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2021 Thesis of Infrastructure Blockchain, Blockchain Consensus, and Future of Scaling

Blockchain Consensus Map, Market Performance Review of Public Chain and Challenge to the Infrastructure: Time Window of Scaling

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1PAR is a blockchain and crypto-focused early-stage research and investment firm. We have been actively participating in multi blockchain technologies in infrastructure networks and its composable ecosystem, from $1M to $10B. The meaning of 'par' is taken from value, standard. We hope to establish industry standards with our high content quality, service level, and investment perspective.

Report Disclosures

Abstract

Through 1Q2021 performance review of infrastructure blockchains, in this report we describe, analyze, and explain the blockchain scaling issues in below:

- dynamics of blockchain consensus
- chain customer acquisition has become fierce
- scaling issue of infrastructure blockchains intend to rise
- the bottleneck of consensus mechanism has become prominent

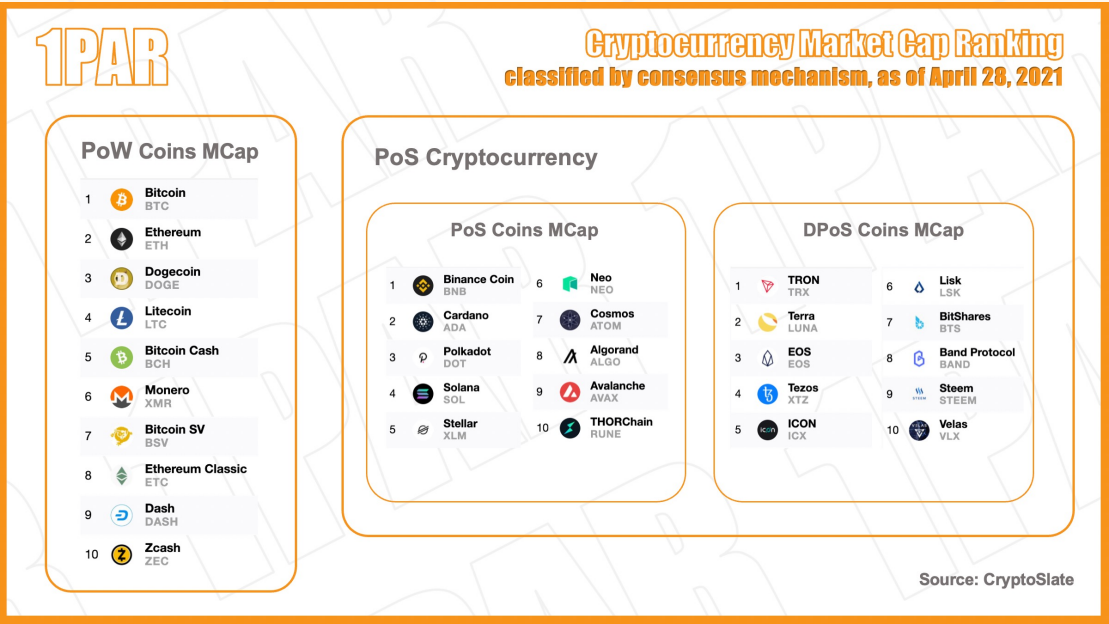and introduce several innovative scaling solution alternatives.

Thanks to Richard Parris for review

Preface

Why Blockchain Needs Consensus

Why Consensus Mechanism is Significant to the Operation of Infrastructure Blockchain Networks. **Consensus is a method of reaching agreement on a shared state.** For the state of the blockchain to continue to be established and move forward, all nodes in the network must reach a consensus. In this way, the nodes in the decentralized network can keep synchronized with each other.

If there is no consensus among decentralized network nodes on the blockchain, there is no way to ensure that the state shared by other nodes is true. Consensus aims to provide *objective* facts about the state between participants, and each participant has his own *subjective* view of the network. The process of communicating between these nodes and reaching an agreement to enable the production of new blocks.

1PAR — Cryptocurrency Market Cap Ranking
classified by consensus mechanism, as of April 28, 2021

PoW Coins MCap

1. Bitcoin — BTC
2. Ethereum — ETH
3. Dogecoin — DOGE
4. Litecoin — LTC
5. Bitcoin Cash — BCH
6. Monero — XMR
7. Bitcoin SV — BSV
8. Ethereum Classic — ETC
9. Dash — DASH
10. Zcash — ZEC

PoS Cryptocurrency

PoS Coins MCap

1. Binance Coin — BNB
2. Cardano — ADA
3. Polkadot — DOT
4. Solana — SOL
5. Stellar — XLM
6. Neo — NEO
7. Cosmos — ATOM
8. Algorand — ALGO
9. Avalanche — AVAX
10. THORChain — RUNE

DPoS Coins MCap

1. TRON — TRX
2. Terra — LUNA
3. EOS — EOS
4. Tezos — XTZ
5. ICON — ICX
6. Lisk — LSK
7. BitShares — BTS
8. Band Protocol — BAND
9. Steem — STEEM
10. Velas — VLX

Source: CryptoSlate

Cryptocurrency Market Value Ranking, classified by consensus mechanism, as of April 28, 2021

Coins and tokens using PoW and PoS consensus algorithms account for the forefront of the market value of cryptocurrencies. But speaking in technical aspects more accurately, Proof-of-Work (PoW) or Proof-of-Stake (PoS) can only be a simplified name for blockchain-

consensus protocol. For example, PoW is an algorithm followed by the creators of the blockchain in Bitcoin. In fact, PoW is part of the Nakamoto Consensus, a subset of the Nakamoto Consensus. PoW and the Longest Chain Rules is on the equal stack, Nakamoto consensus also includes the chain selection algorithm of the longest chain rule.

In the collective name of the blockchain algorithm of PoS: part of the PoS has been integrated into the consensus algorithm of this public chain. For example, Tindermint is a Byzantine fault-tolerant algorithm, and it integrates PoS as part of the algorithm. The method of selecting validators, this fusion or nesting application is applied to multiple public chains such as Cardano, Polkadot, and Cosmos.
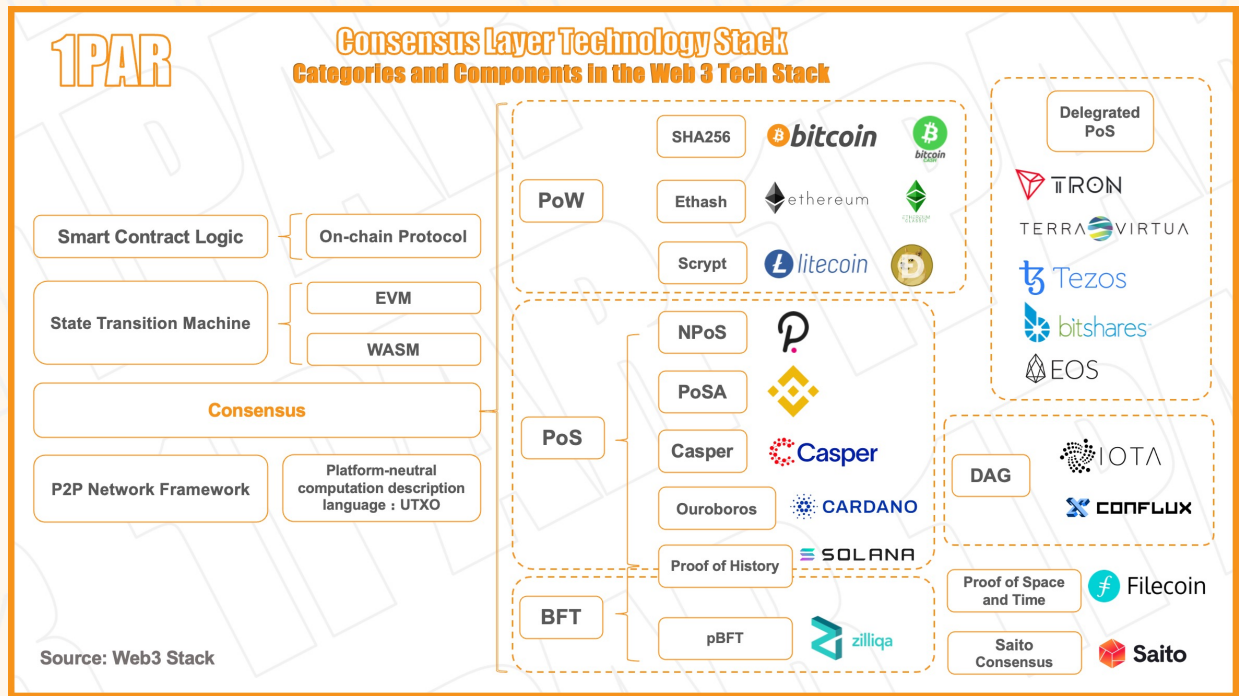
Mapping the Consensus

Consensus Mechanism and the Ecosystem Map of Infrastructure Blockchain

According to the description of the Web3 Stack and Multicoin thesis, infrastructure blockchains include various of public chains: such as Bitcoin, Ethereum, Polkadot, Cardano, Solana, etc., which may or may not have smart contracts.

The above network protocols are divided into some academic circles:

• Data storage and distribution protocol

• Data and information exchange protocol

• Interactive platform, etc.

Among them, their consensus mechanism constitutes an important part of these infrastructure networks and plays an important role in their operation.
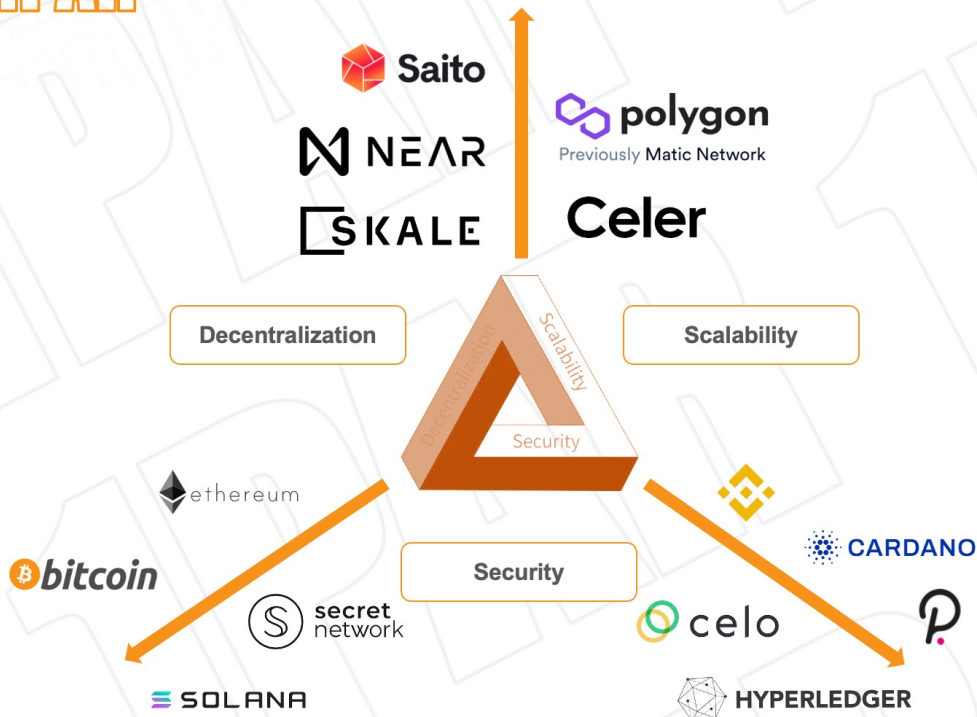
Consensus Layer Technology Stack, According to Web3 Stack

In the above graph, we have listed several infrastructures that are most worthy of our attention. Here are all the current blockchains based on their own underlying blockchain framework that enable smart contracts. This is also called the Layer-1 blockchain. We can find that the majority of consensus protocols such as PoS and Delegated are applied. There are still many blockchain projects that are not listed here. Some of them are their own public chains and scaling solutions. There are NEAR, Avalanche, etc., and more hidden gems with relatively influential market attention, such as FLOW, Waves, WAX, Cocos-BCX, Kadena , Saito and other public chains.

The development history of the infrastructure chains applying different consensus mechanisms

Reviewing the development history of the public chain, the infrastructure blockchain and the consensus mechanism applied have evolved from focusing on consumption, focusing on computation, and focusing on hardware to environmental protection, focusing on participation, and lightweight.

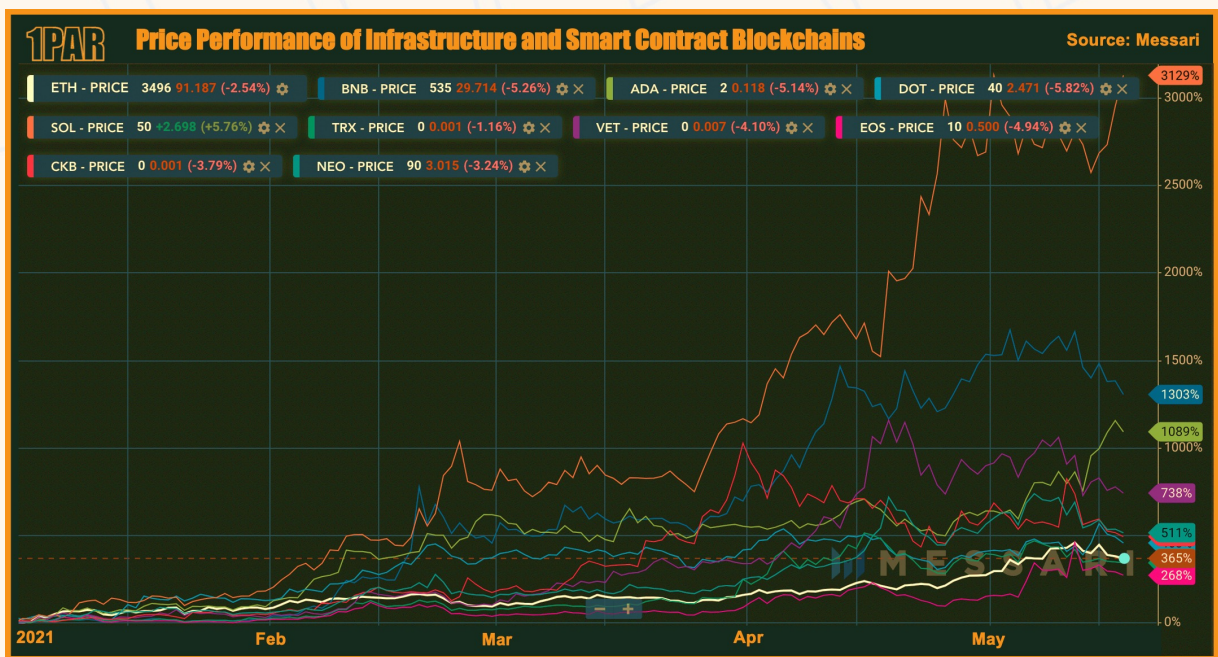*Attribute Axis of Public Chain Consensus Mechanism*

From the current top-ranked public chains in market cap and other blockchains spawned by the consensus mechanism behind them, we can basically draw the competition between proof of work and proof of stake.

Bitcoin, which uses proof of work as the consensus algorithm, has become one of the standards for measuring market diversity, led by Bitcoin dominance. Among other public chains that have built various DApps, Proof of Stake is a unified feature of these public chains, and many of them include various variants of algorithms that still operate based on Proof of Stake.

Ranked by current market cap, including Proof-of-Staked-Authority used by Binance Smart Chain and Ouroboros algorithm used by Cardano. Norminated Proof of Stake (NPoS) used by Polkadot is combined with mixed consensus. GRANDPA/BABE-NPoS is responsible for selecting validators, BABE is responsible for generating blocks, and GRANDPA is responsible for finality.
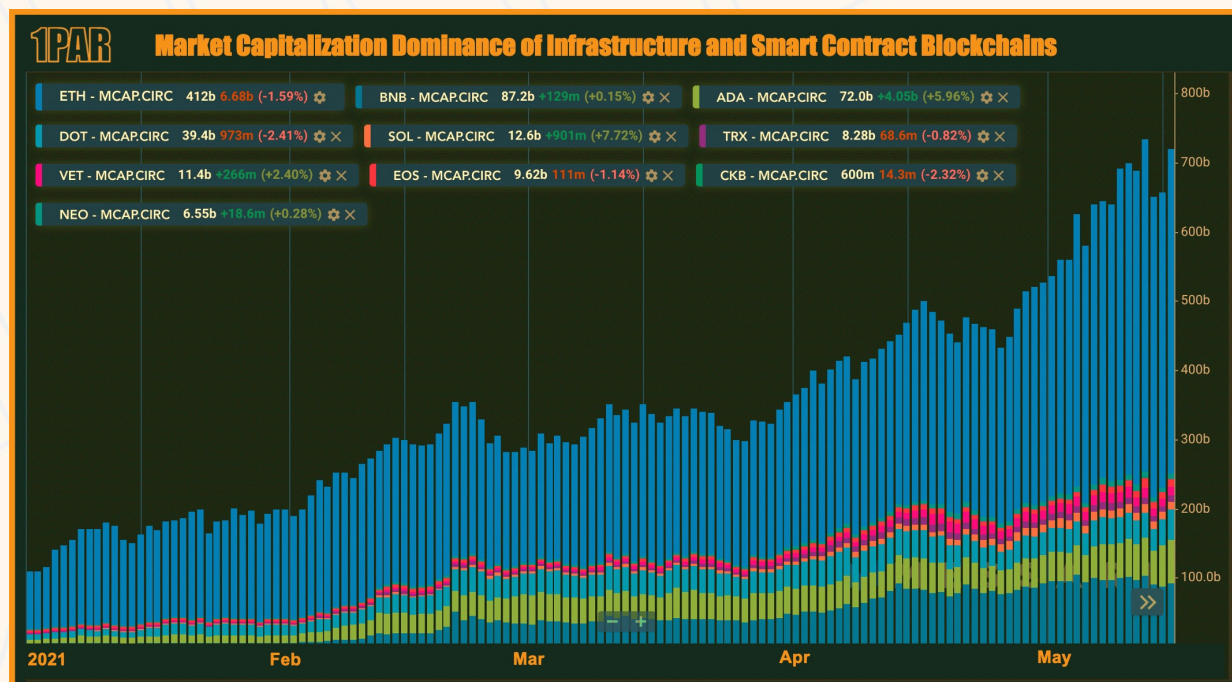
Market Performance Review of Infrastructure Blockchains, Jan to Apr 2021

From January to April of the first quarter of this year, or the market call-back in the mid-to-late April since the beginning of 2021, we defined this period of market performance as New Infrastructure Bull-run. We have witnessed that with new generation of public chains, the Layer 2 chain that serves the scaling plan of Ethereum, and the eco-chains of the head centralized exchange are leading the altcoin market out of a wave of the infrastructure blockchain sector. Relying on the advantages of several light-packed latecomers, the DeFi application on the new generation of public chains leads these infrastructures in the market capitalization ranking and construction of ecosystem projects to achieve a leap in technical and investment adoption.

Price Performance of Infrastructure and Smart Contract Blockchains, 1 Jan to 17 May 2021

From the above graph, at the respective price changes, or the direct return of each infrastructure's investor, the comparison between each new generation public chain and Ethereum, it is shown that the biggest contender of the fastest-growing new generations: Solana is the first, and BNB is the second to achieve the highest ROI.

Market Capitalization of Infrastructure and Smart Contract Blockchains, 1 Jan to 17 May 2021

Since the market value of the above major public chains has risen from January to April this year, we can see a multi-chain universe in the future, and the market value share of Ethereum is gradually declining. Ethereum, as the mainstream smart contract platform, has been declining as the occupation of the market capitalization of the overall infrastructure network. In April, we saw the new ones that emerged in the volatile April. A generation of public chains, Binance Smart Chain with Binance as its backing, Solana ecosystem, Cardano ecosystem, and Polkadot ecosystem are constantly emerging.

We refer to the opinion of Kain Warwick. In Q1 we witnessed the social experiment and concept falsification of many new generations of public chains, which brought an impact on the Ethereum community and witnessed the early days of a multi-chain future.

Since the first half of this year, in the lineup of the new generation of infrastructure networks, for example, the Binance Smart Chain has evolved its own complete ecosystem, which can be regarded as the success of a conceptual social experiment. BSC verified that decentralization may be the needs and demands of developers, rather than the needs of general users. The most direct cost-effectiveness and the direct increase in the holding of-

tokens have attracted users and funds to flow into BSC in large quantities, just as the funds in the liquidity pool might do not have belief or loyalty but proceed with the most favorable return on their investment or farming.

The next-generation infrastructures such as Solana, Cardano, and Polkadot have already released smart contract functions and have been or have not yet been implemented, but many future sharding protocol projects have been completed and are ready to go. The new generation of infrastructure drives the eyes of users, developers, and investment institutions to gradually depart from the high degree of ties with Ethereum economically and ideologically.

The ecosystem construction of infrastructure network will not think that developers and users will come to this ecosystem just because it has achieved decentralization in concept and technology. As a traditional smart contract platform or the largest DeFi platform, Ethereum may be late in its expense rate and efficiency reforms, unless Ethereum makes progress in scaling in the middle of this year.

Price Performance of Layer-2 Platforms and Scaling Solution Blockchains — Source: Messari

ETC - PRICE 91 2.994 (-3.19%)	MATIC - PRICE 2 0.087 (-5.06%)	NEAR - PRICE 6 0.169 (-2.87%)	AVAX - PRICE 35 1.511 (-4.12%)
CELR - PRICE 0 0.002 (-4.59%)	SKL - PRICE 1 0.020 (-3.65%)	OMG - PRICE 9 0.483 (-5.18%)	POA - PRICE 0 0.002 (-3.30%)
LRC - PRICE 1 0.023 (-3.97%)	LOOM - PRICE 0 0.008 (-6.50%)	LPT - PRICE 28 1.955 (-6.44%)	

Price Performance of Layer-2 Platforms and Scaling Solution Blockchains, 1 Jan to 17 May 2021

From the above chart, we can see that from January to April, the major scaling solutions-

with the best performance in the secondary market include Polygon ($MATIC), leading far way ahead, Celer ($CELR), Liverpeer ($LPT), Avalanche ($AVAX), Skale ($SKL) ranks ahead, but in terms of overall market cap, compared with major smart contract platforms other than Ethereum (such as BSC, Solana, Avalanche), the market cap and market attention of the Layer-2 Scaling platform are still relatively underestimated.

The current limited scalability of the Layer-2 scaling plan requires new participants to have a sufficient window of time to familiarize themselves with the development environment to gain more upward space on Ethereum. Otherwise, developers will inevitably look for elsewhere to build, which indirectly drives the blockchain world to a multi-chain development universe.

Analyse the Scaling Limits of Public Chain

Challenge to Layer-2 Scaling Solutions

In the 1st quarter of this year, we witnessed a lot of new chain "customer acquisition" and technical falsifications. At the same time, we also must be a little calmer about the high expectations caused by the future Ethereum EIP1559.

Chain customer acquisition describes that the public chains that appear in the last bull market and the recently emerged public chains are intensively competing for adopters through various developer grants, airdrops, and the main slogan of cheap expense rates.

Binance Smart Chain's social experiment might prove that the ecosystem construction of the public chain will not be because of the decentralization. The answer to the question is left to whether Ethereum can seize this time window to meet the challenge of the customer acquisition competition and make a real difference in scaling.

However, there are too many problems to be solved in Layer-2 scaling.

- Global State:
    - First, there is currently no grounded solution that can make the state of all infrastructures or Layer-1 chains form a unified state or global state (on chain), which results in no composability regardless of whether it is based on EVM or other self-developed ones.
    - As a result, both these new public chains and Layer-2 platforms are in an in-volume customer acquisition competition, rather than truly efficient mergers and acquisitions.
- User Adoption:
    - It is also difficult for people to change their usage habits to use the Layer-2 platform. This is a complex mode that is difficult for developers or users to operate.

This is also an adjustment to the user belief of familiar platform that are affected by chain competition.

Closing thoughts on the challenge to Layer 2 scaling solutions is that if these new public chains or scaling platforms cannot form a combined effect of Lego blocks.

As for developers and communities:

- they will use a new generation of platforms to find new heights,
- Ethereum still has users and developers but no composability,
- the market value of the public chain and scaling platform has also boomed. But it's limited.

Challenge to ETH1.x to ETH2 Upgrades

Then, what other methods can solve the current infrastructure network scaling? After we reviewed the scaling plan of Layer-2 networks above, Layer-1 itself, ETH 1.x upgrade to ETH2. What are the real changes in ETH 2.0 from the consensus mechanism and scaling phases?

In December 2020, the primary form of ETH2-Beacon Chain was launched, and the current ETH1.x is expected to underline merge with ETH2 after a series of upgrades. Before the merge, the current ETH 1.x will be upgraded to solve the current urgent problems of high gas fees and scaling. The most important upgrade is the "London" hardfork, which is estimated to be implemented in July. EIP1559 which is probably the most important Ethereum Improvement Proposals (EIPs) to date will be included in the "London" hardfork. After that, it will usher in the merge at the end of 2021 or 2022-"Shanghai" hardfork.

The first challenge facing Ethereum's scaling is EIP1559. After EIP1559 determined the upgrade time, some large mining pool brands opposed it. In short, before the EIP1559 upgrade, miners' rewards mainly came from miners who dig out the top ore and most of the transaction fees were rewarded to miners. After EIP1559 is upgraded, users will be required to set a base fee and a ceiling fee for processing their own transactions. The fees set in the past will be paid in full by the user, just like a tip. After EIP1559, the difference will be refunded. Therefore, many miners will revolt, because this greatly reduces the revenue of miners, especially in the current Ethereum mining has reached a billion-level business scale in February this year. If the opposition miners successfully initiate a hard fork, it will be a loss for both developers and miners.

Even if ETH1.x and ETH2 merge, they will face another dispute over the interests of miners brought about by Proof-of-Staking. We learned that some Ethereum mining pools are expressing their questions about the specific time of the transition to POS, which the schedule is unclear, and no official announcement was made. At present, the merger time of ETH1.x and ETH2 is not clear, and the Ethereum Foundation is required by some mining pools to release it as soon as possible, which will end PoW mining; while other mining pools expressed their support and support that the upgrade zone will achieve long-term development and stabilization of the current Ethereum price.

Challenge of Binance Smart Chain Scaling

The degree of decentralization of BSC has always been questioned by the Ethereum community, even though the founder of Binance CZ once used CeDeFi, a kind of-

decentralized and centralized finance, as a description of the DeFi application in the BSC ecosystem. As a supplement to current DeFi applications. Then this centralization can be described as limited validator amount on the BSC blockchain.

According to Wilson Withian's source, there are only 21 validator nodes running on the BSC, and each day the 21 node set is selected by the 11 validator nodes of Binance Chain, the other Binance dual chain based on Cosmos IBC framework, through voting. Therefore, many people ignore the influence of Binance Chain itself on the most fundamental status of Binance Smart Chain.

The congestion or temporary maintenance of the BSC became more serious, as it was discovered on May 11 that the transaction time was prolonged due to the originally designed low TPS (about 100 transactions/sec) of BSC. Due to heavy load, low hardware specifications, and some bugs in the BSC validator client, the developers are currently upgrading.

Challenge of Solana Scaling

At present, the DeFi protocols in the Solana ecosystem have attracted about one billion US dollars in Total Value Locked (TVL), and there are about 46 DeFi protocols and applications built on the Solana. Although Solana is not based on an EVM-compatible smart contract functions, it applies WASM smart contract based on the Rust language. Therefore, following the soaring of Ethereum, the logic of funds and projects to other blockchain platforms compatible with EVM tools is different. However, blooming chain platforms like BSC and Solana both happened frequent clogging problems. The "All hands on deck" that occurred on December 5, 2020, was clogged due to an unknown error, and various types of network transactions have been clogged recently.

The same situation exists in Solana's validator nodes for staking the network. The network compresses the validator node set for faster processing speed and cheaper transaction fees. This is reflected in the scale and cost of Solana's validator deployment are higher than the cost of Ethereum. Node operators of this scale almost only allow some advanced data centres to operate. According to the stake ranking, 10 validator nodes control more than 50% of the stake in the entire network. To a certain extent, it is difficult to achieve a further decentralized network status in the future, while speeding up the network and reducing costs in the future will repeat the same mistakes, running like all smart contract platforms, the existing giant whale validator nodes will process transactions and verify the majority of network blocks, and be rewarded by their dominated stake.

The above illustrates the common limitations of all vertically integrated platforms. Whether they are PoW consensus or PoS consensus, these vertically integrated networks can quickly build their own DeFi ecosystem by building some DeFi protocol blocks, but they also always face the problem of scaling like their predecessors. Data on single chain will accumulate and become heavy. Every protocol follows a unified transaction logic. Therefore, the node's operating costs and transaction fees rise with the rise of adoption.

Approaches of Infrastructure Design to Scaling

The common scaling problem of POW and POS

Whether it is PoW or PoS, as the data stored on the block becomes heavier, mass production of the block becomes unsustainable. The PoS chain requires the cost of mining and electricity to scale, and the PoS chain requires paying the price of stake in the open market to scale.

Both miners working for the property owners and validator operators working for the stake owners will have collective behavioral problems that hinder the potential of blockchain scaling. Saito Network, as an innovative infrastructure consensus protocol, gives the reasons for the bottleneck limiting the scaling of public chains:

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Saito Network co-founder David Lancashire believes that all public chain infrastructure participants have collective behavior problems caused by economic problems during the scaling process of public chains.

The scaling of Ethereum-based public chains is facing the problem of the commons dilemma, or tragedy of commons. Users continue to store data on the blockchain. In order to enable the continuous production of blocks, subsequent users continue to pay for the entire chain. The maintenance cost includes the maintenance cost of this continuously existing block. It is like in a pasture where miners continue to benefit from block transactions (sheeps), but they will also continue to destroy the sustainability of the entire pasture. The incentive for the existence of the tragedy of commons is that individuals will continue to profit in the current environment but do not care about the costs in the future.

Another economic problem is the free-rider problem. Compared with the tragedy of commons, free-riding miners or validators are not increasing the cost of the future blockchain, but increase costs for other miners, in the form of competition to grab the head block, thereby forcing other miners increase computing power, stake or storage space, etc. The already profitable or most profitable miners may compel other more selfless miners lose the motivation to continue to maintain the network.

Saito Network co-founder Richard Parris pointed out that Saito Consensus's solution to the scaling problem is that, in the situation of common dilemma, the shared property of the blockchain infrastructure will be free of charge, which means that storing data on the chain will continue to require a certain cost, such as overtime rent, which will be completely determined by the market, thus solving the problem of the dilemma. Saito Consensus will reward the network maintainer with the most contribution. The more the node does the work of introducing the transaction fee into the block, it will be rewarded with the block reward instead of the whole reward of head block which should be mined in all existing protocol consensus.

When commenting on Saito Network, Boxmining pointed out the scaling and economic incentive problems of Bitcoin and Ethereum. The operators that maintain the Bitcoin and-

Ethereum networks do not directly receive rewards. In contrast, if the rewards are directly distributed to operators that can continuously operate the network and broadcast transactions, the infrastructure of this consensus protocol will be uncensorable and open.

Concluding Thoughts

In this report, based on the main thrust of Blockchain Consensus Map, Market Performance Review of Public Chain and Challenge to the Infrastructure: Time Window of Scaling, we analysed and conclude as following key points:

- The importance of the consensus mechanism of the blockchain:
    - The method of distinguishing the consensus mechanism and the competition track of the same kind consensus is not only based on its algorithm to determine the reward method (proof of work or proof of stake), but also to the specific hybrid algorithm consensus.
    - Diversity of consensus mechanisms presented by these blockchain infrastructures.
    - Advantages in different attributes such as security, decentralization, scalability, etc. given by diversity.
- Market review of public chain market performance and scaling solutions from January to April this year
    - The performance of the public chain market has reached a certain stage, indicating that the market has entered a period of calmness after certain adoptions, waiting for the new public chain ecosystems and the urgently needed effective scaling solution to drive new market performance.
- Scaling Limits of Public Chain
    - Ethereum's challenges
        - Ethereum miners protested issues such as the handling of the conversion to proof of stake and the unclear time of its publication. Whether it can smoothly accomplish the merge remains to be verified in practice.
        - Ethereum's current scaling plan has yet to be verified by the market in terms of user habits.

- Potential scaling problems of public chains (explained in BSC and Solana) in developed markets have occurred.
  - BSC's network validator screening has comparably serious centralization problems
  - Solana's validators have relatively high barriers to entry and so there are also monopoly issues.
- Scaling approach improvement case
  - Saito-led new generation public chain with consensus mechanism innovation as one notable direction needs to gain more attention from the developer and user base.