

# Applied Web3

Blockchain-based Systems Engineering

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## 1. dApps and Non-Fungible Tokens

- Technical Overview
- ERC721
- Metadata Standards
- 10,000 of Something Collections
- FAQ

## 2. Metaverse

- Decentraland
- Samsung Flagship
- Signs of Adoption

- **Direct interaction** with smart contracts is **complicated**
- Smart contracts **don't provide a graphical user interface** on their own
- **Programming knowledge or special tools** are **required** to make function calls

Interact with Contract or Deploy Contract

Contract Address  
0xe933c0Cd9784414d5F278C114904F5A84b396919

Select Existing Contract  
WhoHas 0xe933c0Cd9784414d5F278C114904F5A84b396919

ABI / JSON Interface

```
[ { "constant": true, "inputs": [ { "name": "", "type": "address" } ], "name": "votings_", "outputs": [ { "name": "", "type": "uint256" } ], "payable": false, "stateMutability": "view", "type": "function" }, { "constant": true, "inputs": [], "name": "symbol", "outputs": [ { "name": "", "type": "string" } ], "payable": false, "stateMutability": "view", "type": "function" }, { "constant": true, "inputs": [ { "name": "_etherAmount", "type": "uint256" } ], "name": "calculateTokenAmountICO", "outputs": [ { "name": "", "type": "uint256" } ], "payable": false, "stateMutability": "view", "type": "function" }, { "constant": true, "inputs": [ { "name": "raisedIcoValue", "type": "uint256" } ], "name": "payable": false, "stateMutability": "view", "type": "function" }, { "constant": true, "inputs": [ { "name": "prizePool", "type": "address" } ], "name": "payable": false, "stateMutability": "view", "type": "function" } ]
```

Access

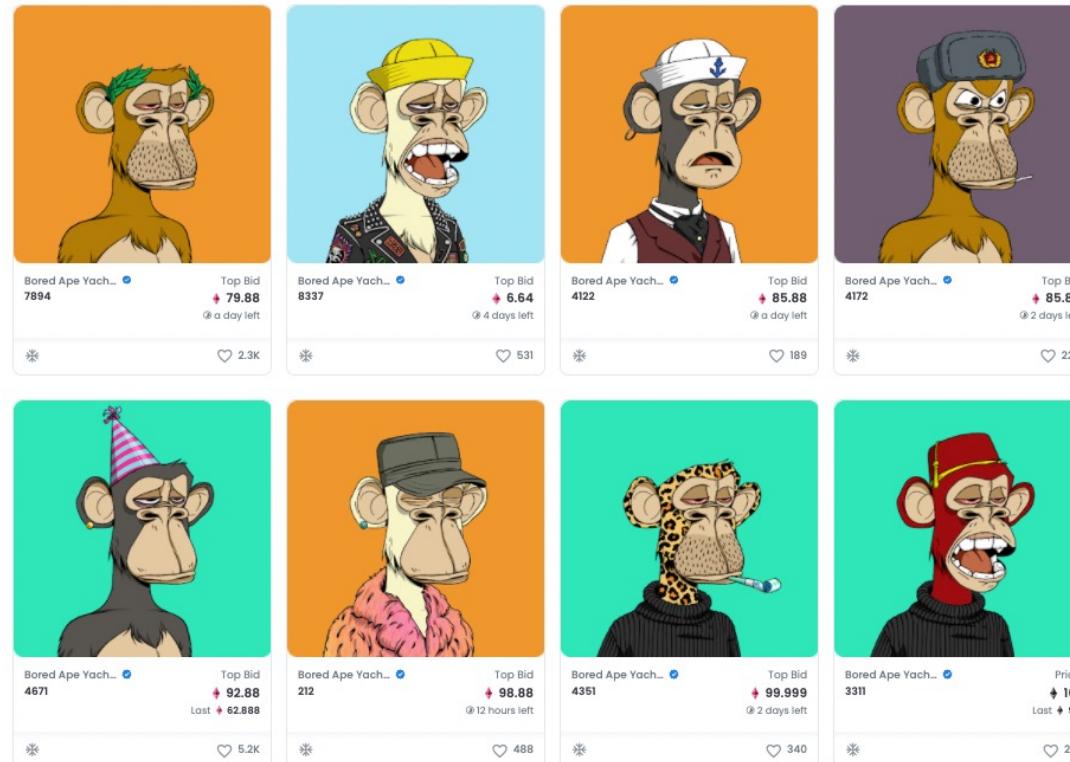
Read / Write Contract  
0xe933c0Cd9784414d5F278C114904F5A84b396919

Select a function ▾

Screenshot of popular Ethereum wallet: MyEtherWallet.com

# Motivation

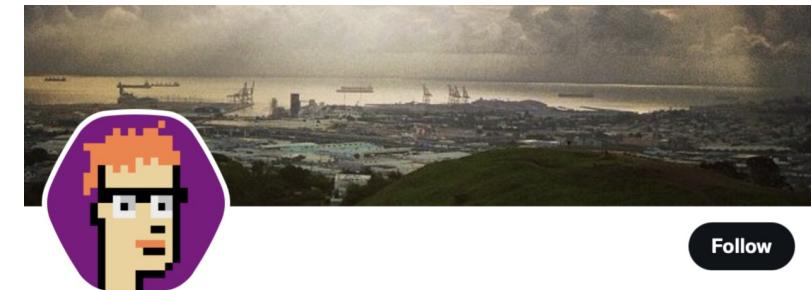
- Building **UIs on top of smart contracts** to make them accessible to average users.
- The UI **abstracts the complicated function calls** and allows a user to interact with them just like with a regular (web) application.



Screenshot of a popular NFT Collection on the OpenSea dApp

# Definition

- In this lecture, we consider a dApp as a decentralized application (in the terms of Blockchain) based on one or more smart contracts and accessible via a dedicated web-based user interface.
- In particular, the following properties must hold:
  - The core data records of the application must be stored on the blockchain
  - The functions that change the core data records must be executed on the Blockchain, i.e. via a smart contract
- dApps are an **analogy to ordinary web apps** in web2
  - use your NFT as your Twitter profile picture
  - prove your certificates on Linkedin (verified by Linkedin)



Jack Morse   
@jmorse\_

Senior Tech Reporter [@Mashable](#) covering security, privacy, cryptocurrency, and Twitter from SF. cryptojunk #420. Defund the police. DM for Signal.

The meaningfulness of implementing a distributed application is dependent on the concrete use case and / or the problem that is being solved.

Some general properties of Ethereum-based dApps:

## **Trust**

The source code of any verified smart contract can be checked by anyone.

## **Payment**

Payment is implemented by default since anyone can send / receive Ether.

## **Accounts**

dApps can be build on top of Ethereum's account system, so there is no need to implement an additional user account management system.

## **Storage**

dApps can leverage the Blockchain as common (expensive) data storage.

Decentralized applications have also some intrinsic disadvantages:

## Costs

Any state change and computation costs money. For that reason, only mission-critical data and functionality should leverage the Blockchain.

## Time

The current block time of Ethereum is around 14 seconds, i.e., it takes at least 14 seconds from the function call to the definite result of it.

## Availability

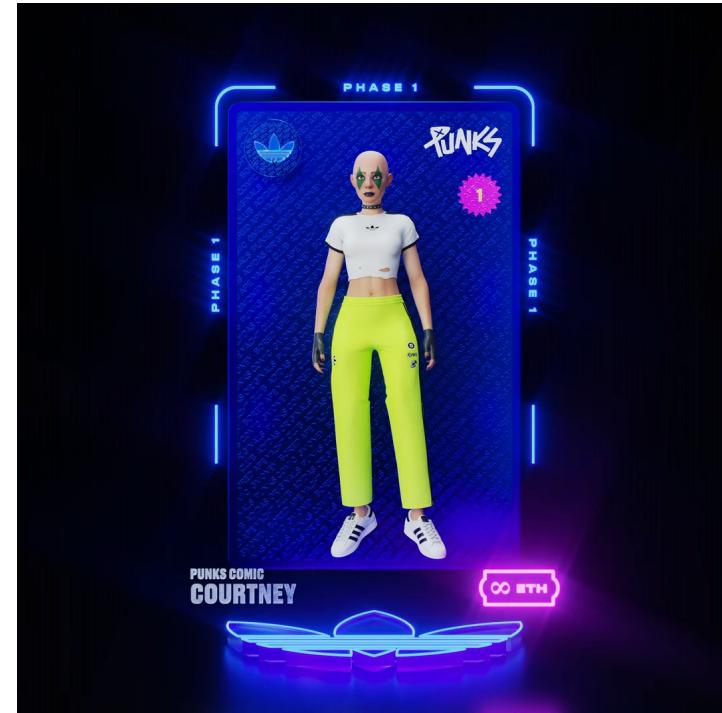
In theory, availability is one of the key advantages of dApps. However, in high transaction scenarios (e.g. the release of crypto kitties) it is possible that the network throttles and is not able to process function calls anymore.

## Transparency

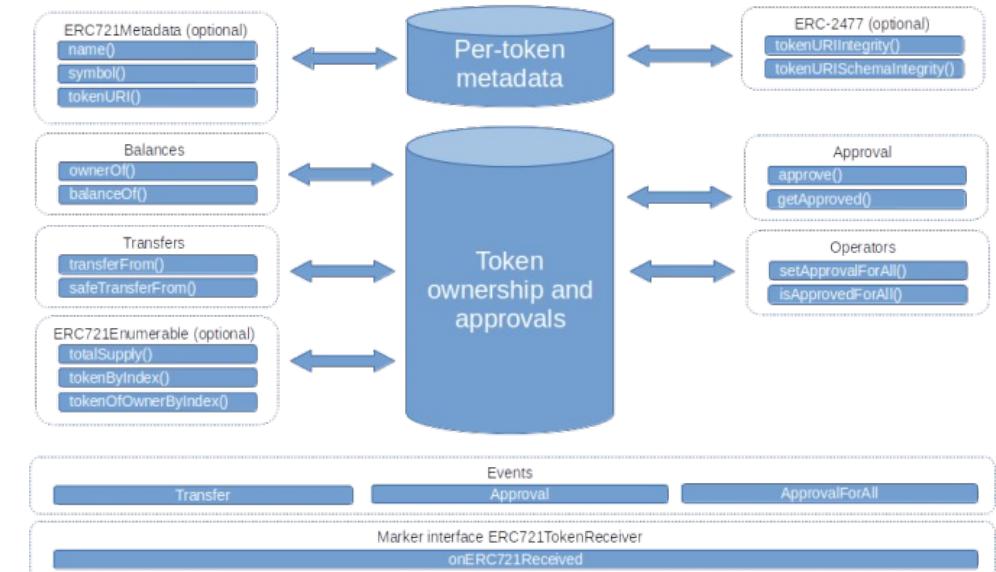
Without third party services, it is impossible to access and verify a Smart Contract source code.

# Non-Fungible Tokens (NFT)

- Unique tokens that cannot be replaced (e.g., a Bitcoin is not an NFT since it can be replaced with another one)
- NFTs are **straightforward to implement** (e.g., ERC-721, ERC-1155), but rather **difficult to market**
- ERC-721 for implementing 10,000 unique pictures type of a collection – e.g., Bored Apes Yacht Club (BAYC)
- ERC-1155 for implementing 10,000 of the same item type of a collection – e.g. an Adidas shoe



- Each token:
  - is **unique**.
  - can be **transferred**.
  - can be **delegated** (e.g., for voting).
  - has its **own metadata**.
- TokenURI returns a token's metadata.



## Solidity implementation:

```
NFT.sol

/**
 * @dev Returns an URI for a given token ID
 */
function tokenURI(uint256 _tokenId) public view returns (string) {
    return Strings.strConcat(
        baseTokenURI(),
        Strings.uint2str(_tokenId)
    );
}
```

## Metadata structure (OpenSea):

```
{
  "description": "Friendly OpenSea Creature that enjoys long swims in the ocean.",
  "external_url": "https://openseacreatures.io/3",
  "image": "https://storage.googleapis.com/opensea-prod.appspot.com/puffs/3.png",
  "name": "Dave Starbelly",
  "attributes": [ ... ],
}
```

# 10,000 of Something Collections

- 10,000 different NFTs can be minted from a contract
- Usually, people pay anywhere from 0.04 to 2.5 ETH for a mint
- Mint means you **create the token yourself and you receive it**
- Each NFT has different attributes and looks different
- Each attribute has a **different weight** making some NFTs rare and others common
- Each NFT is evaluated by its rarity
- Mostly the owner gets full commercial rights of their NFT



Used Collection: Pudgy Penguins

## *Is an NFT immutable?*

- NFTs themselves are immutable, their **metadata is not**; Meaning that the creator of an NFT can easily turn it into something else (e.g., change the linked image).

## *Why are some NFTs worth so much?*

- Social networking effects. If a lot of people give worth to something, it's worth that much.

## *Can I create my own NFTs and become a millionaire?*

- Yes! But probably not. NFTs are not about tech, they are about social effects.

## *How hard is it to create my own NFTs?*

- Very easy. In fact, you will create your own NFTs in our exercises.

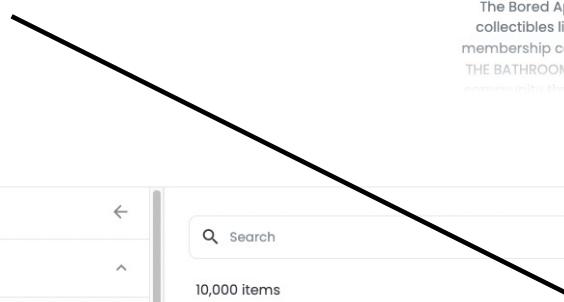
## *What can I do with NFTs?*

- NFTs themselves do not offer anything beyond the representation of something you own. Value is added by the company or community behind the NFTs. For example, BAYC launched big expensive parties and everyone with a Bored Ape could attend for free. Examples are access to gated communities, part of the profits of a company, etc.



# Example dApp: OpenSea

Select an item that you want to buy

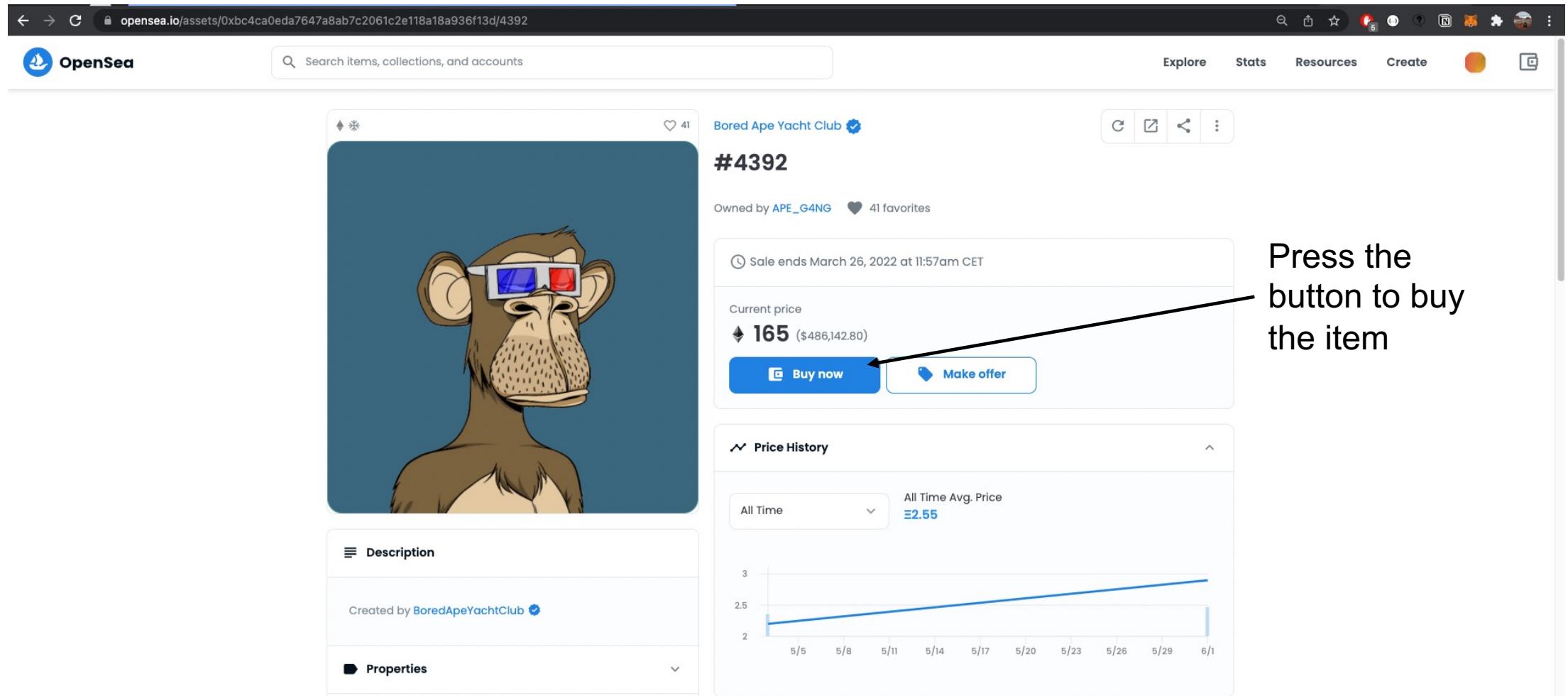


The Bored Ape Yacht Club is a collection of 10,000 unique Bored Ape NFTs—unique digital collectibles living on the Ethereum blockchain. Your Bored Ape doubles as your Yacht Club membership card, and grants access to members-only benefits, the first of which is access to THE BATHROOM, a collaborative graffiti board. Future areas and perks can be unlocked by the community and the Ethereum ecosystem through the Bored Ape Yacht Club's DAO.

**Items** **Activity**

Item	Description	Price	Status
Bored Ape Yacht Cl... 7338	Blue monkey wearing a cap and tie-dye shirt	Price 155	@ 7 days left
Bored Ape Yacht Cl... 4392	Monkey wearing 3D glasses	Price 165	@ 7 days left
Bored Ape Yacht Cl... 2769	Monkey with a halo and vest	Price 103	@ 7 days left
Bored Ape Yacht Cl... 7381	Monkey wearing a crown	Price 199	Lost 150
Bored Ape Yacht Cl... 2966	Monkey smoking a cigarette	Price 150	@ 2 days left

# Example dApp: OpenSea



The screenshot shows a web browser displaying an NFT listing on OpenSea. The item is a Bored Ape Yacht Club #4392, featuring a brown monkey wearing 3D glasses. The listing includes a description from the creator, BoredApeYachtClub, and properties section. The current price is \$165, and there are 'Buy now' and 'Make offer' buttons. A callout arrow points to the 'Buy now' button with the text: 'Press the button to buy the item'. The background of the slide features a dark blue gradient.

OpenSea

Search items, collections, and accounts

Explore Stats Resources Create

Bored Ape Yacht Club #4392

#4392

Owned by APE\_G4NG 41 favorites

Sale ends March 26, 2022 at 11:57am CET

Current price

♦ 165 (\$486,142.80)

Buy now Make offer

Description

Created by BoredApeYachtClub

Properties

Price History

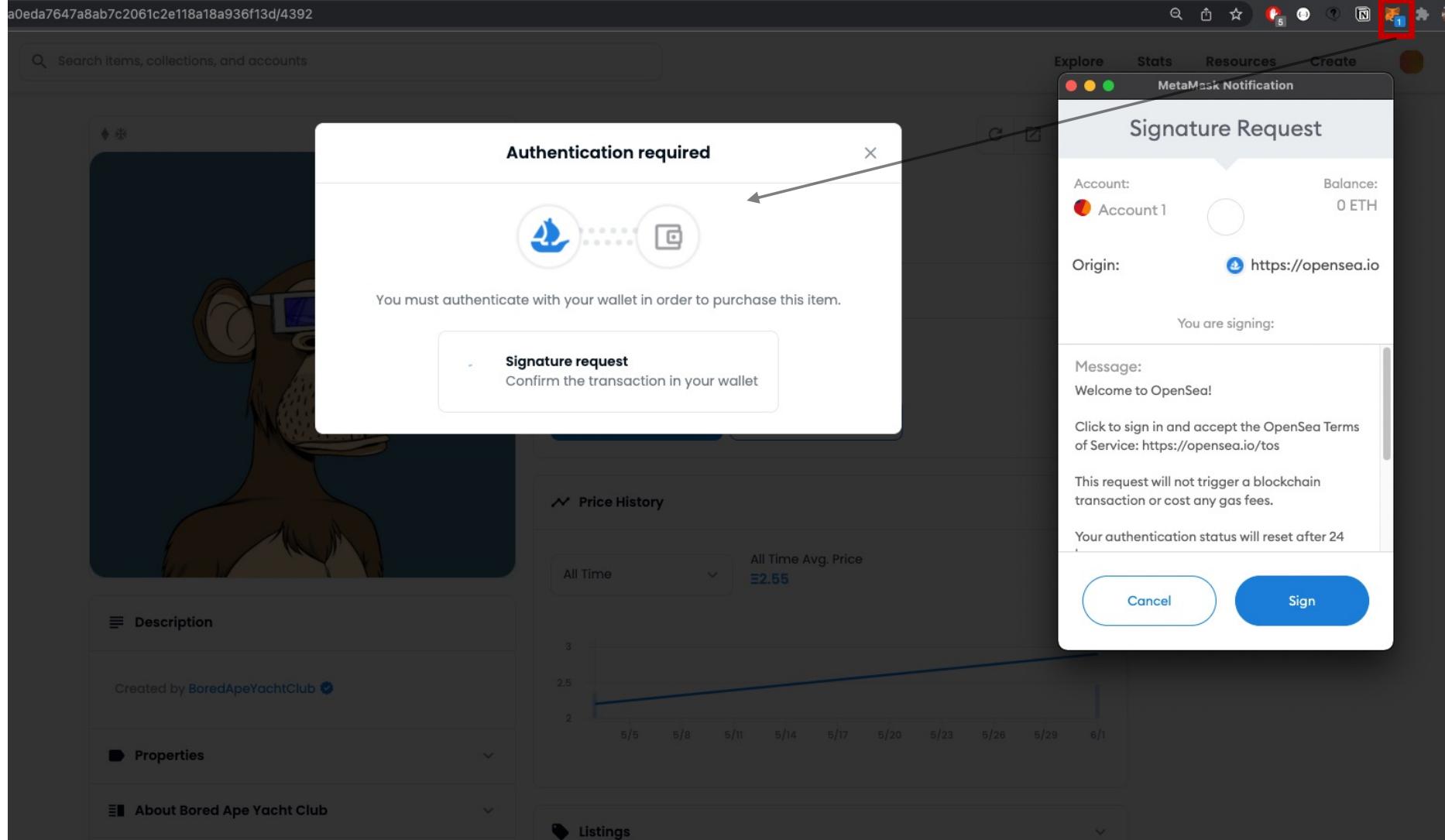
All Time Avg. Price \$2.55

5/5 5/8 5/11 5/14 5/17 5/20 5/23 5/26 5/29 6/1

Press the button to buy the item

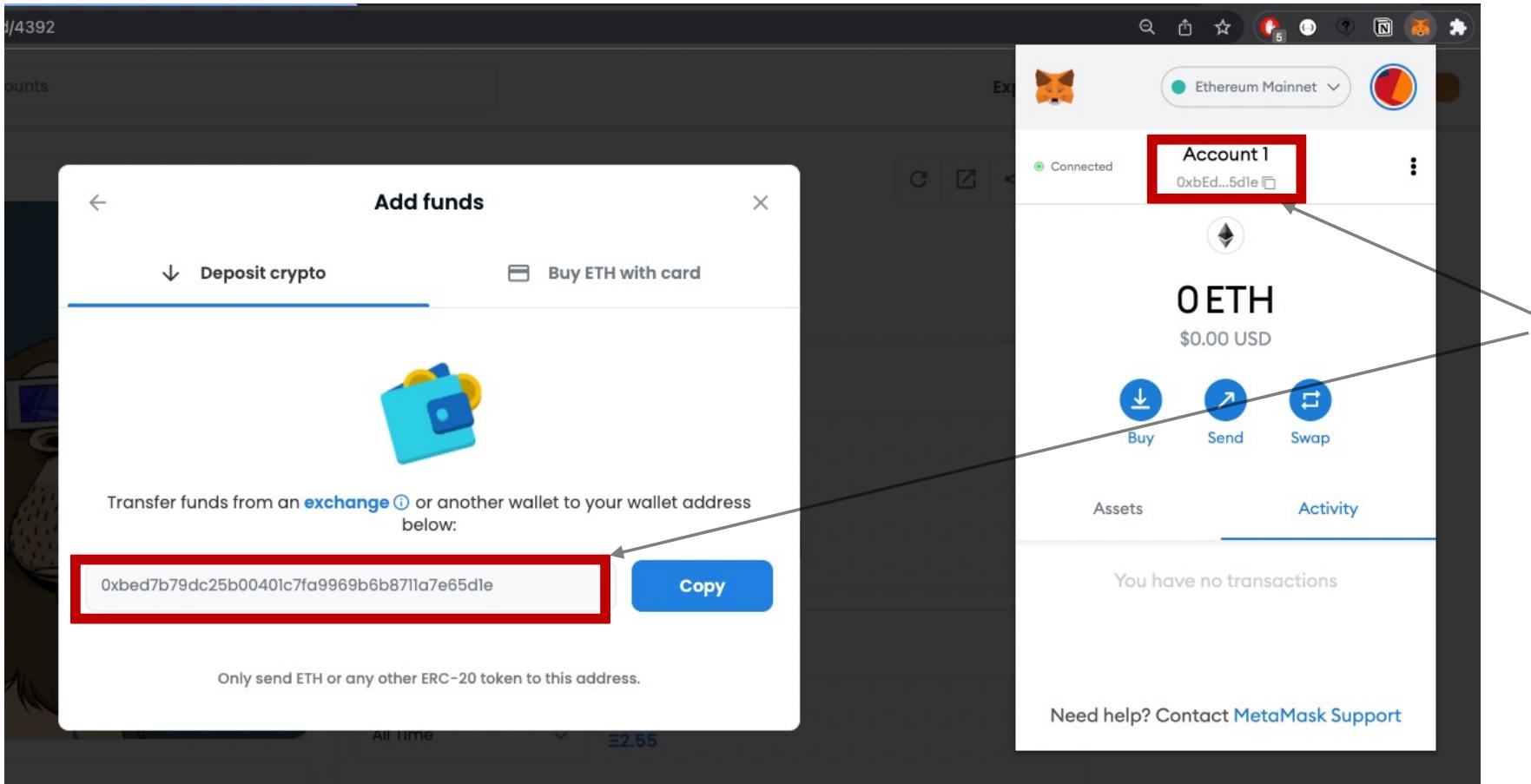
# Example dApp: OpenSea

MetaMask as private key manager



- MetaMask injects a Web3 provider into the OpenSea application
- OpenSea can access your account through the injected Web3 provider

# Example dApp: OpenSea



- Since there is no ETH available at the address, OpenSea asks you to transfer funds from an exchange to your address

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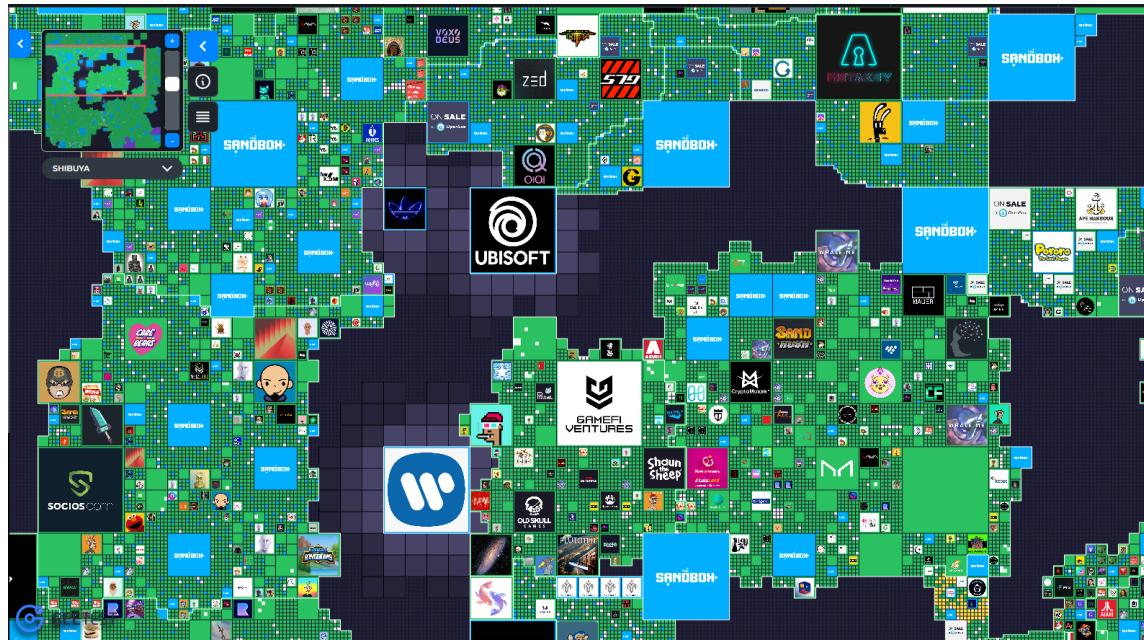
- Decentraland
- Samsung Flagship
- Signs of Adoption

# Defining the Metaverse

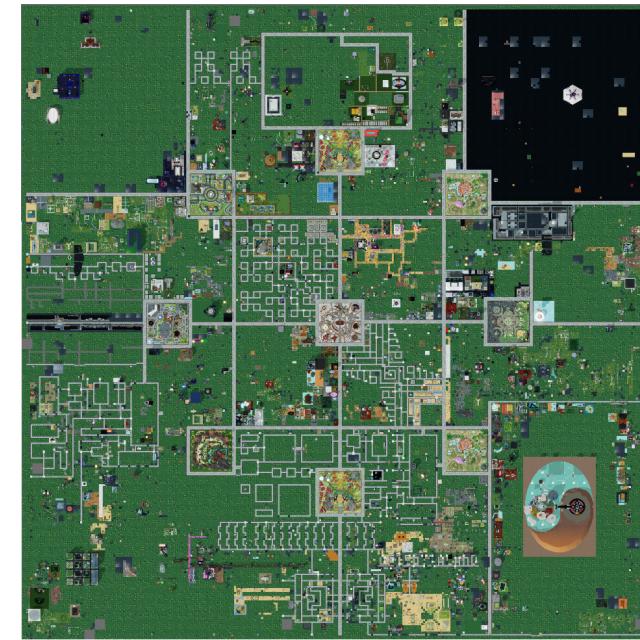
- Different definitions of the “metaverse” exist
- <https://www.merriam-webster.com/words-at-play/meaning-of-metaverse#:~:text=In%20its%20current%20meaning%2C%20metaverse,socialize%2C%20play%2C%20and%20work.>

- A metaverse is (currently) basically a video game but **you own everything you have** in it.
- **Everything is an NFT.** The land you have, the building you own and the cloth you wear.
- **A metaverse is not necessarily virtual reality.** VR is simply one way to experience it.

Sandbox map



Decentraland map





Open World Gaming/  
interactions, central  
ownership of assets



Gaming with on  
chain ownership of  
assets



Open world with  
decentralised ownership  
but limited gaming  
functionality no VR/AR



immersive VR  
experiences

history

now

2040

## Decentralized Metaverses

Decentralized Metaverses offer the user the possibility to **take assets with them and to trade/ share outside of the Metaverse.**

Examples:

- [Decentraland](#)
- [Sandbox](#)
- [BlankosBlockParty](#)

## Centralized Metaverses

Centralized Metaverses **do not offer transferable assets.** Often onboarding might be easier (no crypto wallet required). But, **functionality is limited.**

Examples:

- [Roblox](#)
- [Meta](#)

## Launched in March 2018

- Decentraland is a decentralized, traversable, three-dimensional (3D), virtual reality platform that is being built on the Ethereum blockchain.
- The platform focuses on the ownership of parcels of digital land where users can create unique environments in a virtual world.
- Content creators will be able to prove ownership of, and capture value from, their contributions to the platform. Users will be able to traverse unique areas of content, which can be clustered into districts, giving content creators targeted traffic and allowing for the spatial discovery of new content by users.

## Tokens

- LAND (ERC-721): Individual ownership of land parcels is represented by non-fungible LAND tokens containing the coordinates of a single point on the grid and a reference to the details of each parcel.
- MANA (ERC-20): Purchase of in-game goods and services.

## Number of Users

- 300.000 monthly active users and 18.000 daily users.

- Limited time experience
- Planned crossover with real-world events
- “Mystical Quests” leading to exclusive NFTs
- DJ performing live in the store and in Decentraland
- Unfortunately doors were not open on all servers



<https://www.samsung.com/us/explore/metaverse-837x/>

<https://www.cnbc.com/2022/02/10/samsung-held-an-event-in-the-metaverse-and-it-didnt-quite-go-to-plan.html>

# Signs of Adoption

- McDonalds patented virtual restaurants + delivery service
- Kaufland & H&M bought an island in “Animal Crossing”
- Ralph Lauren & Nike offer products on Roblox
- Walmart protects it's brand name in Metaverse context - apparently planning on offering virtual store solutions for others
- Adidas bought land in Sandbox - Adiverse & Board Ape in Adidas Clothing
- Gucci sold a “virtual handbag” for 4,000 USD
- Morgan Stanley predicts that in 2030, luxury brands will make 50B USD in the Metaverse
- ...



<https://www.handelsblatt.com/unternehmen/handel-konsumqueter/e-commerce-kaufland-und-walmart-treiben-die-expansion-des-handels-ins-metaverse-voran/27992728.html>