PitchBook

Key Factors for Ethereum

Analysis of Ethereum's long-term potential

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Important Disclosure

The analyst primarily responsible for this note has a financial interest in the sector and is an investor in Ethereum (Ticker: ETH) through his/her personal trading account. The analyst's investment has been made as a long-term buy-and-hold strategy.

Introduction

This analyst note will serve as an example as to how we will utilize PitchBook's Crypto Asset Frameworks to analyze blockchain protocols that we believe will have a significant effect on the current investment industry.

Ethereum is a platform that facilitates the establishment and execution of smart contracts between any number of parties. In its simplest form, a smart contract can be thought of as a digital agreement that states "if X happens, then do Y," and is bound by the network once initiated. This simple agreement can be expanded into more complex, multi-layered contracts that are combined to form an application. As such, we view Ethereum as a cloud computing platform that allows for the creation of decentralized applications (dapps)—essentially an Amazon Web Services for the decentralized internet.

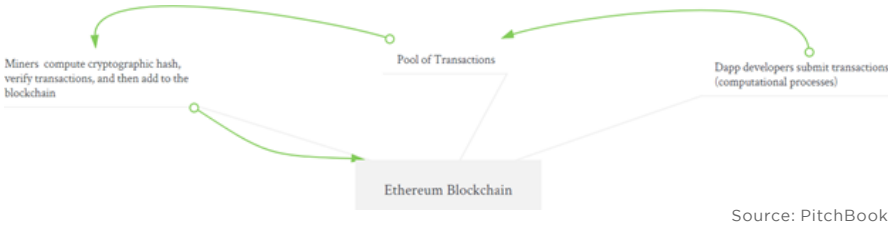
Contents

Incentive Structure

Network Participants

- **Miners**
  - Miners act as independent servers for the Ethereum network. Each miner holds a copy of the blockchain and verifies transactions for the network through a consensus process called Proof-of-Work (PoW).
- **End-users**
  - Decentralized application (dapp) developers use Ethereum's platform to build software programs (smart contracts) for a variety of use cases. The Ethereum protocol provides developers a platform to build dapps without having to worry about the immense technical and security challenges of establishing their own blockchain.
- **Protocol Developers**
  - Major developments are led by the Ethereum Foundation and associated founding developers; however, there are many outside developers who contribute to the improvement of the network due to financial interests as token holders.

Interaction



Source: PitchBook

Economics

According to the medium of exchange theory (MoE, wherein m=pq/v)[1], there must be a high cost and consumption of resources (p*q) combined with a low velocity for a token to accrue value without speculation. If velocity increases or the cost to facilitate the network decreases, then the value of the token decreases. Ethereum's structure makes determining how these variables work more difficult because the development team implemented a system that decoupled the price of Ether from the cost of the service, leaving price determination to market forces. As such, each transaction has a fixed cost for the type of computation required, referred to as "gas." While this gas cost is fixed, the amount of Ether paid for the gas is determined as participants on the network negotiate how much Ether to pay or accept for services.

1: Where m= network value, p= cost of computing resources, q= the quantity of computing resources consumed, and v= velocity of the token

Beyond the reality that no one really knows how this new decentralization paradigm will develop over the next five to 10 years, the decoupling mechanism makes predicting where token value will accrue even more difficult. While we don't purport to have a crystal ball, we will examine the implications for each variable and assess where value is likely to accrue if the protocol grows in usage.

Cost of Computing Resources (p): Proof-of-Work (PoW) consensus mechanisms require enormous amounts of energy, with Bitcoin and Ethereum blockchains now consuming nearly as much energy as a small country. However, Ethereum is in the early stages of implementing the Casper protocol, which will transition the Ethereum consensus mechanism from a PoW protocol to proof-of-stake (PoS), dramatically reducing the cost of maintaining the network. Since PoS removes the computation-heavy process of PoW, the cost of maintaining the network becomes the minimal computing costs associated with running the software plus the opportunity cost of depositing large sums of Ether to act as a miner once PoS is fully implemented.

Quantity of Computing Resources Consumed (q): The number of transactions will increase exponentially as more applications begin to build on Ethereum due to the high number of computational processes each dapp will require. Additionally, as the cost to maintain the network decreases, the price to send transactions should see a corresponding decrease as the verification process is no longer costly to miners on the network, further incentivizing developers to build more complex applications on the platform.

Velocity (v): Velocity is the most difficult variable to predict. Since we view Ethereum as a computing platform, we expect to see much higher velocity than would be found in a traditional fiat currency due to the high turnover associated with running applications. At an extreme, this would create downward pressure on Ethereum token value as developers would only purchase Ethereum tokens as needed for running their applications. However, the PoS protocol requires a significant quantity of Ether to be deposited by miners to act as a validator. In addition, the computational purchasing power of a single Ethereum token is likely to grow exponentially as the implementation of PoS decreases the cost of maintaining the network, thereby allowing nodes to accept smaller transaction fees.

We are not entirely convinced the MoE theory is an appropriate representation of new and young digital economies like Ethereum, so it is possible value accumulation will be driven by different factors. However, we do believe the nature of the Ethereum economy will lead to miners capturing a much greater portion of value than token holders. This is likely driven by the shift to PoS, which dramatically lowers the cost to maintain the network, as well as leads to greater token velocity when a growing number of dapps pay more transaction fees associated with computational processes on the network.

Protocol Security

Consensus Mechanism:

Ethereum currently runs on a PoW consensus mechanism utilizing the Ethash algorithm. However, the Casper protocol is currently in testing and will introduce a hybrid PoW/PoS system to the protocol with an end result of a complete PoS-based protocol. The protocol allows for pseudonymous privacy but not complete anonymity due to the ability to track activity across addresses.

Governance:

There is no governance structure built into the Ethereum protocol and, therefore, decisions regarding the future development of the Ethereum ecosystem are left entirely with individual nodes. This lack of structure can lead to what are called "forks," where a group of miners and supporting developers split from the old blockchain by incorporating, or not incorporating, software updates. In the case of Ethereum, this has resulted in several forks that have pulled participants and capital from the Ethereum network to other competitors. The Ethereum network has few offshoots that have become legitimate contenders in the way we have seen with some Bitcoin hard forks (e.g. Bitcoin Cash, Bitcoin Gold, etc.).

Token Distribution

Classification: Utility Token

Purpose: Ether serves as the medium of exchange for dapp developers (i.e., end-users who pay for the computational power used by their applications). Conversely, Ether acts as the financial incentive for miners to uphold the network because miners earn newly minted tokens and transaction fees for every group of transactions they verify and add to the blockchain.

Distribution

Supply Created During Presale: 72,000,000

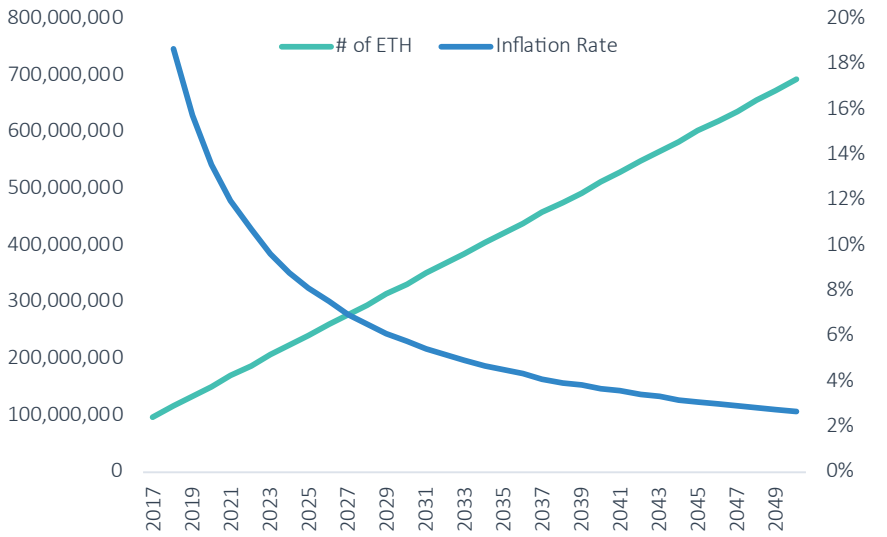
Current Supply: 97,782,705 ETH*

Inflation Schedule: Capped at a maximum of 18 million new Ether per year.

Note: The economic model is likely to change with the implementation of Ethereum's PoS model known as the Casper protocol. There is limited information regarding the new inflation schedule other than the development team ensuring the current 18 million caps per year will remain the ceiling for any future inflation.

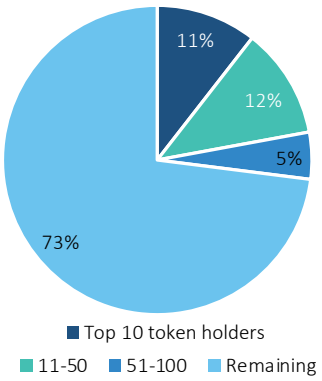
Source: Etherscan.io
*As of 2/25/2018

Ether supply & inflation schedule



Source: PitchBook, Etherscan.io
*As of 1/3/2018

Ethereum wealth distribution



Source: Etherscan
*As of 3/5/2018

Token Holder Concentration

Given the pseudonymous nature of blockchain interactions, it is difficult to determine wealth concentration with pinpoint accuracy. For instance, we took a snapshot of Ethereum account balances on March 5, 2018 and filtered out contract accounts (dapps/smart contracts) and account addresses identified as exchanges or protocols by Etherscan to arrive at the wealth distribution depicted to the left. However, there are several impediments to achieving greater accuracy as not all exchanges identify their account addresses and there is no way to link multiple accounts to a single user without sophisticated time series data mapping connections between accounts over time. Even if we remove 25 random accounts from the top 100 wealthiest accounts that could represent additional exchanges and protocols that cannot be directly identified, a very small number of individual accounts control a substantial percentage of tokens.

This provides the biggest single risk to the success of the Ethereum blockchain as there are essentially no legal barriers to prevent early investors and developers from dumping massive amounts of ETH tokens and recognizing exponential gains if they realize the project is dead in the water before the rest of the market. Without sufficient liquidity, which does not exist yet, any type of massive selloff by some of the largest token holders would plummet the price of Ether. A massive selloff that was sustained over a long period of time would keep prices depressed, forcing token holders, developers and miners to move to more profitable protocols with less concentrated wealth structures.

Market Opportunity

Total Addressable Market

A common valuation technique among early-stage companies is to look at the total addressable market (TAM) and extrapolate potential value creation based on current comparable business models. While the Ethereum Virtual Machine (EVM) is a decentralized open-source network and not a business, the closest existing market is infrastructure-as-a-service (IaaS), a subset of cloud computing. This bucket includes cloud providers like AWS, Microsoft Azure, and Google Cloud, all of which provide Turing-complete virtual machines. The EVM is sometimes referred to as a "world computer" because while it allows developers to create a broad range of applications, the Ethereum database is hosted by a massive number of nodes around the world.

We admit that this comparison is imperfect. Ethereum is not designed to be efficient since it relies on massive parallelization across many nodes. While it is currently more expensive to execute code with the EVM compared to other cloud services, Ethereum (with planned scalability upgrades) provides greater advantages for specific functions than its centralized competitors due to its immutability, redundancy and increased transparency. In spite of these advantages, in the short-to-medium term it remains a certainty that Ethereum will remain a minority of IaaS usage given the legacy systems built on top of low-cost centralized cloud providers.

We utilize projected revenue streams for IaaS services, which includes both cloud storage services like AWS and Google Cloud, because of EVM's many functions including data storage, DNS service or unit of account. The year of comparison is 2021, much further out than the investment horizon of many crypto asset investors, but the longest publicly available projection.

We utilize annual transaction fees in USD terms as a proxy for the aggregate annual revenue of centralized competitors. Transaction fees on the Ethereum network increased considerably during 4Q and into early 2018, with YTD figures annualizing to $536 million. The latest projection for annual global IaaS revenue came out to $40.2 billion per Gartner Cloud Forecast, which would equate to a market penetration of 1.3% for Ethereum. Conservatively, if Ethereum retains a constant market penetration (and the IaaS industry grows as projected by Gartner), transaction fees would total $1.1 billion in 2021. An increase to 5% market penetration by 2021, as Gartner forecasts, would represent $4.1 billion in annual spend. If the popularity of applications on the Ethereum blockchain leads to growth greatly outpacing centralized cloud revenue, market penetration of 10% by 2021 would represent $8.3 billion, while 20% penetration would come out to $16.5 billion.

Global IaaS revenue, constant ($B, post-2017 forecasted)

2016	$21.9
2017	$29.8
2018	$40.2
2019	$52.2
2020	$66.6
2021	$82.5

Source: Gartner 4Q 2017 Cloud Forecast

Ethereum's projected revenues as % of annual IaaS revenues ($M)

ETH market share	2018	2021
0.10%	**$40.2**	$82.5
0.50%	**$201.0**	$412.6
1.00%	**$402.1**	$825.3
1.33%*	**$534.8**	$1,097.6
2.00%	**$804.2**	$1,650.5
5.00%	**$2,010.5**	$4,126.3
10.00%	**$4,020.9**	$8,252.6
15.00%	**$6,031.4**	$12,378.9
20.00%	**$8,041.9**	$16,505.2

Source: PitchBook, Gartner 4Q 2017 Cloud Forecast, Etherscan.io, *denotes current

Competitive Advantages Over Centralized Business Models

Decentralized cloud computing platforms are extremely nascent, making it difficult to draw a direct comparison between established centralized platforms. But in general, the Ethereum protocol provides three major benefits over centralized competitors:

Immutability

The blockchain holds an immutable record of the entire history of the Ethereum blockchain, making it nearly impossible to alter or manipulate processes in the way that is possible on centralized competitors.

Redundancy

Each node verifies and maintains a copy of the blockchain, resulting in over 17,000[2] independent servers rather than several centralized servers that provide a single point of attack for malevolent actors. This feature also results in a platform with 100% up-time, regardless of outside factors including geopolitical pressures. While it may be difficult to imagine the US government issuing a cease-and-desist order to force Amazon Web Services to stop hosting a business's software, there are many areas around the globe where companies face that type of threat every day. The decentralized nature prevents even the most extreme possibilities from affecting the application.

Increased Transparency

The Ethereum blockchain is a public record and all transactions dating back to the inception date can be traced and verified, making any type of digital auditing significantly less complex and more transparent.

Centralized competitors

	Market share (%)
AWS	**34%**
Azure	**14%**
IBM	**8%**
Google	**6%**
Alibaba	**4%**
Next 10	**14%**
Others	**20%**

Source: Synergy Research Group

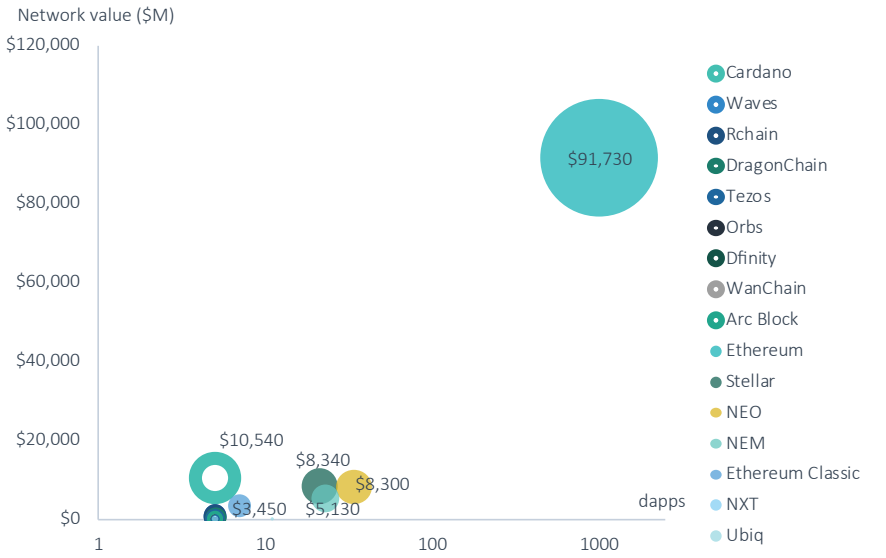
Competitive Advantages Over Other Decentralized Platforms

Ethereum's biggest competitive advantage over other decentralized computing platforms is the enormous ecosystem built around the Ethereum network over the last three years, which continues to grow daily. Ethereum now boasts over 1,000 decentralized applications being developed on the platform and has an array of supportive real-world companies, including institutionally backed mining companies, startups and investment firms solely focused on developing the Ethereum ecosystem. Furthermore, Ethereum's dominating market position is strengthened by compatibility development efforts by multiple global corporations, including J.P. Morgan's private blockchain Quorum.

This translates into thousands of individuals, businesses, and investors that are financially and emotionally committed to the success of the platform. While first-mover advantage is never enough to maintain a dominant position in a market, especially in such a young technology with a myriad of technical issues to overcome, the Ethereum blockchain creates a steep hill for new competitors to climb.

2: www.ethernodes.org/network/1, as of March 16, 2018

Smart contract platforms



Source: Coinmarketcap.com
Note: Bubbles depict relative value of network, with closed representing functional protocols, open nonfunctional protocols.

Plan to Differentiate

Ethereum was the first smart contract protocol and remains the most high-profile decentralized platform in the crypto asset landscape. Despite this leg up, newer protocols launching now are quickly establishing themselves as a force within the landscape. As such, the Ethereum team's plan to differentiate is solely predicated on driving the technology forward since they already have the name recognition and equivalent of brand identity.

Budget Capacity & Restraints

Ethereum's dominant position and first-mover status in the distributed cloud-computing vertical provide plenty of headway as rival platforms compete for projects. The early development team also has plenty of capital to continue work on the project, as Ether is up roughly 42,000% since 2016.

Founding Team & Development

Key Technical Hurdles

The major technical difficulty Ethereum must overcome is scalability, given the blockchain's ability to only process 10-20 transactions per second. This pales in comparison to the 1000s-per-second capability of centralized services and is largely a result of the way the consensus mechanism works. Every single node on the network must verify each transaction, which creates bottlenecks as the number of transactions and nodes grows.

Ethereum founding team

Developer	Vitalik Buterin	Dr. Gavin Wood	Jeffrey Wilcke	Mihai Alisie	Joseph Lubin
Role	**Created and developed Ethereum**	**Wrote Ethereum technical paper**	**Co-founder, lead developer**	**Co-founder**	**Established Ethereum Foundation**
Previous Experience	**Co-founded Bitcoin Magazine**	**Director of Technology—Oxlegal**	**Developer**	**Co-founded Bitcoin Magazine**	**CEO—SyNerG Music**
	Developer for Bitcoin	**Technical Director—Lancaster Logic Response**			**Director—Blacksmith Tech.**
Education/ Accomplishments	**Thiel Fellowship Award, World Technology Award**	**PhD, Computer Visualization**		**Economy, Informatics and Statisitcs**	**Electrical Engineering & CS**
Institution	**University of Waterloo**	**University of York**	**HKU**	**Universitatea Lucian Blaga din Sibiu**	**Princeton University**

Ethereum development history

Date	Development
1/24/2014	**Ethereum is formally announced**
4/1/2014	**Ethereum Techincal Paper is released**
6/1/2014	**Ethereum Foundation is formed in Switzerland**
9/10/2014	**Ethereum conducts $15M ICO**
11/24/2014	**Majority of development team gathers for the first time**
7/30/2015	**Ethereum beta launches**
9/7/2015	**1st update to the protocol**
3/14/2016	**Full release of the protocol**
7/20/2016	**Hard fork reversing the DAO hacking**
10/18/2016	**Hard fork to end DoS attacks on network**
11/22/2016	**Hard fork to further protect against DoS attacks**
10/16/2017	**Hard fork to update protocol**

Development Roadmap

To address the scalability issue, Ethereum developers are taking two approaches. The first is called sharding, which is essentially splitting the blockchain into separate sub-parts—aka shards—so every single node on the network does not need to verify every single transaction. The second is adding additional layers on top of the blockchain that route transactions off-chain, then are only recorded on the Ethereum blockchain as participants enter or exit out of the second layer.

Sharding

In development and nearing implementation on Ethereum's test network.

2-layer Systems

In development on Ethereum's test network.

Legal & Regulatory Concerns

The legal entity that represents the interests of Ethereum is formed as a foundation domiciled in Zug, Switzerland. Due to Switzerland's friendly regulatory environment towards crypto assets and a decentralized group of developers, nodes and participants, we view the legal concerns surrounding the Ethereum blockchain to be low.

The Ethereum token is also traded on at least 69 exchanges, including 26 that allow for fiat-to-ETH conversions. The geographic dispersion of exchanges and 12-month daily trading volume averaging $1.4 billion further erode the legal concerns surrounding the growth of the Ethereum ecosystem. For an individual investor, the regulatory regimes vary between jurisdictions with many governments taking a wait and see approach. Even as the SEC and other regulatory regimes refine their policies, we view a heavy-handed approach to be unlikely for several reasons:

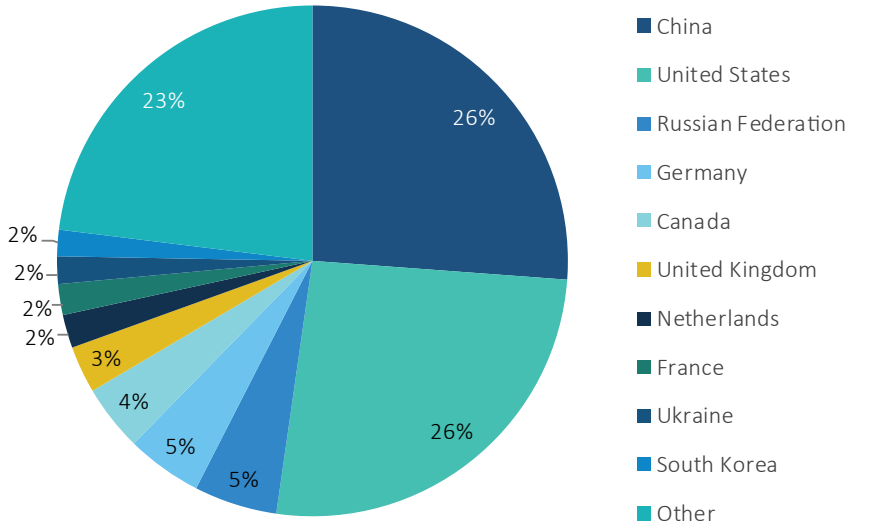
• The decentralized nature of the assets makes policing extremely difficult and, more importantly, doing so risks the innovative aspects of the blockchain technology shifting towards other countries with favorable approaches.

• Most regulatory regimes are concerned with protecting Main Street investors, and crypto assets are the rare, if only, asset class where individual investors were followed by institutions. Outside of harsh crackdowns on token organizers skirting legal requirements or committing fraud, regulatory regimes that take an overly broad and strict approach to crypto assets will cause financial harm for millions of Main Street investors, which are the group of people the regulatory bodies were created to protect.

• Many promises of tokenization may fall flat or fail to come to fruition but one thing is sure: Tokenization can enhance transparency for regulators, as well as greater control of assets for investors, which reduces costs associated with complex auditing and storage.

It is certainly possible the US government will decide to take a hardline approach to crypto assets; we view the above reasons as strong incentives to mitigate the risk of such an approach and therefore assign a low probability of this scenario actually coming to fruition.

Geographic dispersion of exchanges (excluding exchanges with fiat pairs)



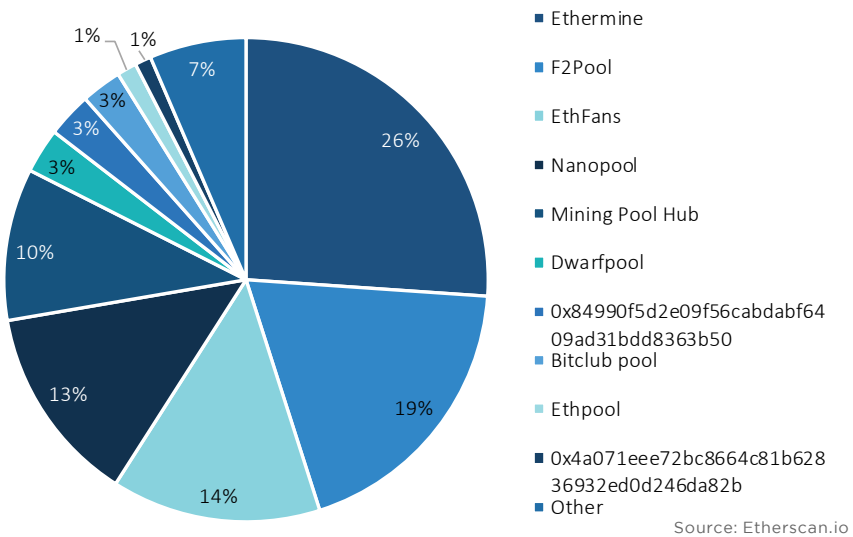
Source: Coinmarketcap.com

Network Ecosystem

Nodes

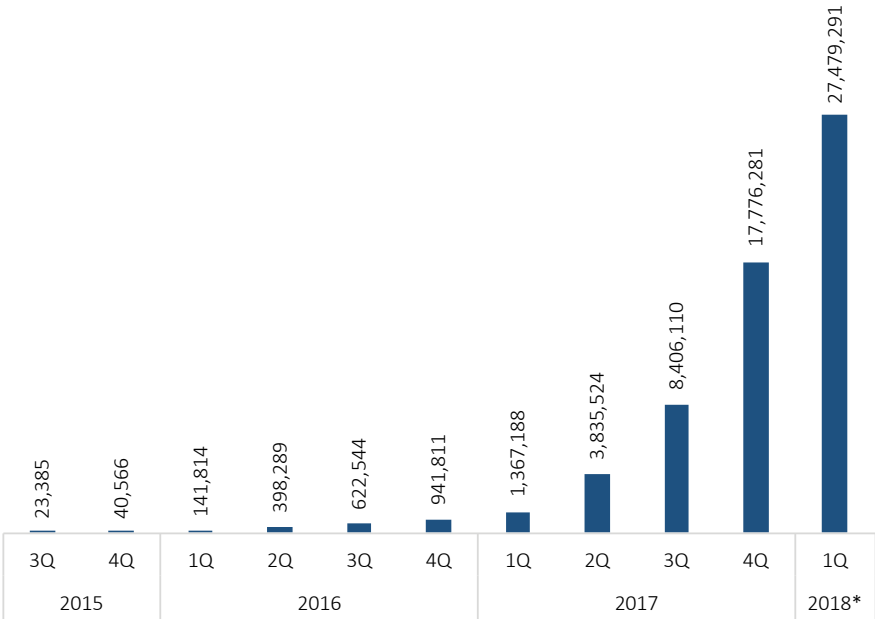
Ethereum's mining infrastructure is fairly dispersed on a geographic basis and is at limited risk of regulatory harm, unless the US, China, and Russia all simultaneously agreed on the same negative policy towards cryptos. We consider this scenario highly unlikely given the current geopolitical environment and the relatively low importance of crypto assets compared to other more pressing political concerns. While any one of these nations taking a hardline approach to crypto assets will have a significant impact on the short-to-medium term price, we believe the blockchain itself will continue to operate and, in the long term, investors/participants will move to more crypto-friendly jurisdictions providing some risk mitigation if investments in Ethereum are focused on a long-term time horizon.

Node concentration



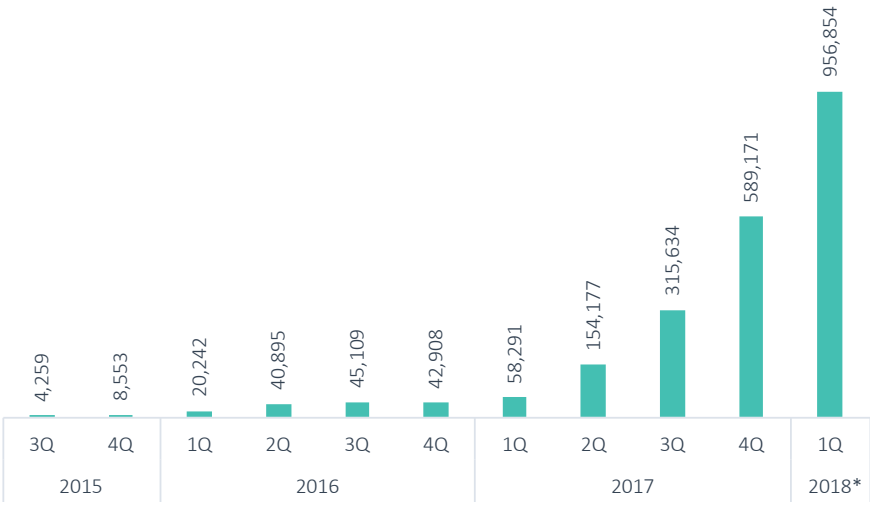
Source: Etherscan.io

Ethereum unique addresses



Source: Etherscan.io
*As of 2/25/2018

Average daily Ethereum transactions



Source: Etherscan.io
*As of 2/25/2018