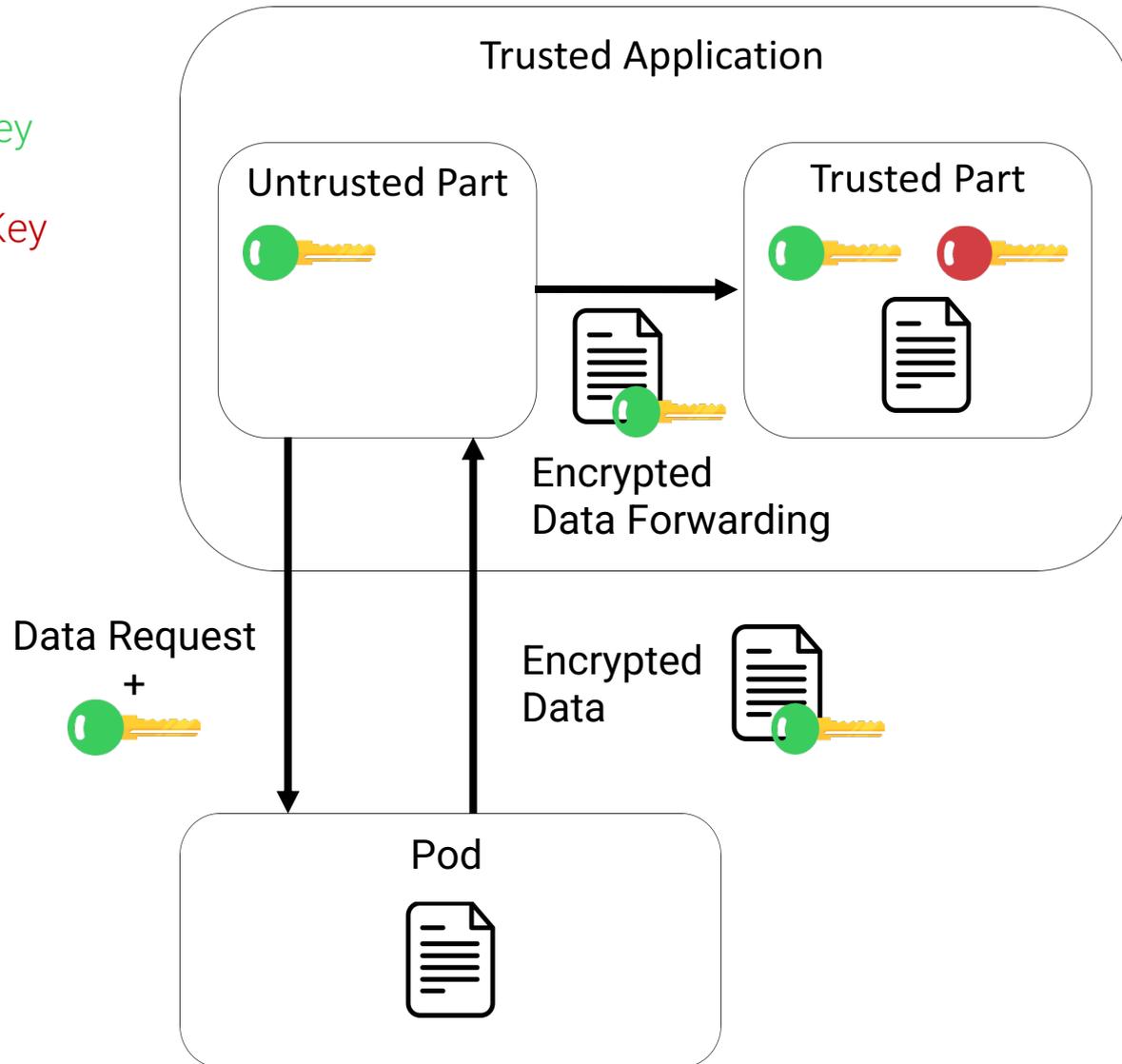


# The Trusted Execution Environment requires data

Key Legend:

 Trusted Application **Public Key**

 Trusted Application **Private Key**

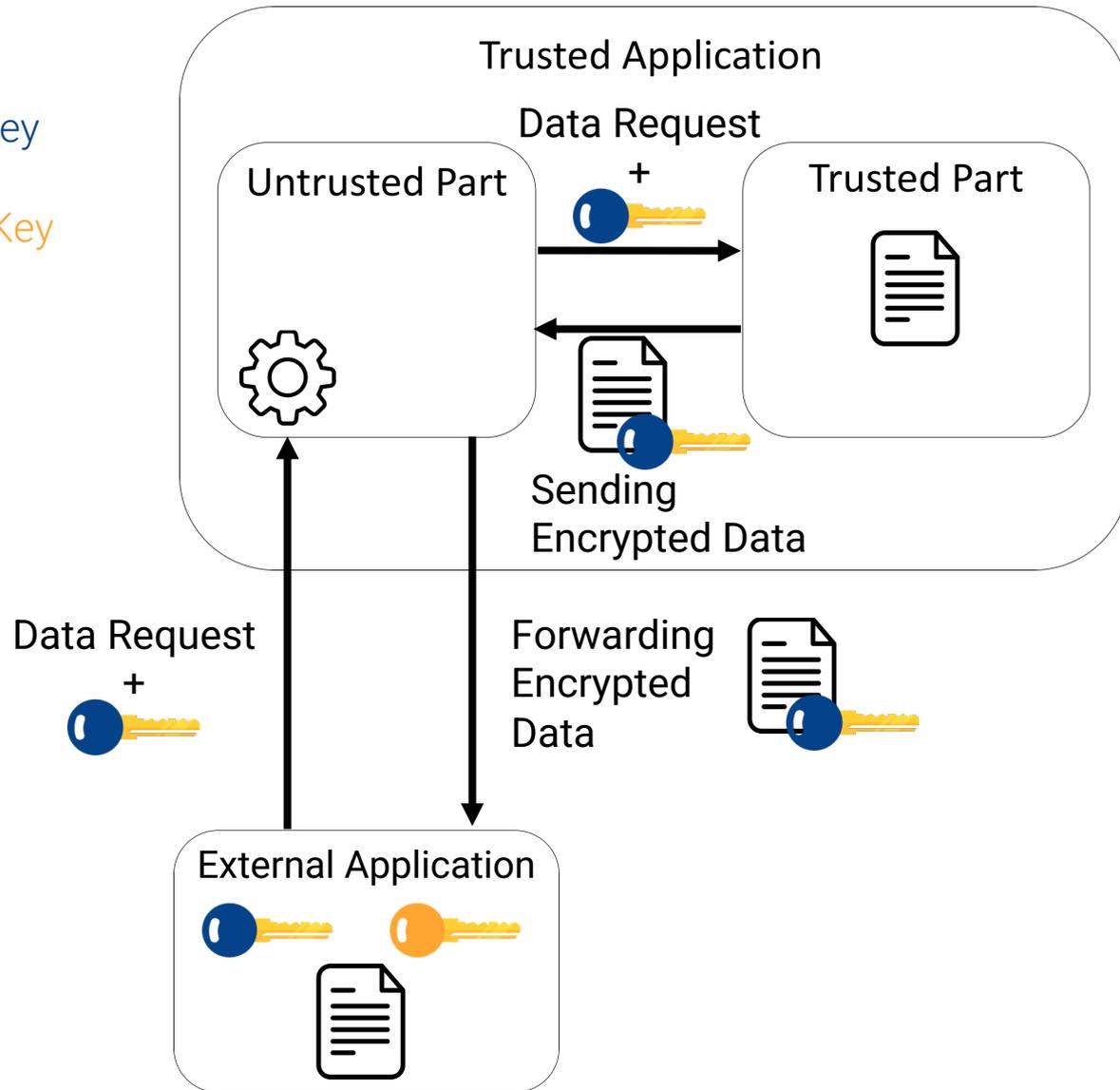


# External application requires data

Key Legend:

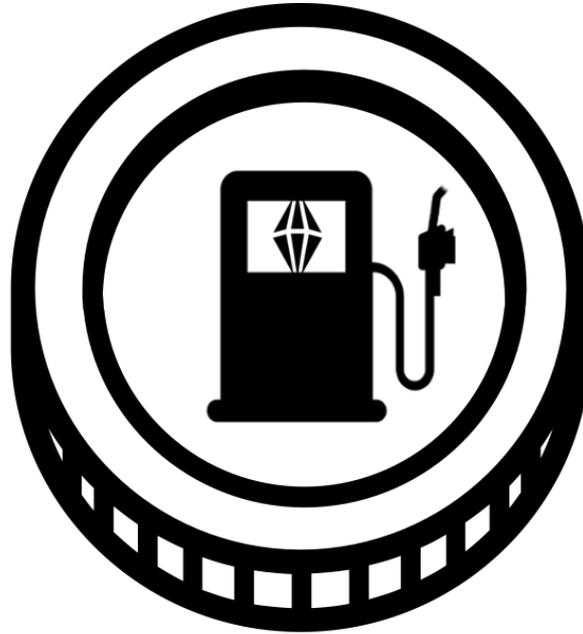
 External Application **Public Key**

 External Application **Private Key**



**Subject of the evaluation**

**Evaluation**



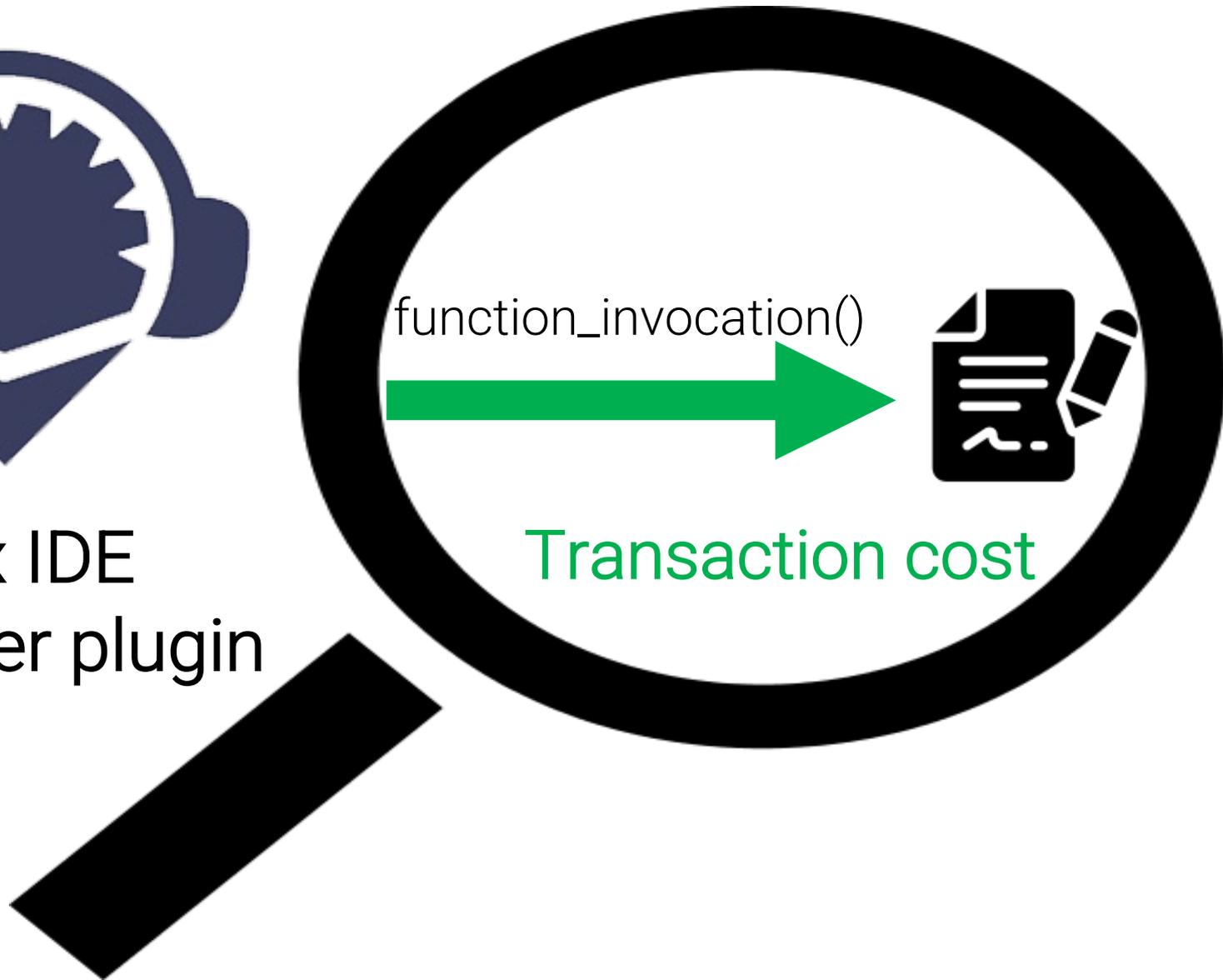
Gas

# Methodology

# Evaluation



Remix IDE  
Gas Profiler plugin



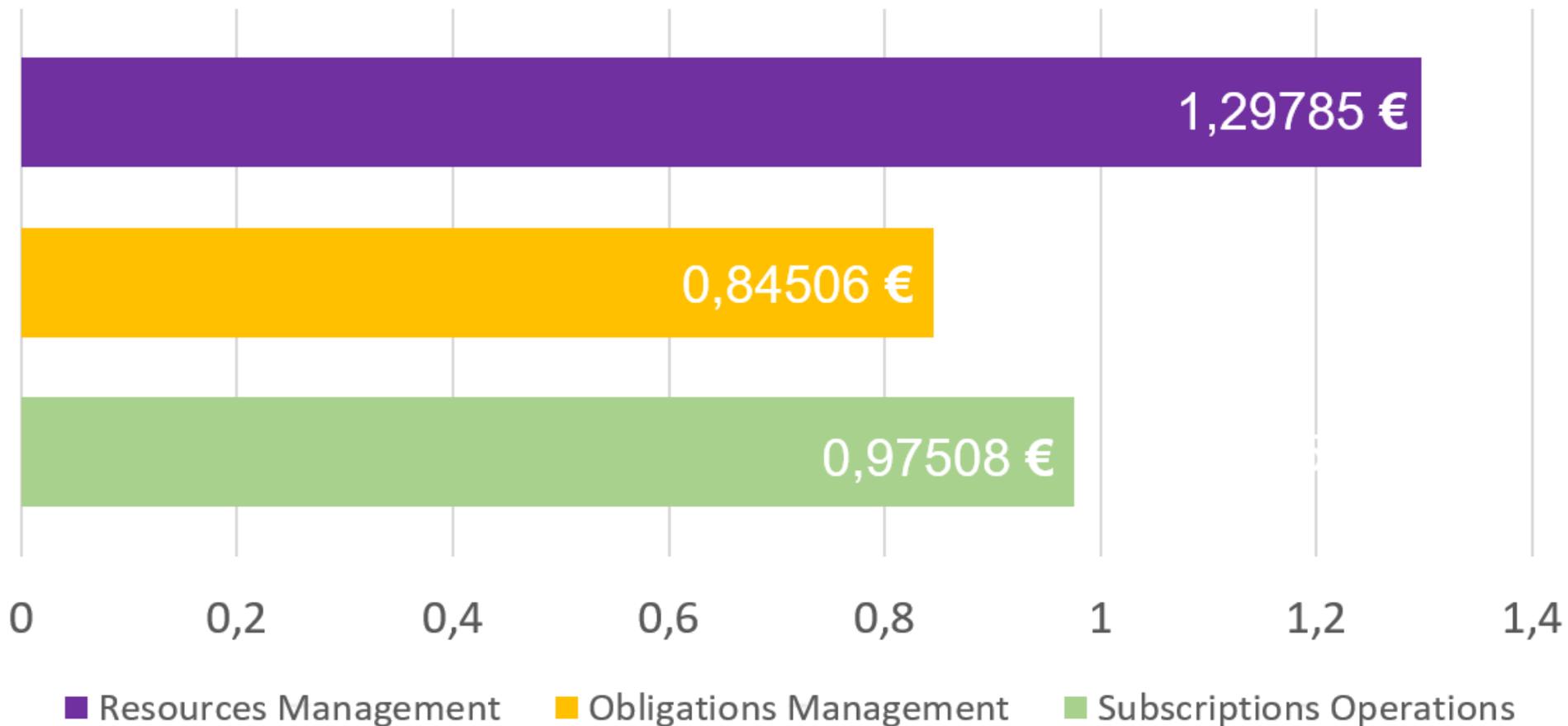
# Methodology

# Evaluation

Function	Cost (Gas)	Target User
deployment	1623406	Service Providers
mint()	37640	Service Providers
burn()	36730	Service Providers
transfer()	36811	Service Providers, Data Owners, Data Consumers
transferFrom()	45752	Service Providers, Data Owners, Data Consumers
increaseAllowance()	46000	Service Providers, Data Owners, Data Consumers
decreaseAllowance()	15828	Service Providers, Data Owners, Data Consumers
allowance()	-	Service Providers, Data Owners, Data Consumers
balanceOf()	-	Service Providers, Data Owners, Data Consumers

Results table for the DTtoken smart contract

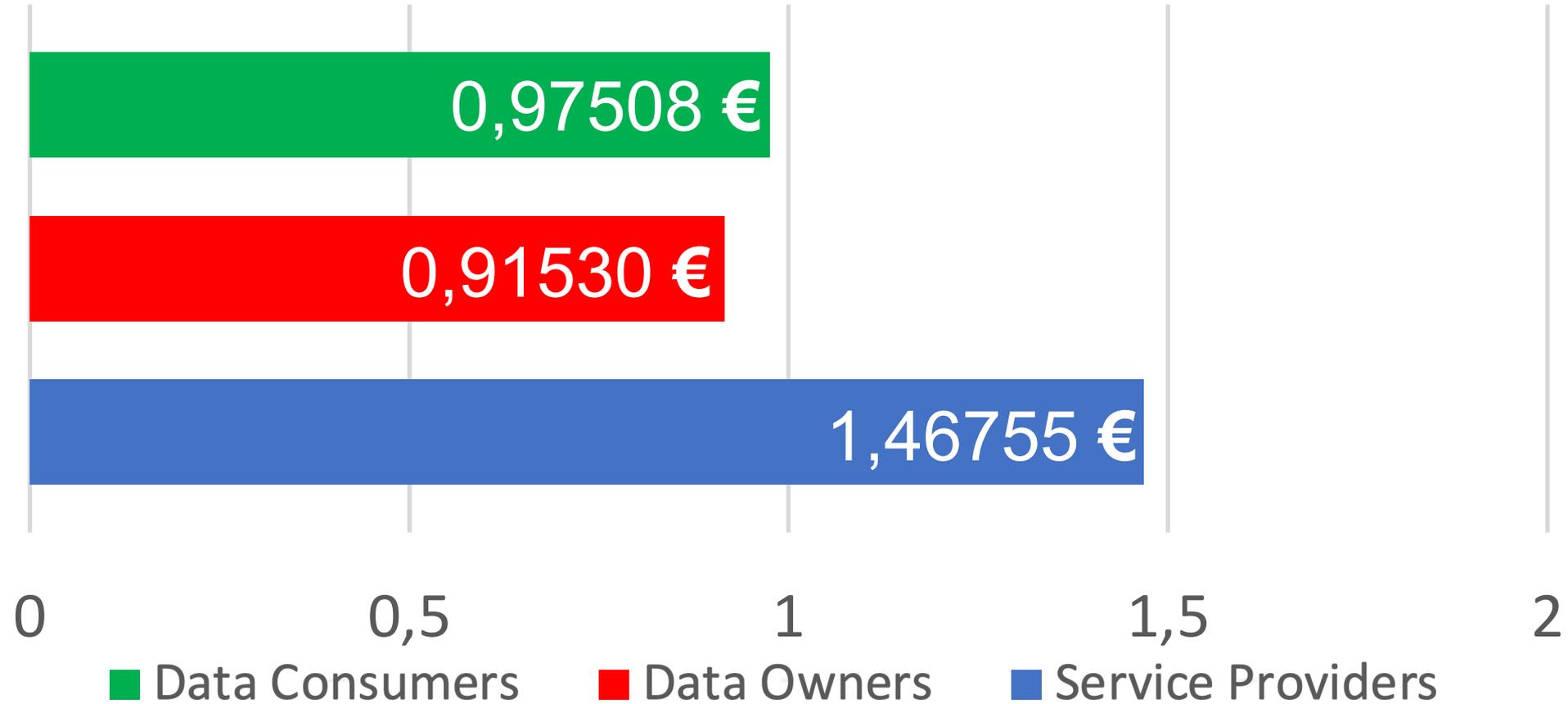
Average per invocation expense (EUR)



# General results

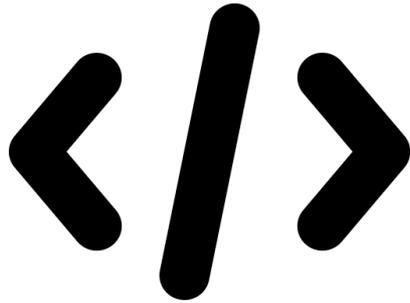
# Evaluation

Average per invocation expense (EUR)

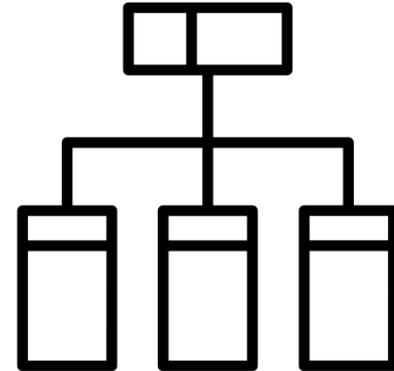


# How to reduce costs for users ?

## Conclusion

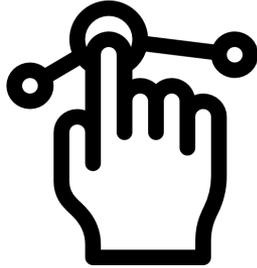


On-chain code  
optimization



Architecture  
alternatives

## Future work



ethereum 2.0



**HYPERLEDGER**



IOTA

**Algorand**

## Conclusion

System  
usability

Integration  
with  
Ethereum 2.0

Blockchains  
comparasion

# Publications

- Blockchain based Resource Governance for Decentralized Web Environments, Davide Basile, Claudio Di Ciccio, Valerio Goretti, Sabrina Kirrane

<https://arxiv.org/abs/2301.06919>

<https://www.frontiersin.org/articles/10.3389/fbloc.2023.1141909/abstract>

- An Ethereum-based system for resource ownership in data markets, Davide Basile, MSc Thesis.
- Safe and controllable information consumption for data market applications: A solution based on Trusted Execution Environments and the Ethereum blockchain, Valerio Goretti, MSc Thesis.

# Thank you / contact details

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SCIENCE



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