Market Design with Blockchain Technology

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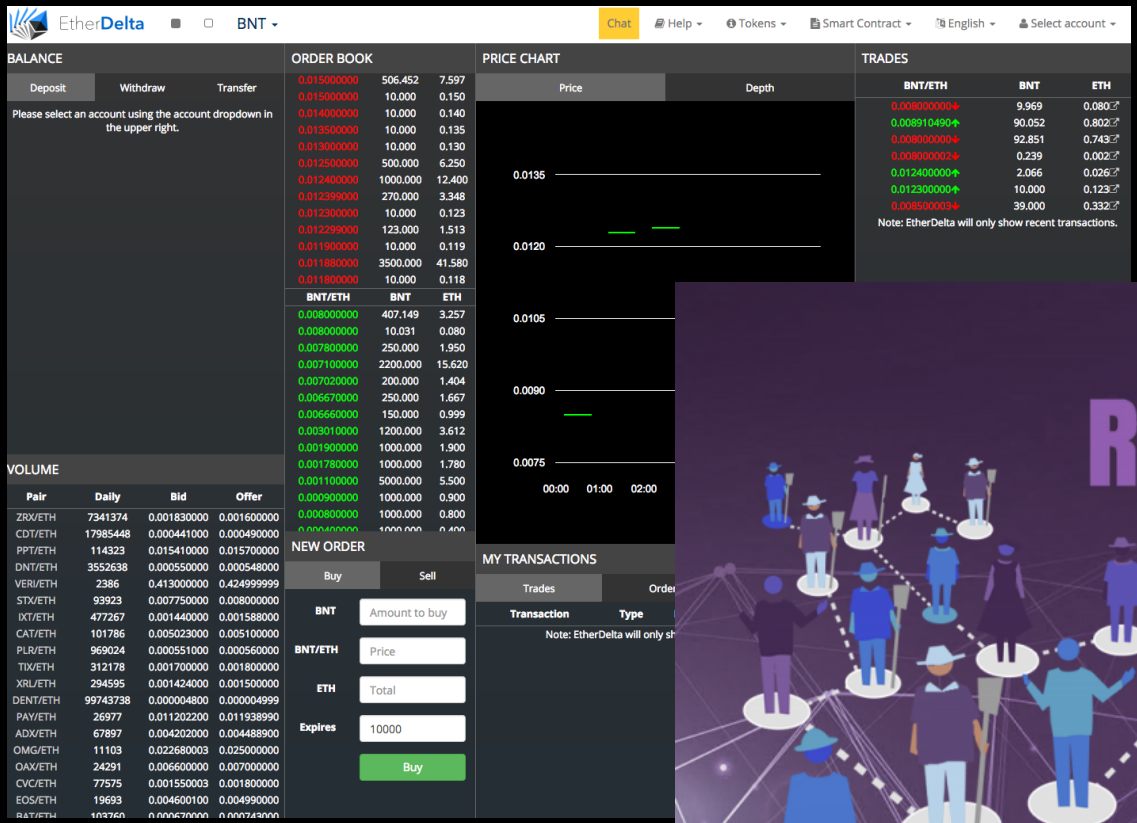
DeGroote SCHOOL OF BUSINESS
EDUCATION WITH PURPOSE

McMaster University

source: coinschedule (data from Sept 5, 2018)

What is different?

1. Multiple Trading Protocols are possible



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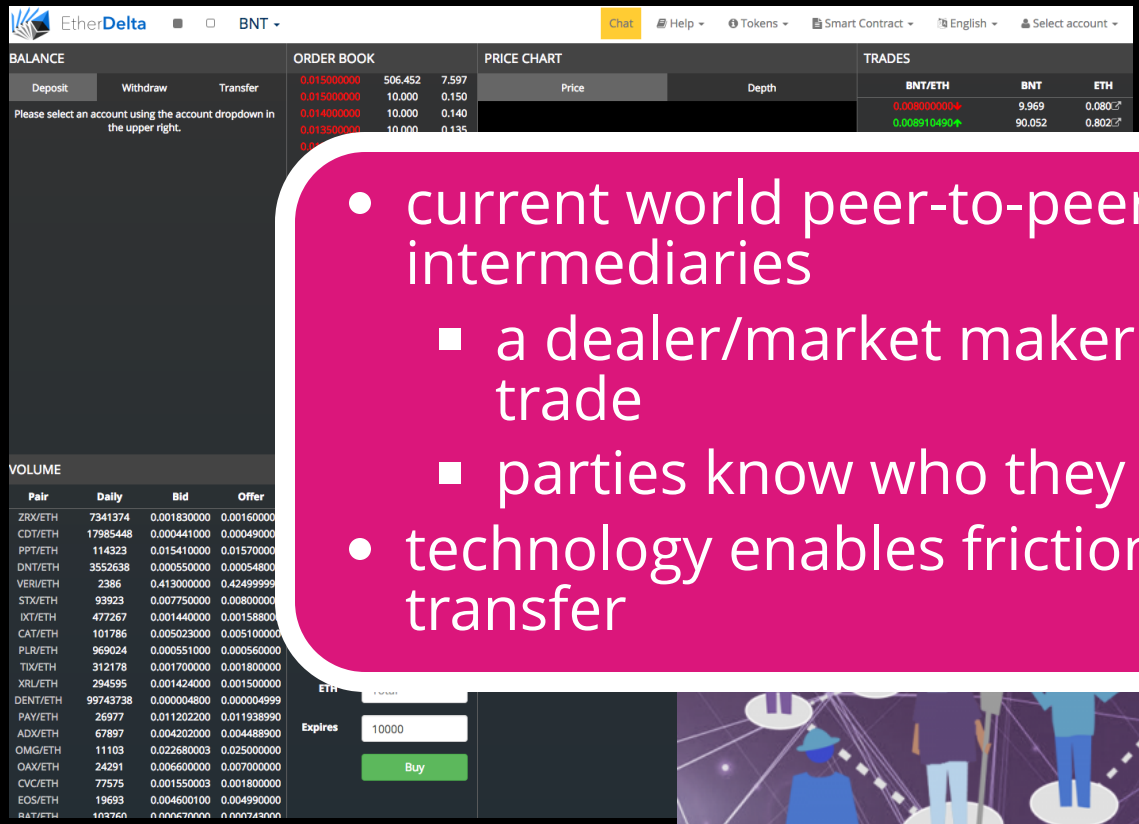
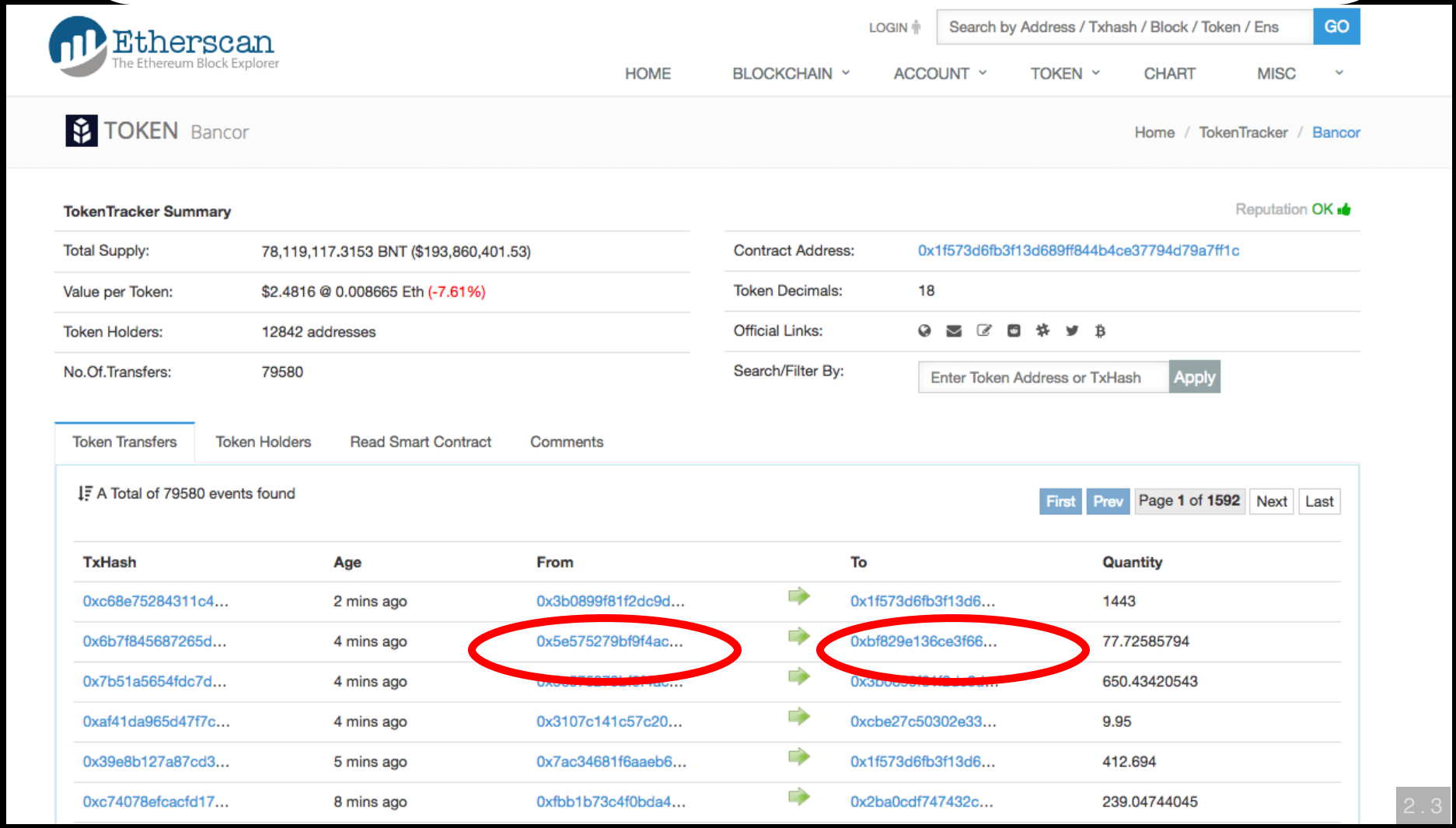


- current world peer-to-peer -- through intermediaries
  - a dealer/market maker is on one side of trade
  - parties know who they are trading with
- technology enables frictionless value transfer

What is different?

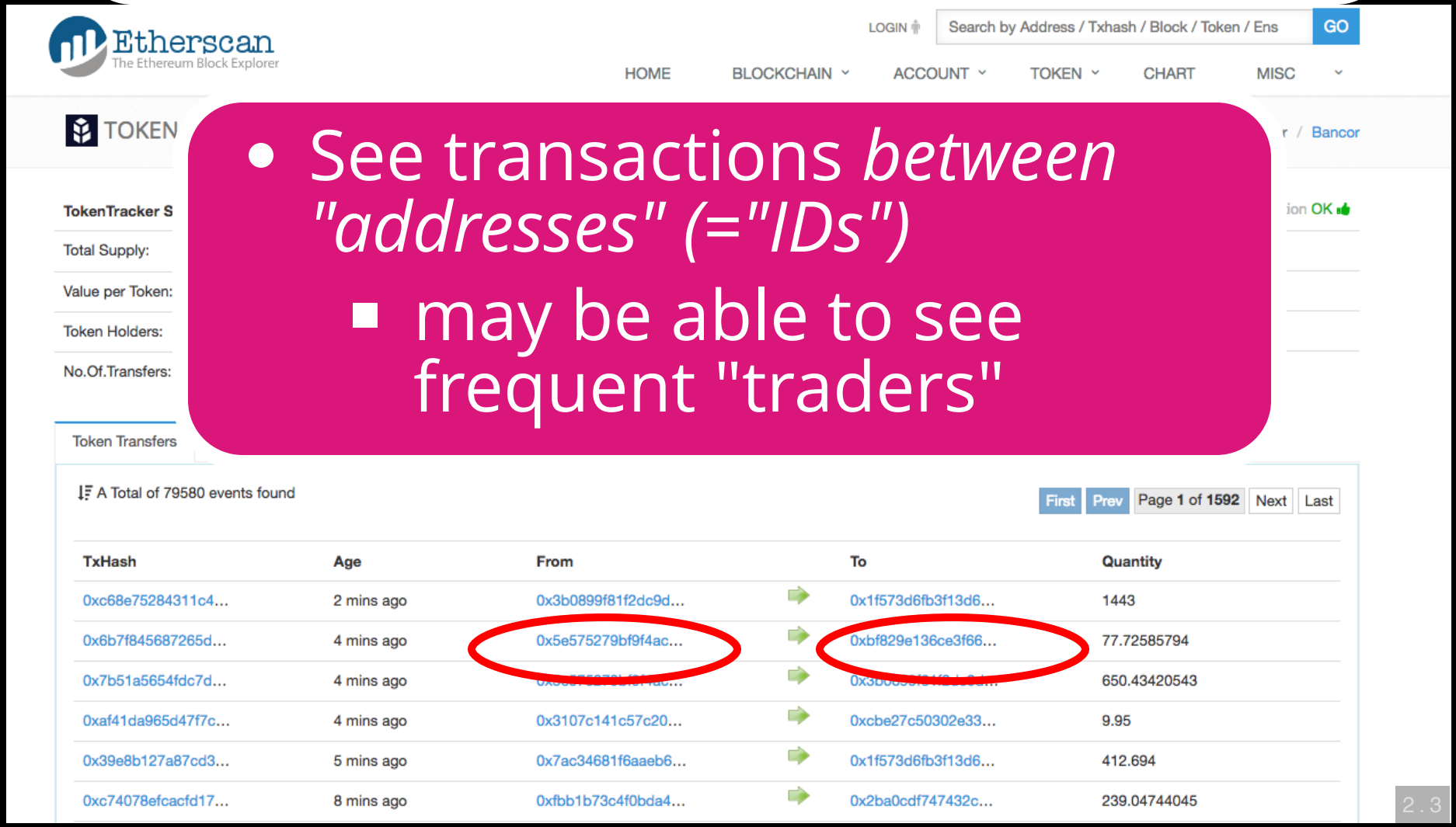
2. High Level of Transparency



What is different?

2. High Level of Transparency

- See transactions *between "addresses" (="IDs")*
  - may be able to see frequent "traders"



What is different?

3. You can tell who owns what

TokenTracker Summary

Reputation OK

Total Supply:	78,119,117.3153 BNT ($193,860,401.53)
Value per Token:	$2.4816 @ 0.008665 Eth (-7.61%)
Token Holders:	12842 addresses
No.Of.Transfers:	79580

Contract Address:	0x1f573d6fb3f13d689ff844b4ce37794d79a7ff1c
Token Decimals:	18
Official Links:	
Search/Filter By:	Enter Token Address or TxHash Apply

Token Transfers | Token Holders | Read Smart Contract | Comments

TokenHolders Chart

A total of 12842 Token Holders found

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Rank	Address	Quantity	Percentage
1	0x5894110995b8c8401bd38262ba0c8ee41d4e4658	15865957	20.3103%
2	0x79e7ccb8e7a61ad4781c98864c40e380bb10dd26	14312616.4803711	18.3218%
3	0xad04835b1129c08be6093d683d725ff82cd24036	10539657.098791	13.4920%
4	0x7af1362060ec77ca30be2508cce10169210393ee	7853648.22	10.0536%
5	0xfbb1b73c4f0bda4f67dca266ce6ef42f520fbb98	4227754.51610493	5.4120%
6	0x7bb42206cddc93380ed1115d15fb1e65a1d754fc	1312102.22092	1.6796%
7	0x0c43eb0b18774a15bca2e639ba470796147b8d24	1207481.05212123	1.5457%
8	0x31fc2dbe295a8570b69c09c5aaec33459fc1a1b3	750000	0.9601%
9	0x696618b03604354787b631695bfc9d14c203360a	659100.152343954	0.8437%
10	0x86842054dd8802519dc7dcc458dc9311c1434639	426100	0.5455%

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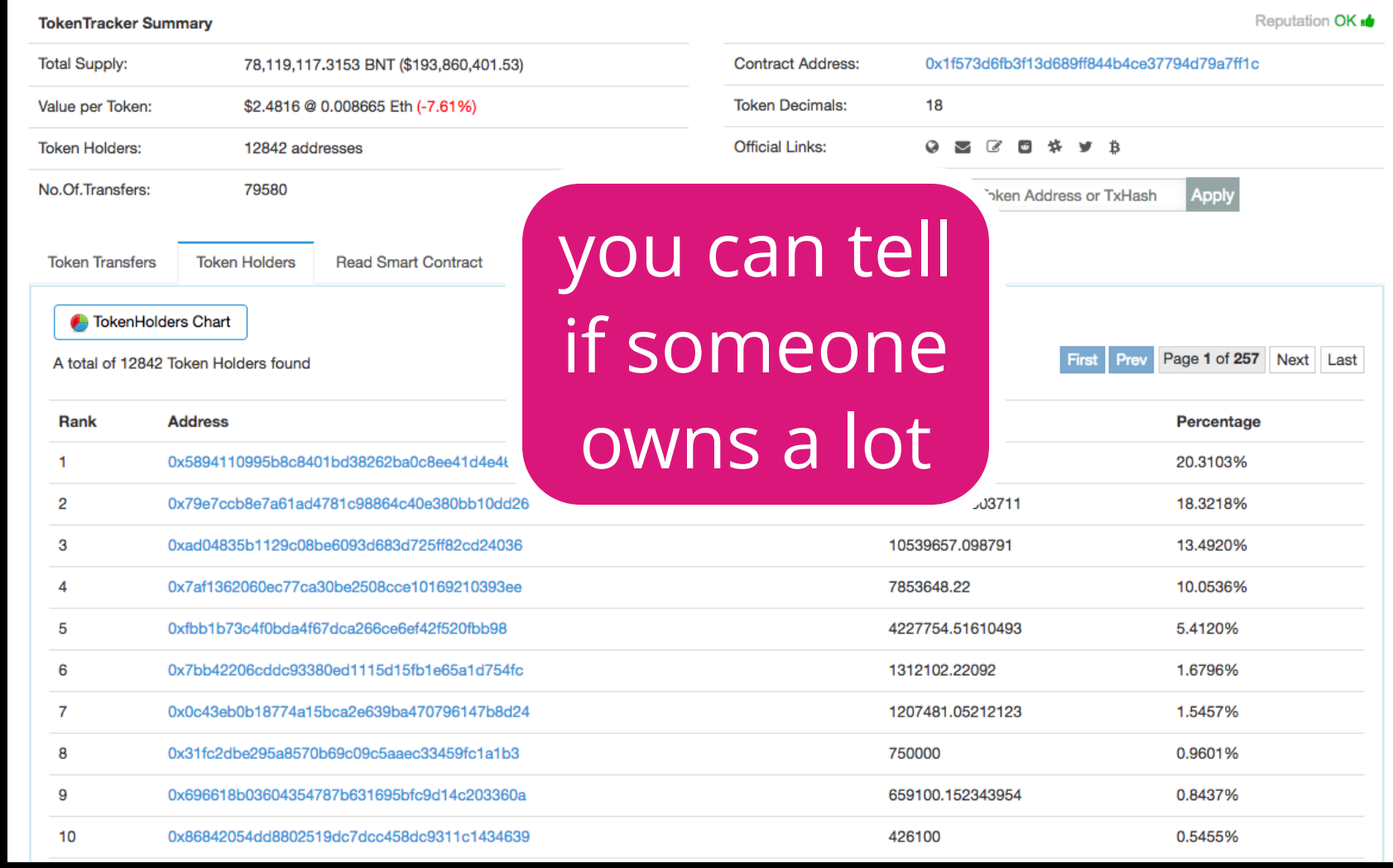

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you can tell if someone owns a lot

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3	0xad04835b1129c08be6093d683d725ff82cd24036	10539657.098791	13.4920%
4	0x7af1362060ec77ca30be2508cce10169210393ee	7853648.22	10.0536%
5	0xfbb1b73c4f0bda4f67dca266ce6ef42f520fbb98	4227754.51610493	5.4120%
6	0x7bb42206cddc93380ed1115d15fb1e65a1d754fc	1312102.22092	1.6796%
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Frictionless peer-to-peer trading

+

Informational environment changes drastically

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Key: wallets/addresses = IDs but NOT = traders

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Informational environment changes drastically

Key: wallets/addresses = IDs but NOT = traders

Research Question

How does the design of ledger transparency and identifier-usage with possible P2P interactions affect trading behavior and economic outcomes?

Literature

- Economics of blockchain protocols and transaction costs
  - there is a large literature in computer science, e.g., Eyal and Sirer (2014)
  - Gans and Halaburda (2015); and Halaburda and Gandel (2016)
  - Budish (2018), Saleh (2017), Biais, Bidiere, Bouvard, Casamatta (2018)
  - Huberman, Leshno, and Moallemi (2017), Easley, O'Hara, Basu (2018)
- Smart contracts and other uses of blockchain
  - Cong and He [2017], Yermack (2017)
- *Blockchain and financial securities/markets*
  - Boehm et al [2015]; Harvey [2016], Raskin and Yermack [2016; 2017]; Aune, Krellenstein, O'Hara, and Slama [2017]

Model Ingredients

- Risky asset, normally distributed
- Two large investors, one hit by liquidity shock, repeated interactions
- Continuum of small investors, half buys, half sells
- Shocked **"liquidity trader" (LT)** may trade
  - peer-to-peer with other large
  - with many small
  - with risk-averse intermediary

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Direct Costs

- Data processing to contact small
- Linear *mining/validation* cost

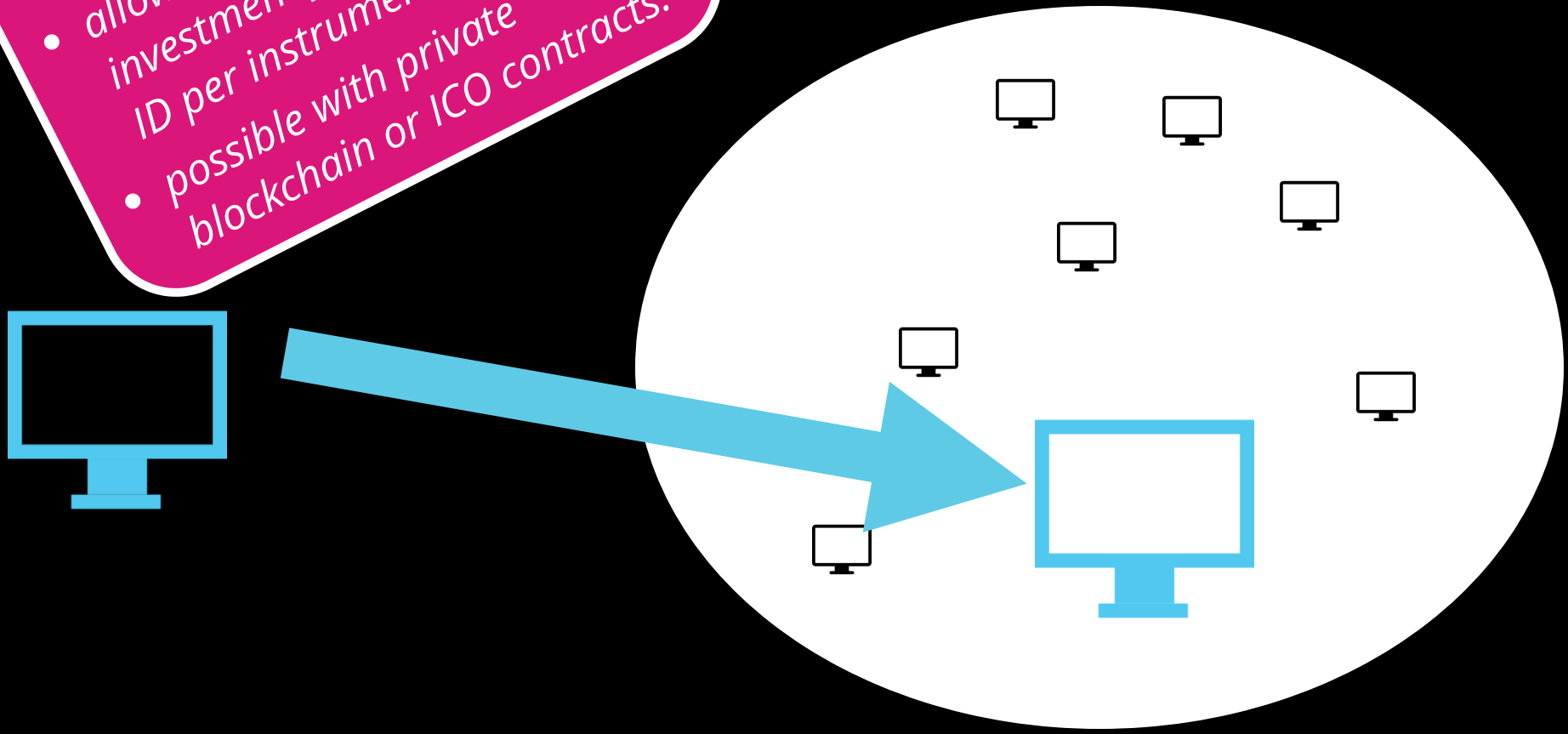
Indirect Costs

Liquidity Providing peer may front-run **Liquidity Trader**

Benchmark: fully transparent (single ID) ownership

Requires a system design choice:

- allow an entity (individual, investment fund) only a single ID per instrument
- possible with private blockchain or ICO contracts.



Options for the Large Liquidity Trader ("LT")

Trade with small investors and intermediary

Trade with the large liquidity provider ("LP")

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- costs:
  - complexity + validation
  - intermediation

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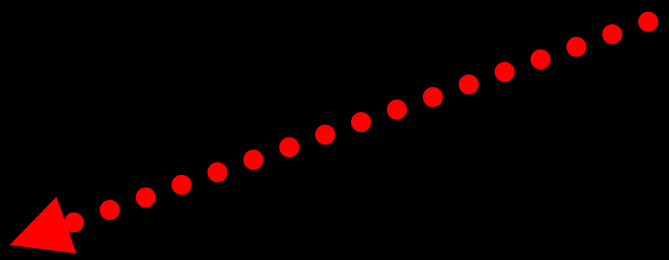

Single shot:
LP extracts all surplus

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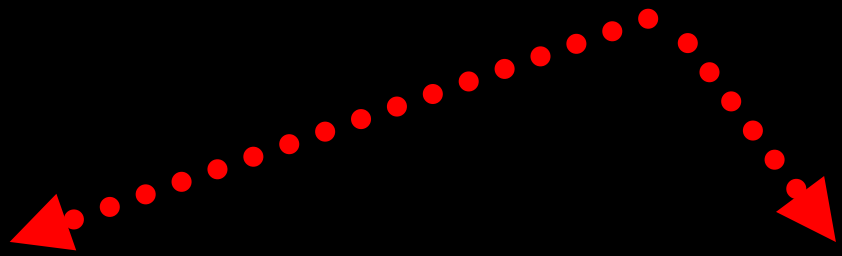

Single shot:
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Repeated setting:
Front-running is punished by "grim trigger"

Options for the Large Liquidity Trader ("LT")

Trade with small investors and intermediary

Trade with the large liquidity provider ("LP")

- costs:

- costs

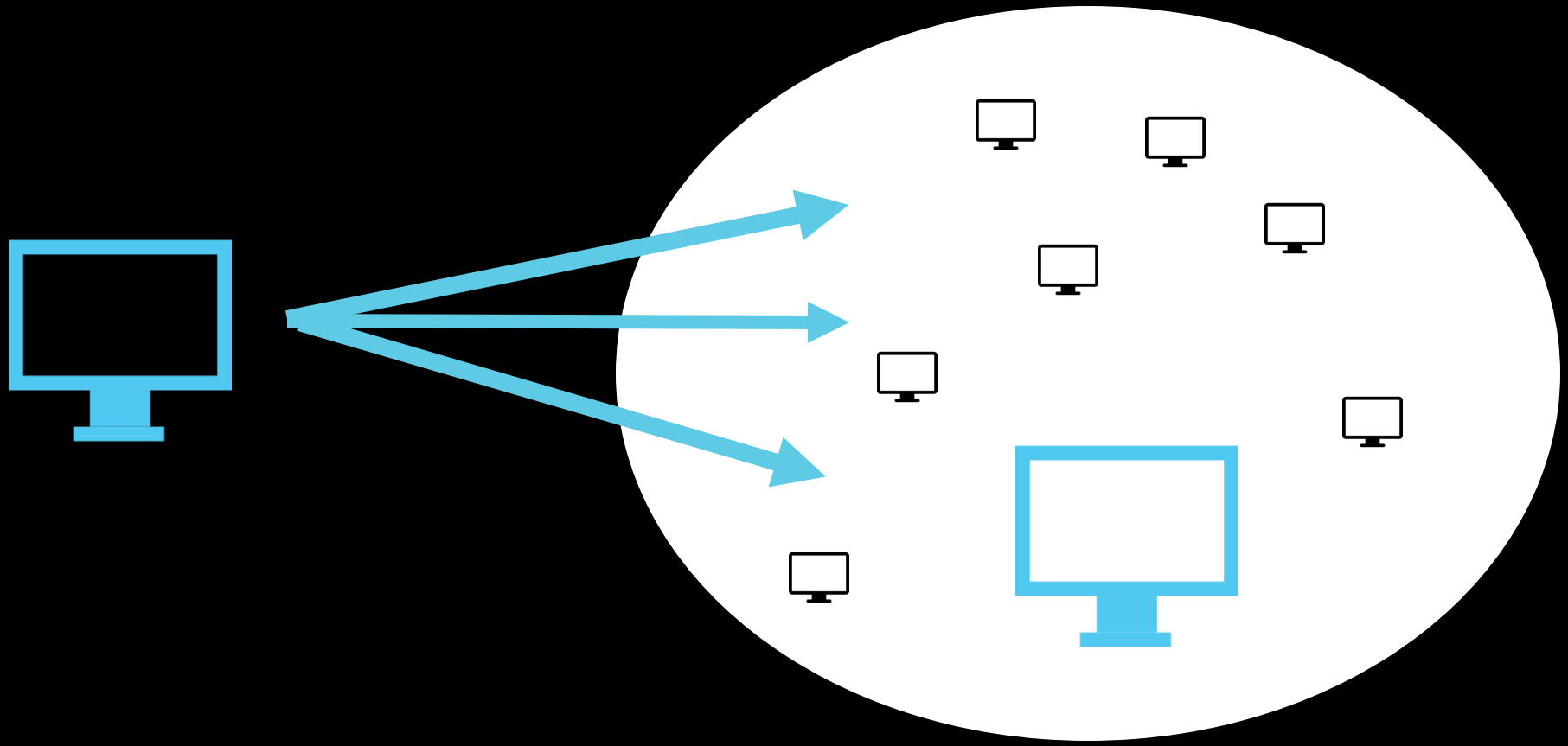
surplus

grim trigger

Equilibrium

- "social norms" have bite: **LT** always trades with **LP**; share cost savings.
- Price concession: none for frequent interactions (=large enough discount factor)

Opaque single ID ownership

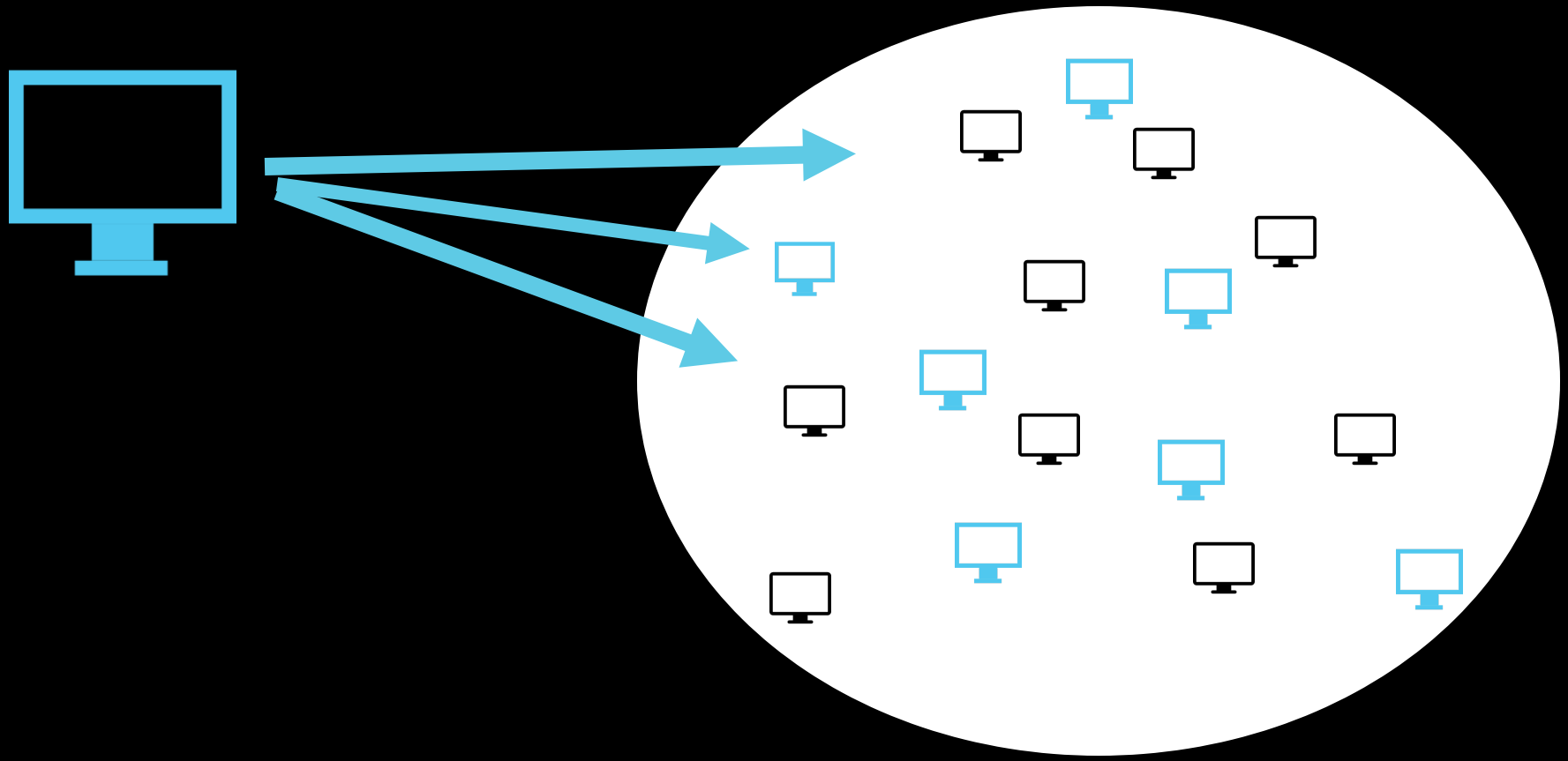


Opaque single ID ownership

Equilibrium

- %IDs contacted independent of intermediary's inventories, but depends on:
  - probability of small accepting
  - (il-)liquidity of intermediated market
  - complexity/data processing costs.
- For non-large validation cost, **LT** trades with small (and intermediary)

Opaque multi-ID ownership



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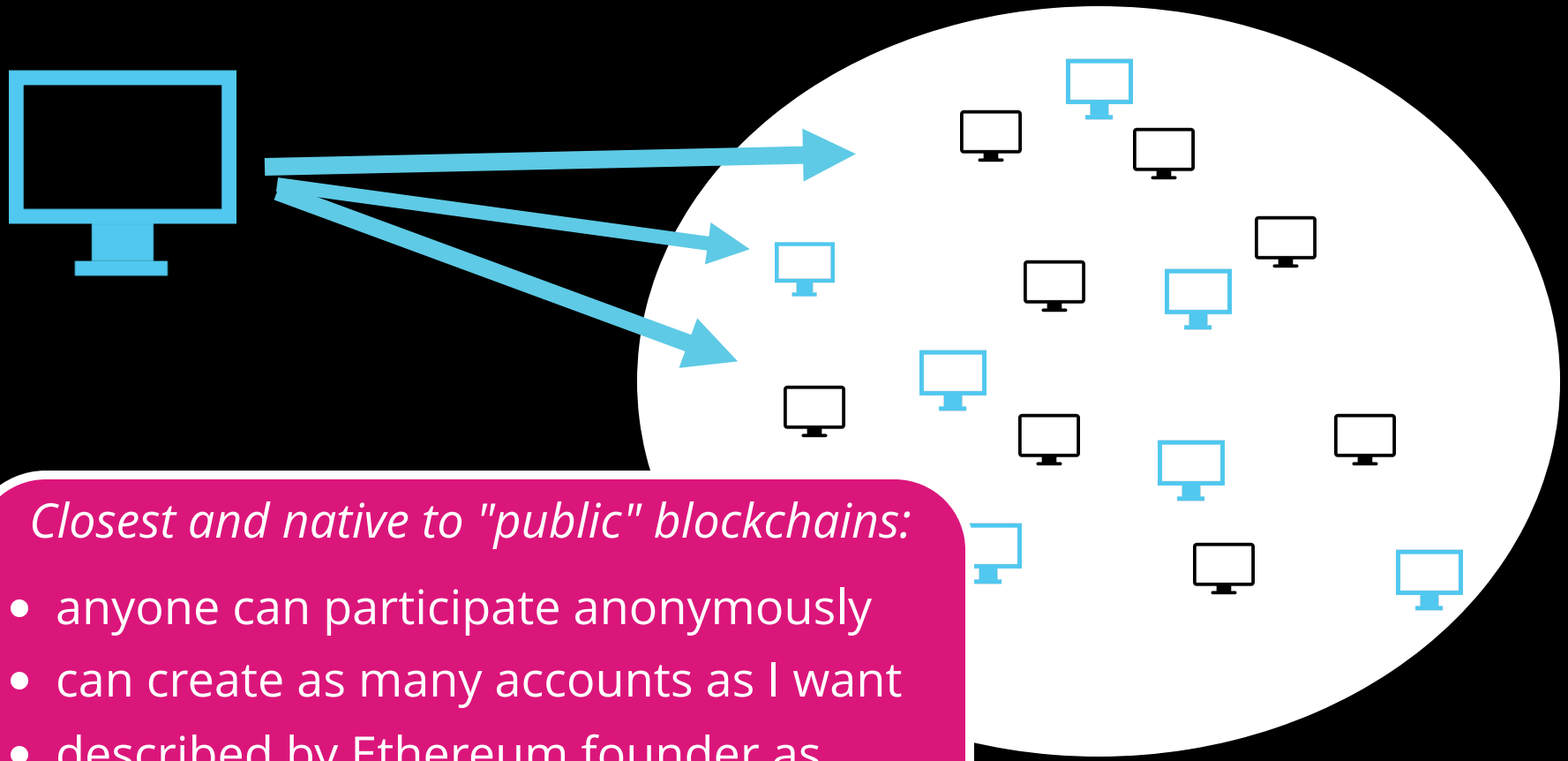


Closest and native to "public" blockchains:

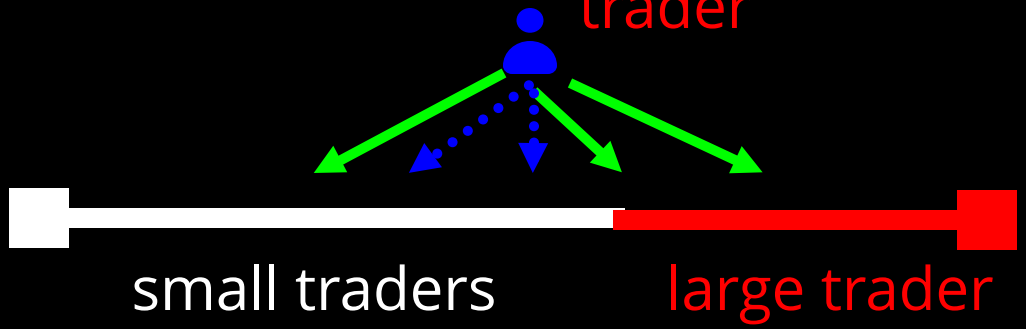
- anyone can participate anonymously
- can create as many accounts as I want
- described by Ethereum founder as simple solution to achieve privacy
- private blockchains can choose to organize like this

Acceptance Probabilities in Opaque Settings

Opaque Single ID

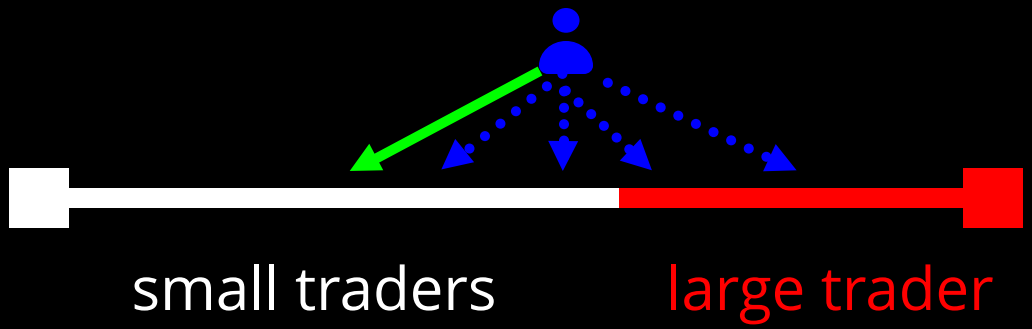
Opaque Multi-ID:

LP accepts



Opaque Multi-ID:

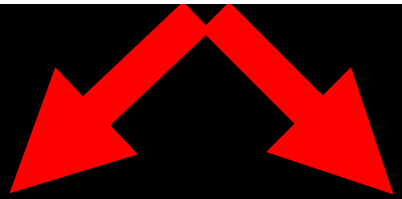
LP rejects



filled

unfilled

Decision problem LT



"target" IDs of both: large and small

- price concession "wasted" on small
- complexity costs: high
- intermediary costs: low

"target" small investors only

- no price concession
- complexity costs: low
- intermediary costs: high

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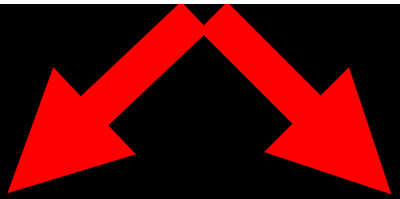

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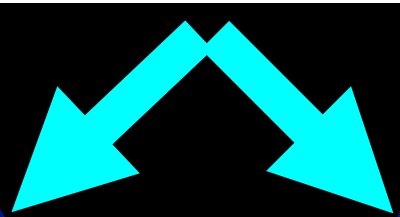

accept offer

front-run

- validation fees

Equilibrium & More

Theorem: There exists an equilibrium with no front-running where:

- **LP** accepts
- price concession = 0

provided:

- frequent interactions
- or very liquid intermediated market (front running hard)
- or high validation costs (front running expensive)

Equilibrium & More

Theorem: There exists an equilibrium with no front-running where:

- **LP** accepts
- price concession = 0

Result 2 (numerical): For infrequent interactions, the equilibrium with no front-running where **LP** accept does ***not*** exist. Then:

- In equilibrium, **LT** offers p = 0 to the continuum, and
- **LP's** IDs reject the offer.

=> "over-trading" with intermediary

- Note: an increase in the validation cost may curb front-running.

Comparing designs

Observations

- Intermediary involved $\Rightarrow$ social inefficiency
- Small with large traders $\Rightarrow$ complexity costs
- $\Rightarrow$ Best if large interact
- payoffs under the full transparency highest *by construction*.

Comparing designs

1. *Large traders do interact:*
   - *welfare single ID < welfare multi-ID*
   - *payoff to large multi-ID (assume price=0) > payoff large single ID*

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3. *(Numerical) ∃ parametric configurations with*
   - *large interact in multi-ID & p > 0 s.t.*
     - *payoff to large with single ID > payoff large multi-ID*

Summary

1. Blockchain="Back office" tech **with front office implications**!
   - with peer-to-peer there are critical design choices
     - Who can see the ledger?
     - How are virtual identities managed?
2. Findings:
   - Transparent ledger with single IDs is welfare optimal and has lowest wealth redistribution (almost by construction)
   - Between (A) public blockchain solution with multiple IDs and (B) private, non-transparent ledger with single IDs:
     - **public blockchain privacy solution** has higher aggregate welfare
     - but does not necessarily lead to higher payoffs for large investors.