



## Polygon: Ethereum’s Internet of Blockchains

### Introduction to Polygon (MATIC)

Originally founded in 2017 by Sandeep Nailwal, Jaynti Kanani, Anurag Arjun and Mihailo Bjelic as the Matic Network, MATIC started as a Layer 2 (L2) scaling solution which aims to solve some of the major challenges which Ethereum faces, such as high gas fees, low transaction throughputs and poor user experience using a Plasma framework and a decentralized network of Proof-of-Stake (PoS) validators.

In February 2021, the Matic network rebranded to become Polygon which saw the project transition from being a simple L2 scaling solution for Ethereum to becoming an interoperable protocol and framework for building and connecting Ethereum-compatible blockchain networks. To understand why a scaling solution such as Polygon is required, it would serve us well to first understand the existing problem which Polygon is seeking to solve.

### Blockchain Trilemma

Coined by Vitalik Buterin, the Blockchain Trilemma refers to the challenge which many blockchain projects face of improving scalability without sacrificing security and decentralization. Often, many blockchain projects must make tradeoffs between these 3 aspects of being scalable, secure and decentralized and is a longstanding issue which has prevented the widespread adoption of blockchain technology.

Using Bitcoin as an example, the Bitcoin blockchain has been around for 12 years and is presumably the most secure blockchain network in the world. This is due to the level of decentralization requiring many miners around the world to validate transactions and secure the network, yet the resulting tradeoff is the low throughput of around 7 transactions per second. In comparison, Enterprise blockchains such as the Hyperledger Fabric by IBM are more scalable and secure yet are extremely centralized with only a few consensus achieving nodes which allows the blockchain to control the blockchain, network participants and data in it.

Polygon seeks to solve this trilemma by leveraging the Ethereum network for security while solving the issue of scalability and decentralization using their PoS sidechains and “Security as a Service”. This will also be elaborated more in the later part of this paper as we explore more about how Polygon does this through their network architecture.

### Ethereum Scalability Problem

With Ethereum gaining popularity resulting in an increasing user base and high transaction volume, users face issues such as high gas fees (which could range anywhere from \$9 to \$30 per transaction during peak periods) and low throughput of about 15-20 transactions per second. This is due to how the Ethereum network

functions, requiring its miners to validate every transaction in order to secure the network, ultimately restricting the network and leading to massive congestion on the network.

This is a huge problem for Ethereum especially when competing and attempting to disrupt current businesses such as Visa which can process up to 1,700 transactions per second. These issues act as massive hurdles in Ethereum’s race towards mass adoption and where Ethereum is plagued by such woes, Polygon sees them as opportunities to improve and challenges which can be solved by using Polygon as a solution.

### Polygon’s Solution

Polygon seeks to solve these issues relating to Ethereum and Blockchain in general, using their scaling solution and become a one-stop solution for interoperability and scalability in the blockchain space. As a scalability solution, one might expect Polygon to sacrifice security in order to achieve greater transaction throughput and decentralization (as per the blockchain trilemma). However, the project circumvents this by leveraging on the security of Ethereum’s main net and the Ethereum miners who secure the blockchain. Polygon also has its own set of validators running its PoS chain which provides security as well for the projects who do not wish to leverage on the Ethereum network. An interesting thing to note is that this security is optional and does not limit anyone who does not wish to utilize the security features such as projects or entities which would like to run their own chain on the Polygon Network.

### Polygon’s Architecture

At the heart of Polygon’s popularity and burgeoning interest is its architecture. However, prior to addressing the crux of Polygon, we must understand its usage. As a precursor to the discussion, Polygon can support two types of Ethereum compatible networks, the stand-alone networks and secured chain networks. These networks are largely unrestricted, and therefore, they offer the highest amount of independence and flexibility. However, the trade-off to this is that these networks sacrifice on security, making it more difficult for them to establish a reliable security model. For example, the PoS framework requires a high number of reliable validators, and this kind of model is usually suitable for enterprise blockchains and already established projects with strong communities. This means that projects that are just starting out or do not have the required structures and frameworks will not be feasible. On the other hand, secured chains utilize “security as a service”. Security as a service is a business model whereby the provider can integrate their security solutions into the user’s database or framework at a much cheaper cost. In most cases, providers are able to tap on economies of scale or certain technologies to make this business model viable. However, in this case, the security is either provided directly by Ethereum, or by professional validators. These validators are run in the Polygon ecosystem, and they can be shared by multiple projects. These chains offer the highest level of security, but they are less flexible and independent. This model is

more suited for startups and security-focused projects. One example of a security-focused project that utilizes this service would be Neon District, which taps on the security to ensure that asset ownership is not compromised.

With the ecosystem of polygon established, there is a need to now understand the architecture behind Polygon. In Polygon, there are 4 abstract and composable layers<sup>1</sup>. The first is the Ethereum layer, followed by the security layer, the Polygon networks layer and finally the execution layer. The Ethereum layer is implemented as a set of smart contracts on Ethereum and can be used for things like finality and checkpointing, staking, dispute resolution and messaging between Ethereum and Polygon chains. The security layer is a layer that proves “validators as a service” function. This means that it allows polygon chains to make use of a set of validators that can periodically check the validity of any Polygon chain in return for a fee. The Polygon Networks Layer consists of sovereign blockchain networks where each network can maintain the following functions: transaction collation, local consensus and block production. The execution layer on the other hand is responsible for interpreting and executing transactions that are included in Polygon’s chains. It consists of the execution environment and logic sublayers. The Ethereum layer and the security layer are not compulsory and only the polygon networks layer and the execution layer are compulsory. This means that certain projects can calibrate the level of security and freedom that they need. Put simply, Polygon enables teams to hand pick and calibrate their projects such that it is custom fitted for their use. This unique architecture also allows for multiple different polygon-based scaling solutions to communicate with each other. This is important as it prevents creating siloed systems.

### Polygon Adoption

On February 27, 2021, Polygon announced that the Chainlink would be integrating their Verifiable Random Function (VRF) feature into their ecosystem. This was a great step for the network and for Dapps developers working on NFTs based gaming projects.

This partnership with Chainlink would also eventually pave the way for another significant event for Polygon which was the launch of Aavegotchi on the Polygon Network<sup>2</sup>. This was a significant decision and a big win for Polygon as it showed the adoption of the network and how developers and projects recognized the benefits of using Polygon instead of launching and running the project on Ethereum. Besides Aavegotchi, the Atari Group also announced shortly after that they would be partnering with as well to bring NFTs and their Token Products to the network. The Atari Group is one of the world’s most iconic consumer brands and interactive entertainment producers and the partnership further demonstrated the confidence and belief placed in the Polygon network<sup>3</sup>.

Polygon is also actively involved in the Decentralized Finance Space. One of the first few

major players to shift to the Polygon Network is Aave, the current largest decentralized finance lending platform (According to defipulse.com). This shift as announced by the Aave team was due to the high network fees on Ethereum and congestion faced on the network due to the increasingly high number of users and transactions<sup>4</sup>.

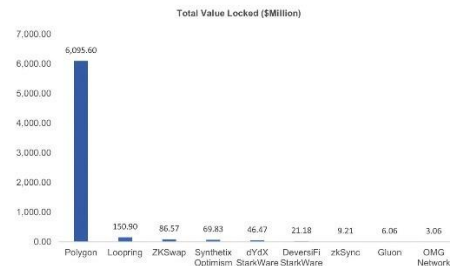
What is interesting to note is that according to a report by Dappradar<sup>5</sup>, the Polygon platform versions of projects who have shifted from Ethereum to Polygon such as Aave and Sushiswap have exceeded their Ethereum counterparts in terms of transaction numbers and volume. However, while transactions recorded were higher on the Polygon network, the volume transacted on Ethereum still continues to be significantly higher which could mean that larger players still prefer to use Ethereum instead of Polygon.

Besides Aave, other notable projects on the Polygon network include Decentralized Exchanges (DEXs) such as Sushiswap, Quickswap, Balancer and Curve Finance. By using Polygon instead of Ethereum, these DEX users will be able to transact with significantly lower gas fees and faster confirmation time which is crucial especially in the volatile cryptocurrency space.

On May 29, 2021, Polygon also announced a major partnership with Google Cloud's BigQuery as part of Google's effort to make cryptocurrency data available. This is significant for Polygon as the partnership provides greater transparency of on chain activities and allows users to track and analyze real time on chain data such as the number of monthly active addresses on the Polygon Blockchain. Polygon has also gained institutional interest in the likes of Mark Cuban, billionaire investor and shark tank who has openly confirmed that he has invested in the project and is looking to integrate it with his Lazy.com NFT platform. While the sum invested remains undisclosed, the investment itself signals confidence in the project and is a promising sign for the future of Polygon as the project continues to develop and gain traction.

At the time of writing, Polygon currently has 450+ Dapps running on its platform, 455M transactions processed and 20.5M unique addresses which is a significant increase to the network from the start of the year where it only had 5M transactions and 127,048 unique addresses. The number of Dapps and partnerships that Polygon has announced has also been consistently increasing and is a good indication that Polygon will truly be able to achieve their vision of being an unconstrained interoperable ecosystem of Dapps.

## Polygon's Competitors on Ethereum

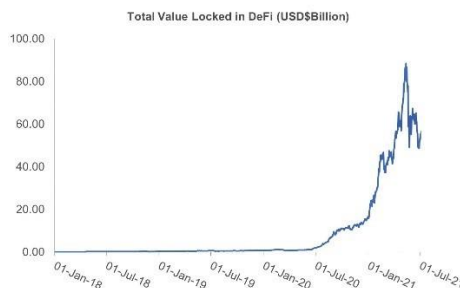


Source: The Block Research<sup>6</sup>, 2021

Polygon is currently the most popular scaling solution on Ethereum, with its Total Value Locked (TVL) far exceeding its competitors. Recently, in May 2021, Polygon's TVL had increased by 1,102%<sup>7</sup>. Its huge growth can be attributed to famous investor, Mark Cuban's recent investment in it, which generated a huge buzz around it, and the migration of many existing Dapps from Ethereum to Polygon. Unlike other layer 2 scaling projects which provide only one or two scaling solutions, Polygon intends to incorporate multiple scaling solutions and some upcoming solutions in the midst of development include the optimistic rollups and ZK-rollups, which will allow developers to choose and customize their scaling and features that are most suitable for their respective needs.

## Opportunities: Potential growth in decentralized finance space

Over the past few years, the DeFi space has grown rapidly. In 2020, there was a massive growth of as much as 20 times in the Total Value Locked (TVL) in the DeFi space. Furthermore, TVL in DeFi has already more than tripled in the first half of 2021. At the time of writing, TVL in DeFi stands at \$53,746B. With big companies like Facebook and PayPal Holdings<sup>8</sup> entering the DeFi space, it is expected that more companies will follow suit in the coming years. As the DeFi space continues to expand, Polygon stands to benefit as scaling demand is expected to increase as well.



Source: DeFi Pulse<sup>9</sup>, 2021

## Opportunities: Decentralized applications in gaming and betting

Currently, games on Polygon have seen a tremendous growth in the number of users due to the low transaction fees. However, with Polygon's newly launched Chainlink Verifiable Random Function (VRF) technology, it is expected that more decentralized apps (Dapps) in gaming and betting will be turning to Polygon. Chainlink VRF provides a secure and verifiable

source of on-chain randomness that cannot be manipulated by any user. A random number will always be generated along with a cryptographic proof of how the number was generated through the VRF process, thus users can be assured that the random outcome generated is tamper-proof. The Chainlink VRF allows blockchain gaming applications to introduce an element of fun and surprise to users as random and unpredictable outcomes can be generated. Furthermore, Dapps in betting can also ensure that random winners can be selected without any bias. With many gaming and betting platforms gaining prominence quickly, it is expected that more applications will embrace the use of Polygon.

## Threats: Ethereum 2.0

The upcoming upgrade of Ethereum 1.0 to Ethereum 2.0 (ETH 2.0) is estimated to complete by the end of 2022. ETH 2.0 will solve Ethereum's scalability issues by switching to the Proof-of-Stake consensus mechanism and employing the use of shard chains.

Sharding is the process of breaking down large databases into smaller portions called "shards". Ethereum intends to spread the network's load horizontally by splitting the current single blockchain into 64 new shard chains running in parallel. Hence, it is set to be 64 times more scalable than the current Ethereum. The current Ethereum blockchain requires all data to be verified by every node in the entire blockchain. However, with sharding, data only needs to be verified by the shard that validators are validating, which only consists of a small group of nodes, instead of the entire network. This means that the new Ethereum will be able to process transactions at a faster rate, thus increasing the number of transactions it can process per second (TPS).

The imminent arrival of ETH 2.0 may reduce the need for Polygon and other layer 2 solutions. However, Polygon's co-founder, Sandeep Nailwal, is confident that layer 2 scalability solutions will not become obsolete even with the release of ETH 2.0 as he expects the increase in demand from Ethereum's upgrade to surpass the expansion of the network, which is expected to cause bottlenecks to emerge again<sup>10</sup>.

## Future of Polygon

As Ethereum's scalability issues worsen, Polygon has undoubtedly attracted much media attention as Ethereum's top scalability solution. Its provision of multiple scaling solution has allowed it to establish an extensive ecosystem as it is able to cater to the needs of many different developers. However, with the entry of many up-and-coming scalability solution providers and Ethereum 2.0, it is expected to face even fiercer competition in time to come. While only time can tell how Polygon would fare in the future, the project seems promising at the present with the network overtaking Ethereum and Binance Smart Chain in transaction numbers and adoption rates.

Contact: Leonard Tan, Research Director  
leonard.tan.2020@business.smu.edu.sg

This publication contains material prepared by SMU FinTech and is sole for SMU FinTech's information and internal research purposes. It may not be published, circulated, reproduced or distributed in whole or in part without SMU FinTech's written consent. Whilst we have taken all reasonable care to ensure that the information contained in this publication is not untrue or misleading at the time of publication, we cannot guarantee its accuracy or completeness, and you should not act on it without first independently verifying its contents. Opinions expressed are current opinions as of the original publication date appearing on this material only and the information, including the opinions contained herein, are subject to change without notice. SMU FinTech is under no duty to update this Publication.

Sources:

- <sup>1</sup>Jakub. (2021, March 14). Polygon (MATIC) - Ethereum's Internet of Blockchains. *Finematics*. <https://finematics.com/polygon-matic-explained/>
- <sup>2</sup>Aavegotchi. (2021, February 16). Why Aavegotchi Chose Polygon. *Medium*. <https://aavegotchi.medium.com/why-aavegotchi-chose-polygon-356238977fb2>.
- <sup>3</sup>Polygon. (2021, February 26). Gaming Giant Atari Partners With Polygon to bring their NFT and Token Products to Layer 2. *Medium*. <https://polygontech.medium.com/gaming-giant-atari-partners-with-polygon-to-bring-their-nft-and-token-products-to-layer-2-cec4dff71588>.
- <sup>4</sup>Allison, I. (2021, March 31). DeFi Major Aave Working With Polygon to Bypass Ethereum Congestion. *CoinDesk*. <https://www.coindesk.com/defi-major-aave-working-with-polygon-to-bypass-ethereum-congestion>.
- <sup>5</sup>Yordanova, H. (2021, June 10). Polygon DeFi Platforms Surpass Ethereum Versions. *DappRadar*. <https://dappradar.com/blog/polygon-defi-platforms-surpass-ethereum-versions>
- <sup>6</sup>The Block Research. (2021, 8 July). Scaling Solutions Overview. *The Block Research*. <https://www.theblockcrypto.com/data/scaling-solutions/scaling-overview>
- <sup>7</sup>Njui, J., P. (2021, June 5). Total Value Locked on Polygon (MATIC) Grew by 1,102% in May 2021. *Ethereum World News*. <https://en.ethereumworldnews.com/total-value-locked-on-polygon-matic-grew-by-1102-in-may-2021/>
- <sup>8</sup>BTC Peers. (2021, January 18). What's in Store for DeFi in 2021? - The Analysis and Predictions. *Benzinga*. <https://www.benzinga.com/markets/cryptocurrency/21/01/19202556/whats-in-store-for-defi-in-2021-the-analysis-and-predictions>
- <sup>9</sup>DeFi Pulse. (2021, July 7). Total Value Locked (USD) in DeFi. *DeFi Pulse*. <https://defipulse.com/>
- <sup>10</sup>Kuhn, D. (2021, April 28). Polygon's Ethereum Scaling Project Is Never Complete: Sandeep Nailwal. *CoinDesk*. <https://www.coindesk.com/polygons-ethereum-scaling-sandeep-nailwal>