MarketVector™

Infrastructure Applications Indexes

The Picks and Shovels of the Digital Asset Revolution

Martin Leinweber, CFA

Digital Asset Product Strategist

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Infrastructure Applications - The Picks and Shovels of Digital Assets

Decentralized software is only truly decentralized if the hardware that supports it is decentralized as well. In 2022, it became apparent that centralizing hardware can make decentralized software vulnerable to censorship. Decentralized file storage, wireless Internet and cloud computing are examples of infrastructure projects that are necessary for the growth of the new decentralized Internet, also known as Web3[1]. Scaling such hardware-intensive networks profitably is difficult due to the significant capital investment.

These infrastructure protocols have minimal utility on their own, but when coupled, they function similarly to LEGO blocks, allowing a developer to construct a variety of potentially new and beneficial user-facing Web3 applications. For example, the development of Chainlink oracles enabled the development of lending and borrowing platforms such as AAVE and Compound, which rely on high-quality, real-world data regarding asset prices. Decentralized file storage, in particular, is a critical component in establishing a censorship-resistant, free Internet. In 2022, solutions such as Filecoin, IPFS and Arweave saw some interest.

Why do we need Web3 infrastructure?

There are various attack vectors when it comes to crypto protocols. Centralization is a serious factor. Although every protocol should by definition be decentralized, there are significant differences. Decentralization affects various dimensions, including the community, the developer team, stakeholders, and infrastructure. The infrastructure aspect is often overlooked and not given much attention.

Ethereum and Solana, as base layer protocols, illustrate how infrastructure can be centralized[2] (Kassab, Akash: Solving Web3's Centralization Problems, 2022):

1. The backbone of blockchain, including nodes and validators, are mostly located on the cloud servers of a small number of big tech companies.

2. The same cloud providers host protocol front ends and middleware.

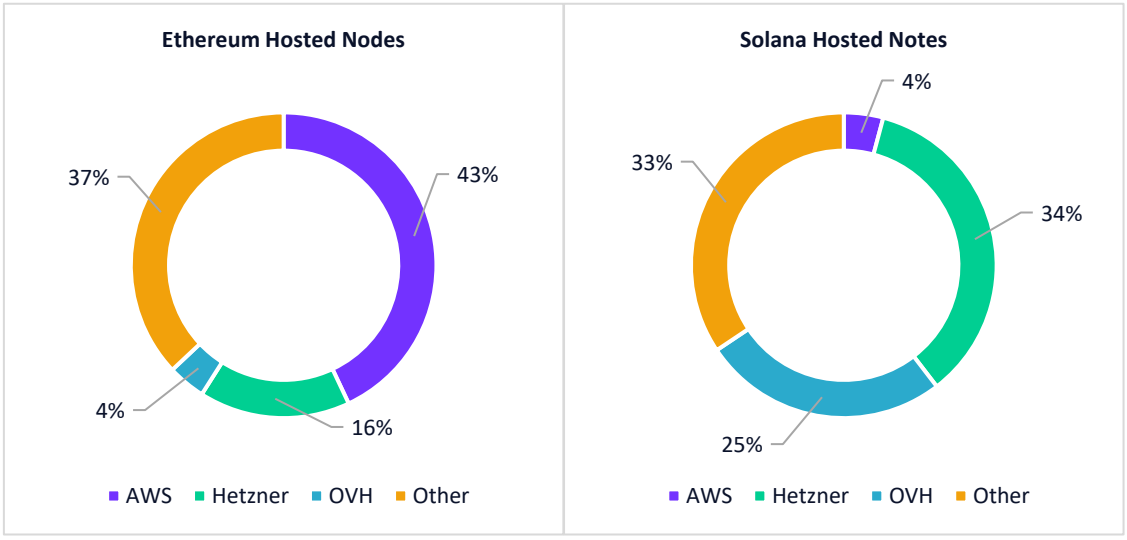
[1] Web3 has evolved into a catch-all word for the notion of a new and improved internet. At its heart, Web3 employs blockchains, cryptocurrencies, and NFTs to return power to users in the form of ownership. Web1 was read-only, Web2 was write-only, and Web3 will be read-write-own.

[2] In a blockchain network, a node is a computer or other device that participates in the network by maintaining a copy of the blockchain and validating transactions. These nodes work together to ensure the integrity and security of the blockchain by following a consensus protocol, which is a set of rules that govern how new transactions are added to the blockchain. Validators, on the other hand, are a specific type of node that play a key role in the consensus process. They are responsible for verifying that new transactions are valid and then adding them to the blockchain. In order to do this, validators must have a certain amount of a cryptocurrency, often called a "staking token," as collateral. This is to ensure that validators have a financial incentive to act honestly and to deter them from attempting to cheat the system.

Currently, Ethereum's blockchain network has more than 4,650 active nodes. A crypto analytics firm, Messari, states that about two-thirds of these nodes are located on centralized servers, with over half of them being controlled by Amazon Web Services (AWS).

This centralization poses a risk to Ethereum, as it could lead to various failure scenarios. According to Messari, the Solana blockchain also has a similar vulnerability (Exhibit 1).

Exhibit 1: 3 cloud providers represent 66% of hosted nodes for ETH and SOL



Source: messari.io, Akash: Solving Web3's Centralization Problems. Data as of June 2, 2022.

As more of the Web3 infrastructure is controlled by a few large tech companies and governments, these entities gain the power to censor and shut down protocols. Additionally, this concentration also makes it more likely for regulators to try to exert control over the sector. This is why a lot of Web3 front ends act as a primary attack vector.

There are various solutions available in the market to address the issue of centralization in decentralized infrastructure. One example is Akash Network, which aims to provide a decentralized infrastructure for cloud computing. Akash Network allows for a more distributed approach by enabling the use of a wider range of cloud service providers. Compared to working directly with a single, traditional cloud service provider, this arrangement is typically less expensive, more flexible, and more secure. Some of its key features include a permissionless structure and resistance to censorship. It's worth noting that there are other solutions that address the same problem and it's important to research and compare different options before deciding.

Real-World Infrastructure

Through the coordinating powers of blockchain technology, crypto economic protocols can promote the construction of real-world infrastructure and hardware networks. Instead of a centralized institution, millions of sovereign individuals can work together to install and operate infrastructure in a trustless, permissionless, and programmatic manner.

This industry has been dubbed Proof of Physical Work by Multicoin Capital (PoPW) (Jain & Sengupta, 2022). PoPW compensates users for doing verifiable physical effort, such as setting up a 5G hotspot. Based on a predetermined set of rules, the protocol algorithm verifies the device's state and pays the owner. Many PoPW protocols are already coordinating hundreds of thousands of participants worldwide, encompassing industries such as wireless networks, mobility, the environment, computation, and storage.

Key Advantages of using Web3 in Infrastructure

The use of decentralized protocols for infrastructure networks has two key advantages: the ability to quickly expand networks on a global scale and the system being jointly owned by its participants rather than a limited number of stockholders, eliminating the need for a centralized market.

Web3 protocols enable people all around the world to create permissionless networks simultaneously. Participants with specific expertise of their jurisdiction can concentrate on deploying infrastructure that suits the needs of their local market. In exchange for expanding out the supply side of a network, participants gain ownership stakes in the network, which motivates them to see it flourish. It is feasible to collectively bootstrap a network without requiring permission or trust. This is also a more cost-effective technique for bootstrapping a network by dispersing the costs associated with developing and sustaining it to supply-side participants.

The Infrastructure Application Ecosystem

The MarketVector Infrastructure Application architecture is shown here to demonstrate where and how dApps can decentralize their infrastructure, as well as the numerous options for Web3 infrastructure providers to provide access to distributed node networks. The structure is divided into seven major layers:

- **Blockchain-as-a-Service** (Stratis, Unibright): Includes B2B infrastructure application platforms which are marketed to blockchain developers but do not fit neatly into any of the above categories.
- **Computing Platform** (Ankr Network, Keep Network, Render Network): A network of computers operating together to accomplish a particular task. Decentralized compute networks connect individuals looking for compute resources to systems with idle computing power
- **Data Management** (Arweave, The Graph, Filecoin): Tokens native to applications that use blockchain data's public nature to query, collect, process, encrypt, monetize, or broadcast data for various use cases. The category also contains a new generation of cooperative storage clouds to meet the storage requirements of new Web3 applications.
- **Digitization** (Civic, Ethereum Name Service): Protocols, taking care of real-world documents, contracts, public names and other data. With the help of the blockchain, transparency, publicly verifiable ownership, and immutability are guaranteed.
- **Interoperability** (Ren, Synapse): With the growth of L1, L2, and sidechain networks, there is an increased demand for cross-chain communication and interoperability to bridge value across the composite network space. Cross-chain bridges strive to serve this goal by allowing users to transfer value from one chain to another.
- **Internet of Things** (IOTA): The Internet of Things (IoT) is a term used to describe devices that exchange data with each other and systems via a network. Interoperability between IoT networks and blockchain dApps is enabled through IoT platforms. IOT infrastructure applications include those that collect and send information (sensors), receive information and act on it (3D printers), and those that do both.
- **Decentralized Wireless Networks** (Helium): Incentivizing operators to deploy and maintain telecom hardware in exchange for token rewards.

What's the value proposition of Web3 infrastructure protocols?

There has been a proliferation of infrastructure protocols. They are all faced with the difficulty of matching network usage to token pricing. Because Web3 protocols are still in their infancy, they require agreement on the best tokenomics standard[3]. The disparity between value generation and value accrual is seen in Uniswap[4]. Uniswap is a decentralized exchange (DEX) built on Ethereum, which allows users to trade tokens without the need for a central authority. Its token has struggled to gain value despite being the most popular DEX with the highest volume because its main benefit is protocol governance.

The basic idea of Web 3 infrastructure involves rewarding users for completing a verifiable physical activity (Kassab, 2022):

- The token payout encourages supply-side participants to build infrastructure.
- More supply-side participants are attracted by network fees produced by end customers.
- The network utility increases and so does the token price.

The **Burn-and-Mint Equilibrium (BME)** model and the **Stake-for-Access (SFA)** model are two popular token models used to construct a relationship between network consumption and token pricing.

The BME model operates by converting protocol usage into token buying pressure. In this model, users are required to burn (destroy) a certain number of tokens in order to access the network or perform a certain action. This creates scarcity in the token supply, which in turn drives up the token's price. The token is then minted (created) back into the system in order to reward the network's validators or to be sold back to users. This creates a self-regulating mechanism to balance the token's supply and demand, and thus its price.

On the other hand, the SFA model converts network involvement into token buying pressure. In this model, users are required to stake (lock up) a certain number of tokens in order to access the network or perform a certain action. The staked tokens are used as collateral to ensure that users act in the network's best interest. The longer the tokens are staked, the more access and benefits the user has on the network, and the more the token price increases. In summary, the BME model operates by converting protocol usage into token buying pressure through a burn-and-mint mechanism, while the SFA model operates by converting network involvement into token buying pressure through a stake-for-access mechanism.

[3] Tokenomics: Token economics is the study of how tokens are used in blockchain networks, and how their value is determined. Tokenomics is the set of rules and incentives that govern the issuance, distribution, and circulation of tokens within a network.

[4] Value accrual techniques: These are methods used to ensure that the value generated by a network is captured by its token.

The Chainlink protocol, for example, is a decentralized oracle network that enables smart contracts to securely access off-chain data feeds, web APIs, and traditional bank payments. It employs LINK as both a payments token and a work token. LINK is a payment token used to compensate Chainklink node operators for providing Oracle services. As a work token, LINK can be staked as collateral by node operators to perform oracle services, with node operators' staking incentives being decreased ("slashed") as a penalty in the event of errors or downtime. Filecoin, a data storage protocol, operates similarly.

Case Study Helium Network: Disrupting the wireless business

The telecoms industry is well-known and well-understood. To illustrate how blockchain technology might enhance the current business paradigm, Helium serves as a prime example in the Web3 industry.

Helium Network is an important example of a Web3 protocol. Helium is a decentralized economic system and platform for the construction of wireless decentralized networks. The protocol started with an IoT network, but a 5G network is now being developed. Helium had tested a variety of other methods before settling on blockchains. This is most likely the correct approach to addressing global issues: Define the problem first, then decide how to address it (elementalcrypto.com, 2022).

Due to significant capital expenditures (CapEx) and operational expenses (OpEx), challenging logistics, and regulatory impediments, wireless network deployment has traditionally required the work of huge enterprises. Developing gear, securing properties for hosting towers and antennas, and purchasing spectrum licenses all cost a lot of money. Because a few corporations control the pricing structure and terms for the end user, the customer is extremely dissatisfied. The legacy telco model has historically been optimized to cover highly populated areas, and new networks are difficult to develop since they are frequently not economically viable. IoT networks, in particular, which require only short packets of data and do so infrequently, are unappealing to telcos (Kassab, The Telecom Cowboys of the Decentralized Wireless Movement, 2022).

According to Sami Kassab, a research analyst at Messari, the economic flywheel that enables a network to be bootstrapped without a central organization is the result of an incentive structure. By incentivizing users with rewards, a protocol can speed up the growth of a network's supply side to the point where it can be used by consumers. With this, protocols can obtain the traction they need to begin gaining traction toward adoption and competing with monopolistic telecoms. Operators are incentivized to ensure the success of a network in which they have invested by being given a financial share in return for constructing its supply side.

In case of Helium, CapEx and OpEx are crowdsourced to the network's various operators. In exchange for purchasing a hotspot machine and connecting it to your router, you will receive HNT, Helium's native token, every time a device sends and receives data through your hotspot. Because HNT is tradeable on exchanges, it has value whether measured in US dollars, Euros, Bitcoin, or HNT itself. It runs on a public spectrum, which means that anyone can use it.

There are numerous methods for rewarding infrastructure providers:

1. Proof of stake validators will check hotspot transactions, perform consensus, and add new blocks to the Helium blockchain, earning HNT incentives for contributing to the network's stability.

2. BME model: To use a BME model to access a protocol's services, the end user must burn the protocol's tradable token to obtain the proprietary payment token (credit) necessary for payment. High usage will result in a decrease in HNT token supply.

3. Device traffic: If you are in an area where sensors are transmitting data through you, the sensor operator will pay you in HNT.

Table 1 shows the benefit of building decentralized networks.

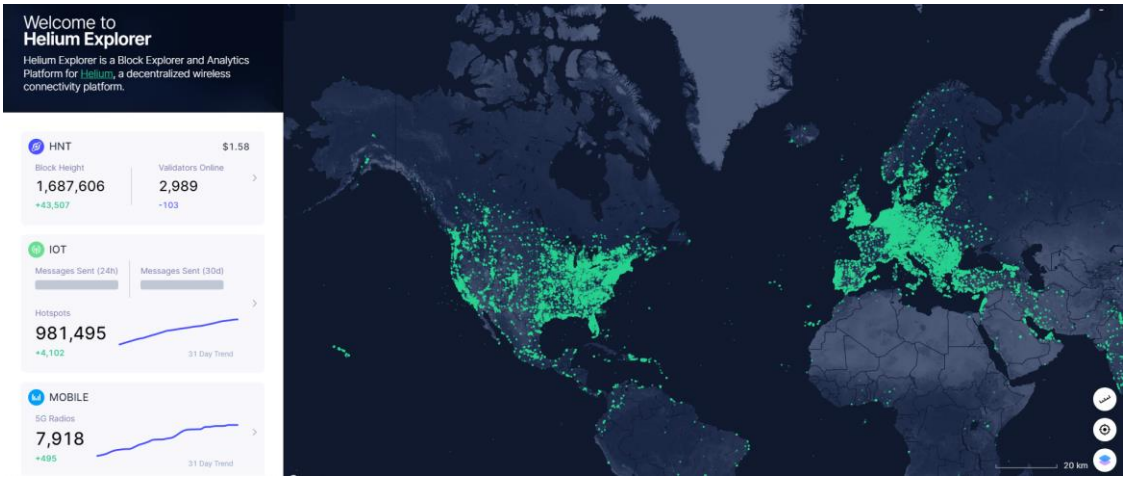
Table 1: Centralized vs. Decentralized Networks

Legacy Way of Building Networks	Decentralized Networks
CapEx Intensive: Extremely expensive proprietary equipment with vendor lock-in.	**CapEx Corwdsourced:** Token rewards incentivize individuals to deploy commoditized, off-the-shelf hardware.
Labor intensive: Operators hire techniciians to install equipment.	**Reduced Labor Cost**: Plug-and-play hardware simplifies the installation process.
H**igh Maintenance Costs**: Field technicians must maintain equipment. Many singlepoints of failure.	**Limited Maintenance**: Hardware has warranty. Networks have increased resilience through redundancy.
Expensive Real Estate: Operators lease/buy placements for hardware deployments.	**No Real Estate Cost**: Individuals deploy hardware at properties they own.
OpEx Intensive: Operators maintain massive back-end infrastructure for billing, onboarding, customer support, etc.	**Blockchain Automation:** Blockchains permissionlessly coordinate participants. Back-end is automated on-chain.
Local Natural Monopoly: High costs limit competition.	**Open access and Global Reach:** Anyone can build networks in parallel around the world.
Expensive Flat-Rates: Limits the feasibility of l.ow marginal value use cases.	**Pay-as-you-go Model:** New payment model unlocks a multi-billion-dollar market.
Fixed Coverage: Network coverage is dictated by the network operator.	**Flexible Coverage:** Individuals can solve their own coverage issues.

Source: Messari: The Telecom Cowboys of the Decentralized Wireless Movement

So far, it's safe to say that Helium Network has done well. Around the world, there are now more than 900,000 Helium hotspot devices (Exhibit 2). They work in more than 76,000 locations in 188 countries and are still growing. As part of its Ready Refresh beverage delivery service, Nestlé uses it to check how much water is in customers' water coolers. Lime uses the Helium network to find scooters that have been lost.

Exhibit 2: Helium Network Map



Source: Helium Explorer, data as of Jan 3, 2023

The Art of Web3 Infrastructure Token Incentives

As the world of Web3 infrastructure continues to evolve, it's important to understand the key role that token incentives play in driving network adoption and value capture. In order to effectively design a token incentive system, it's important to strike the right balance between incentivizing network growth and ensuring that token holders are rewarded for their participation.

One of the main challenges with using tokens as a bootstrap for network adoption is that they can sometimes encourage less valuable activity if tokens are issued for the wrong reasons. Additionally, early adopters may gain an unfair advantage over later participants, which can lead to dilution of value for other stakeholders.

Despite these challenges, token incentives remain a powerful tool for driving network growth and adoption. As more and more Web3 networks come online, it will be important to closely evaluate the different approaches being used to ensure that they are providing sufficient value to all stakeholders. This will require careful consideration of the trade-offs involved in different incentive structures, and a willingness to adapt and evolve as the market evolves.

Infrastructure Applications Methodology & Performance

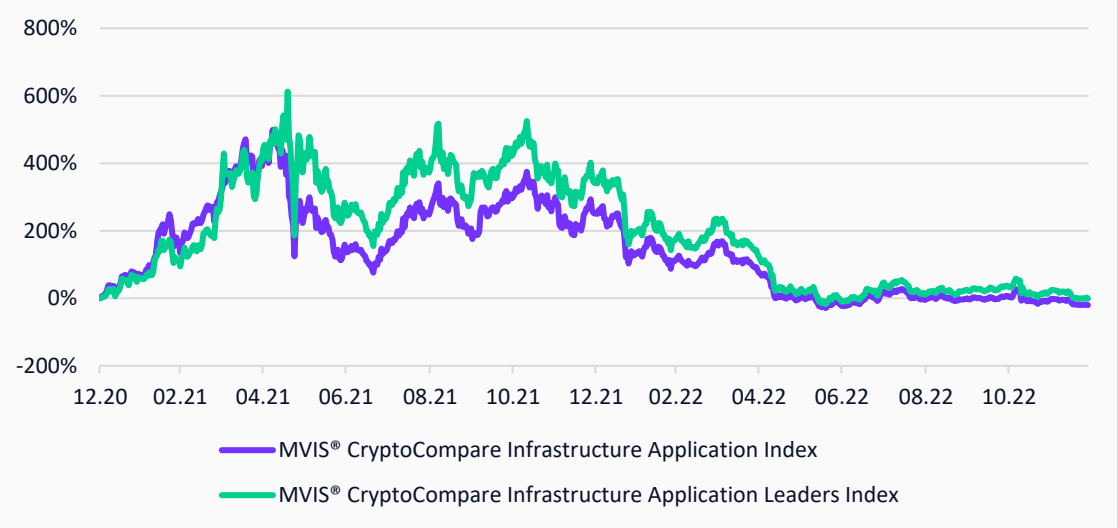
MarketVector Indexes™ ("MarketVector") categorizes Infrastructure Applications tokens in different indexes according to size and liquidity criteria. Broad indexes will capture the performance of coins with $250mn market cap and $10mn average daily transaction volume (ADTV). Leader indexes capture the performance of coins with $1bn market cap and $25mn ADTV, and introduces additional screening requiring the coins to be traded on a major US exchange and supported by a reputable crypto custodian.

To increase diversification, the leaders index has a maximum cap per token of 30%. Importantly, MarketVector places a strong emphasis on investability. The market capitalization and liquidity requirements ensure that our clients can replicate the index.

The categorization is split into 3 layers: Category, Industry Group and Industry. MarketVector differentiates platforms by their use case. For example, Infrastructure Applications is the category, Data Management an industry group and Oracle is an

industry:

Exhibit 3: Cumulative Performance of the MarketVector™ Decentralized Finance Indexes since January 2021.



	Leaders	Broad
Annualized Return	-0.34%	-7.53%
Annualized Volatility	99%	91%
MarketCap bn USD	12.57	12.57
# Constituents	5	5

Source: MarketVecto, data as of Dec 20, 2022.

In the world of digital assets, speculation can make it difficult to understand the relationship between token price and network usage. For example, in a bear market, people may use less games, metaverses, and NFTs, which can lead to less demand for storage solutions. However, as the industry evolves, it is expected that there will be a natural need for services regardless of market cycles, indicating how early we are in this space.

An extreme indicator for this bear market is the fact that the components of both the leaders and the broad index are the same. This effect is caused by the market cap and, in particular, the liquidity criteria. Because the category has fallen thus far, fewer and fewer tokens are meeting these investability criteria.

Conclusion

There has been an explosion of infrastructure protocols serving the middleware layer of the Web3 stack in recent years. They are all faced with the difficulty of matching network usage to token pricing.

Tokenomics that create intrinsic value are critical for the future of Web3. The speculation component of a token's price remains significant and is unlikely to go away completely. It is critical to remember that the existing token mechanisms of supply and demand, staking, and burning techniques are not fixed. New variations or perhaps new models are likely to emerge as developers continue to experiment.

We must be candid, critical, and focused on the token's value accrual. Finally, the goal should be for token prices to be determined by actual network utilization rather than speculation. So far, several protocols have disappointed. However, there are other promising networks that are addressing a real issue. Cloud computing and storage, in particular, are critical to the success of the entire NFT area. Identity is another key barrier that must be decentralized. Web3 protocols will never be able to fulfill their promise of inclusivity and censorship resistance without the requisite tooling.

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Contact

info@marketvector.com

Martin Leinweber, CFA

Digital Asset Product Strategist

mleinweber@marketvector.com

Martin Leinweber works as a Digital Asset Product Strategist at MarketVector Indexes™ providing thought leadership in an emerging asset class. His role encompasses product development, research and the communication with the client base of MarketVector Indexes™. Prior to joining MarketVector Indexes™, he worked as a portfolio manager for equities, fixed income and alternative investments for almost two decades. He was responsible for the management of active funds for institutional investors such as insurance companies, pension funds and sovereign wealth funds at the leading German quantitative asset manager Quoniam. Previously, he held various positions at one of Germany's largest asset managers, MEAG, the asset manager of Munich Re and ERGO. Among other things, he contributed his expertise and international experience to the establishment of a joint venture with the largest Chinese insurance company PICC in Shanghai and Beijing. Martin Leinweber is co-author of "Asset-Allokation mit Kryptoassets. Das Handbuch "(Wiley Finance, 2021). It's the first handbook about integrating digital assets into traditional portfolios. He has a Master in Economics from the University of Hohenheim and is a CFA Charter holder.

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