April 2021

The world computer

Introduction to Ethereum (ETH)

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Ether is the second largest cryptocurrency by market capitalization behind bitcoin. Its current market cap stands

at 290.69 billion USD, representing approximately 14% of the total cryptocurrency market1

.

Imagined in 2013, and created in 2015, the blockchain network Ethereum has grown in innovation and utility.

Different from Bitcoin’s primary function as a peer-to-peer electronic cash system, Ethereum invents a new world

of peer-to-peer applications.

Before we dive into details, it’s important to distinguish ether (ETH) from Ethereum. Ether refers to the

cryptocurrency used on the Ethereum blockchain. Ethereum refers to the blockchain network.

What’s Ethereum?

Ethereum is a blockchain platform that handles programs and applications without relying on a centralized party.

It is “the world’s programmable blockchain2

”.

The platform is built on the public, open-source, decentralized, and cryptographic blockchain technology. It

powers decentralized applications (dApps) that are supported by a transaction protocol called smart contract.

With its collective computing power on the distributed network (the Ethereum Virtual Machine), it executes

peer-to-peer transactions to realize automatic, conditional transfer of value and information, including money,

voting rights, and property.

Ethereum can be compared to a “world computer” on a blockchain, where the underlying blockchain technology

is the virtual machine’s hard drive, smart contracts are programs, miners are CPUs, and users pay with ETH to

use this “computer”.

1 On April 15th, 2021

2 https://ethereum.org/en/what-is-ethereum

Clients Users

Smart Contracts Programs

Miners CPUs

Blockchain Hard Drive

ETHEREUM COMPUTER

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Solving the Problem

Ethereum’s invention is inspired by Bitcoin.

Bitcoin established the foundation for decentralized blockchain technology. But its functionality is limited to

peer-to-peer electronic cash transfer. Ethereum expands upon Bitcoin’s functionality to programmable apps.

Essentially, it aims to create a decentralized computer network to run various applications. To borrow its founder

Vitalik Buterin’s metaphor: Bitcoin is like a calculator, but Ethereum wants to become a smart phone running

many applications3

.

This decentralized network would automate decisions and transactions, thus reducing the need for a trusted

central party. It can lower the need for intermediaries, reduce arbitrations costs, prevent fraud, and minimize

accidental incidents.

How Does Ethereum Work?

SMART CONTRACTS

At the core of Ethereum are smart contracts.

Smart contracts are one of the two types of Ethereum accounts in which a set of instructions is programmed

to tell the system what to do. Nick Szabo, developer of the concept, often compared it to the codes behind

vending machines.

A smart contract is executed when triggered by a transaction. In the example of a vending machine, the

transaction is when users insert a coin. Once the smart contract is triggered, actions are executed based on the

“if…then…” conditions embedded in the smart contract code.

For example, by pressing a combination of buttons on a vending machine, a bottle of water would get dropped.

The specific good that gets dropped in the vending machine is the outcome of the smart contract. On the

Ethereum network, that could be either a value transfer of ETH to another account, or a transaction to trigger

another smart contract.

3 Vitalik mentioned this metaphor during a speech he gave on October 10th, 2016, called “Ethereum in

25 Minutes.”

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A smart contract abides by a pre-defined set of rules, that allows it to automatically execute code the same way

on any Ethereum node on the network. This eliminates the need for a third party to carry out code execution

on behalf of users, making the system decentralized. It empowers coders to create a wide range of applications

layering together different smart contracts.

To provide a concrete example, consider Etherisc, a decentralized insurance application on the Ethereum

network. Members can purchase insurance directly on the application with its native token. Then, a pool of

money is established, aggregating insurance payments from all members. When a disaster hits, payouts will

be made to impacted members without the need to go through traditional insurance industry’s cumbersome

reimbursement process. Crop insurance for example, could automatically pay out money if drought or flood

events are reported in the area by government agencies.

GAS

Fees need to be paid in ETH to miners in order to facilitate transactions and execute smart contracts. The fee

that’s charged is called gas. Gas price is often a small fraction of ETH, which is denoted in the unit of Gwei

(109

Gwei = 1 ETH).

Gas is essential in sustaining the Ethereum network. It motivates miners to process and verify transactions for

a monetary reward. The amount of gas needed in a transaction is roughly equivalent to the value of energy

needed plus a small transaction fee. Gas price fluctuates with supply and demand for processing power since

miners can choose to not process transactions when gas prices are low.

Gas has another important function in preventing unintentional waste of energy. Because the coding language

for Ethereum is Turing-complete, there is a possibility of a program running indefinitely, and a transaction can be

left consuming a lot of energy. A gas limit is imposed as the maximum price users are willing to pay to facilitate

transactions. When gas runs out, the program will be terminated, and no additional energy would be used.

APPLICATIONS

Ethereum’s applications take advantage of blockchain technology’s decentralized and immutable nature. They

can be created and contributed to by anyone, without tempering the system’s security. Their functions range

widely. Here are a few important examples:

+ Decentralized Finance (DeFi): DeFi aims to build an open and global financial system that can be

accessed by anyone with access to the Internet. Unlike the trust-based finance industry or FinTech,

DeFi is trust-minimized, meaning that the system’s operation does not rely on any single individual

entity but owned by their users. This structure enables it to be accessible on-demand, transparent,

and potentially faster and cheaper. It connects peer-to-peer supply and demand, eliminating the

need for intermediaries.

DeFi’s functionalities have grown to become a financial ecosystem since its launch. Now, users can

borrow, lend, invest, trade, earn interest, buy insurance, and transfer money like they would in the

traditional financial system.

+ Decentralized Autonomous Organization (DAO): A DAO refers to an organization without a third party

that is established for a common purpose. This organization operates and collaborates through a

shared, defined, and automated protocol to ensure all group members’ voices are heard and the

decision-making process is transparent. Each DAO has an embedded treasury in which the funds are

stored, and the funds are spent according to decisions made by members’ voting.

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One of the examples of DAO is a decentralized venture capital fund named “The DAO” launched

in 2016. Members could purchase DAO tokens to gain rights to vote on investment proposals. If

the voted project became profitable, members would be given a return according to their stakes.

Although the DAO was an innovative idea, it failed due to a bug that existed in its smart contract code.

Hackers stole a portion of the organization’s funds. This event resulted in a decision to implement a

hard fork on the Ethereum network, creating a branch called Ethereum Classic. Other examples of a

DAO have continued to successfully operate. MakerDAO enables the continued generation of Dai, a

decentralized stablecoin.

+ Non-fungible Tokens (NFT): NFTs are records of data on the blockchain, which makes the underlying

assets immutable and differentiated. They range from digital assets such as photos, audios, videos,

shares, and certificates to physical assets such as properties and paintings.

Since digital files are easy to replicate, having non-fungible tokens that prove ownership of the digital

files is important. When a NFT gets bought, the owner gains an unchangeable ownership record.

The appeal of NFTs for digital assets lies in the sense of rarity it creates and thereby improves the

asset’s collectable value. For artists selling the assets, NFTs allow more direct distribution of their work

without a third-party platform, which could better protect their copyrights and increase their profits.

For NFTs backed by real physical assets, tokenization proves digital ownership of the item as well as

preserves the uniqueness of the item. Although physical assets’ NFT market is not as developed as

the market for digital assets, there are a lot of possibilities in putting tokenized assets into use. These

could be facilitating selling and buying among NFTs and using them as collateral to borrow funds.

Nyan Cat GIF created by Chris Torres was sold for 300ETH (~$600,000) on Feb. 19th, 2021.

Where is Ethereum going?

The idea of Ethereum was proposed in 2013. On July 30th, 2015, the first version of Ethereum was released,

called “Frontier.” There are four main stages of Ethereum’s development, which are:

+ Frontier (July 2015 – March 2016)

+ Homestead (March 2016 – October 2017)

+ Metropolis (October 2017 – December 2019)

+ Serenity (December 2019 – 2022)

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