Open Infrastructure for Edge:
A Distributed Ledger Outlook

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How Will Edge Get Deployed?

- "Edge" = "edge for shared or general purpose computing"
- Private edge deployments for specific purposes not relevant for us

Spectrum of edge deployments

Small number of large providers (like cloud today)

Large number of small providers (our focus)

Motivation: An Open Infrastructure for Edge

- Where will the edge servers come from?

- Anyone should be able to become an edge provider

- Set of common standards and practices for edge providers is required

- Solution for handling agreement and financial transactions
  - Large number of independent providers
  - Large number of clients/users

- Is a distributed ledger a possible choice? (our focus in this paper)

Why Distributed Ledgers for Edge?

- Widely used and popular, despite known issues
- In principle, they provide decentralized trust and transactions
  - Very interesting and useful for open edge
- Two key building blocks:
  - Smart contracts: Executable code
  - Ricardian contracts: Legal agreement in machine-readable tamper-proof form
- Ricardian triple: <prose, parameters, code>
  - Prose = Ricardian contract
  - Code = Smart contract
 - Parameters: This particular instance of the agreement

Requirements for Agreements in Open Edge

- Fast and cheap transactions
- Appropriate level of privacy and accountability
- Protection from volatility of crypto assets
- Conflict resolution and escrow service
- Legislation for digital agreement
- Environmentally sustainable operation
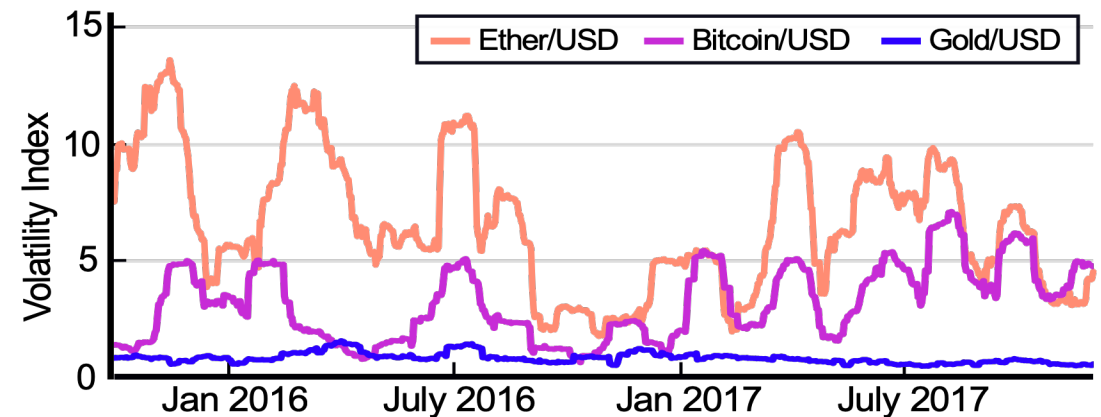- True decentralization, no central authority

Sustainability, Transaction Cost, Volatility
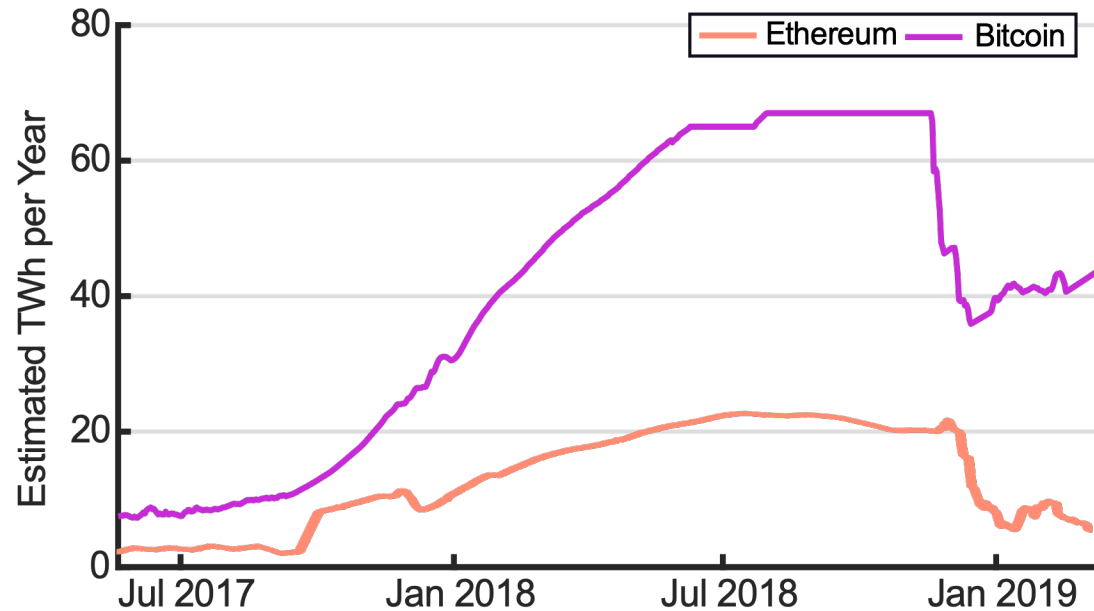
Energy consumption of Bitcoin and Ethereum, similar levels to Colombia or Portugal
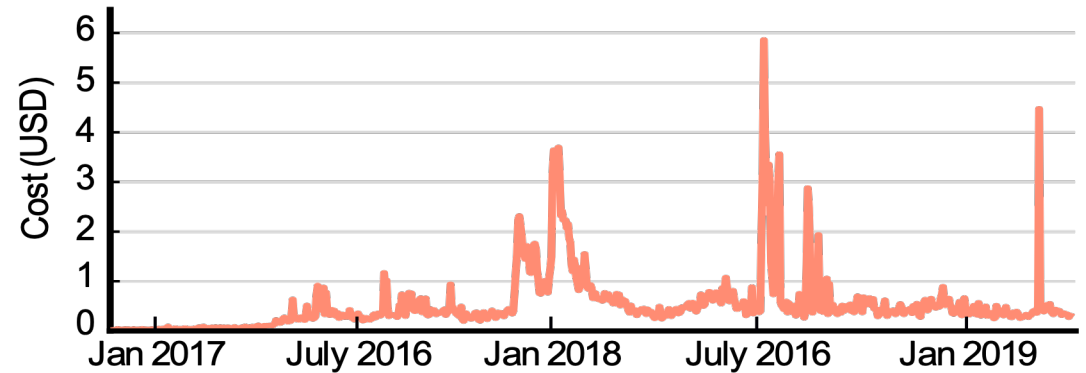
Ethereum's transaction costs peak at ICOs.

Volatility of Ether, Bitcoin, and gold.

Smart Contract Platforms

- Ethereum has been the leader so far
  - Cons: high energy consumption (proof-of-work), low performance, high costs
  - Pros: truly distributed, backing community is largest (7000-20000 nodes)
  - Transition to greener proof-of-stake Casper protocol is expected

- Second generation of platforms
  - EOS, Stellar, Cardano, etc
  - Many use delegated proof-of-stake (DPoS), greener and faster
  - Some charge zero fee

- Decentralization vs. efficiency
  - DPoS is efficient, but its decentralization is often questioned (e.g., EOS)

Other Considerations

- Volatility protection
  - Stable coins, e.g., Tether, USD Coin, TrueUSD, backed by some institution
  - Buyer of the coin must trust the institution, **no decentralization**
  - Allegations, e.g., no real money backing Tether, no way to check

- Privacy
  - Blockchain is open by design
  - For business considerations, edge providers might want to conceal their prices
  - Systems like Zcash use zero knowledge proofs to store private data while keeping blockchain public
  - No smart contract system supporting privacy in convenient way so far

Takeaways

- No distributed ledger exists that would support everything that open infrastructure for edge ideally requires
- Common tradeoffs
  - Accountability vs. privacy
  - Efficiency and low costs vs. true decentralization
  - Volatility vs. Trusting a non-regulated institution
- Legal status of digital agreement will always be out of technical scope
- Energy wasteful PoW and low transaction throughput are likely to be tackled as proof-of-stake family of protocols take hold
- Interledgers unite diverse systems enabling interactions between participants using different ledgers
- Current developments are leading into a positive direction

Open Questions? Issues? Problems?

- Will there ever be a general-purpose edge?
- What form will it take?
  - Based on current cloud operators?
  - Based on independent edge providers?
- This paper: Thought experiment + requirement analysis for open edge
  - Main conclusion: Feasible, although needs more work
- Shared edge looks very likely
  - Shared = One application, many providers
  - Need: Standardized APIs, discovery, agreements

Thank you!

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