

# NFTs & Token Standards

## A Five-Minute Overview

BSc Blockchain Course

# Why Would Anyone Pay Millions for a JPEG They Cannot Touch?

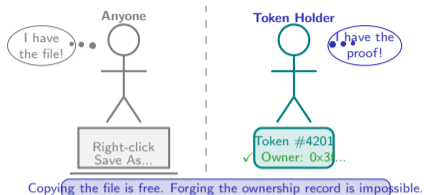
The internet made digital files perfectly copyable – yet in 2021 a JPG sold for \$69 million at Christie's. The buyer received no physical object. Anyone can right-click and save the same image. **The ownership paradox in every digital**

medium:

- **Physical art:** provenance travels through auction house certificates and gallery receipts.
- **Digital art:** anyone holds the file – but who holds the *proof* of original ownership?
- **The gap:** copying a file is free; copying the on-chain ownership record is cryptographically impossible.

*NFTs answer a question the internet never could: who is the original owner?*

NFTs do not prevent copying of a file – they create an unforgeable, publicly verifiable record of who holds the original claim to that file.



Source: Entriken et al. (2018). EIP-721: Non-Fungible Token Standard. [eips.ethereum.org/EIPS/eip-721](https://eips.ethereum.org/EIPS/eip-721); Christie's (2021). "Beeple's Opus." [christies.com](https://www.christies.com)

# What Makes a Token Non-Fungible – And Why Does That Matter?

## Three Ethereum token standards – three different ownership models:

Property	Fungible (ERC-20)	Non-Fungible (ERC-721)	Multi-Token (ERC-1155)
Uniqueness	Identical units	Each token unique	Mix of both
Divisibility	Yes (decimals)	No (whole only)	Configurable
Interchangeable	Yes	No	By type only
Use case	Currency, voting	Art, collectibles	Gaming items
Example	DAI stablecoin	CryptoPunk #3100	Axie Infinity card
Gas efficiency	High	Moderate	High (batch mints)

## Why fungibility is the decisive property:

One dollar bill is worth exactly as much as any other. One token in a bank account is interchangeable with any token of the same type. But one first-edition print, one stadium seat, one university credential – these are not interchangeable. ERC-721 encodes that irreplaceability directly into the contract.

Non-fungibility is not a feature added on top of a token – it is the fundamental change from “how many?” to “which one?”

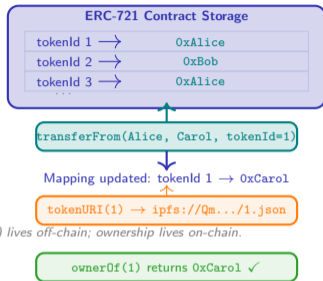
## The key distinction at the code level:

- **ERC-20 (Fungible):**  
`balanceOf(address)` returns a number.  
All tokens of the same contract are identical.
- **ERC-721 (Non-Fungible):**  
`ownerOf(tokenId)` returns an address.  
Each `tokenId` is unique and carries its own metadata URI.
- **ERC-1155 (Multi-Token):**  
`balanceOf(address, id)` queries a specific type.  
Efficient when one contract manages thousands of item types.

*The standard determines what “ownership” means in each case. ERC-721 makes the token the unit of ownership – not the address.*

Source: Entriken et al. (2018). EIP-721. [eips.ethereum.org/EIPS/eip-721](https://eips.ethereum.org/EIPS/eip-721); Radomski et al. (2018). EIP-1155. [eips.ethereum.org/EIPS/eip-1155](https://eips.ethereum.org/EIPS/eip-1155)

# How Does a Smart Contract Know This Token Is Yours and Not a Copy?



*Metadata (image, attributes) lives off-chain; ownership lives on-chain.*

**What the contract actually stores:** A single mapping from integer token IDs to Ethereum addresses. That is the entire ownership record. **Three operations that matter:**

- **Mint:** assign a new `tokenId` to an address. The creator chooses the first owner. Token enters circulation.
- **Transfer:** update the mapping. Only the current owner (or approved address) can call `transferFrom`. The blockchain enforces this rule globally.
- **Burn:** assign ownership to the zero address. The token still exists in history, but no one controls it.

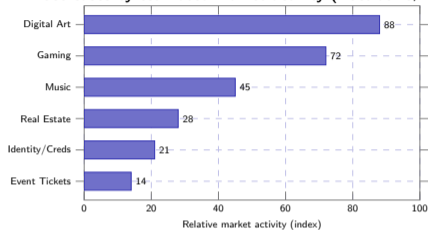
*There is no copy to forge – the contract has one authoritative state, replicated across every node on the network.*

Ownership of an NFT is nothing more than an integer-to-address mapping in a smart contract – but that mapping is enforced by every node on the Ethereum network simultaneously.

Source: OpenZeppelin (2024). ERC721 Implementation. [github.com/OpenZeppelin/openzeppelin-contracts](https://github.com/OpenZeppelin/openzeppelin-contracts); Ethereum.org (2024). "NFT Standard." [ethereum.org/en/nft](https://ethereum.org/en/nft)

# Beyond Bored Apes: Where Are NFTs Creating Real Value Today?

## NFT use cases by estimated market activity (illustrative, 2024):



*Illustrative indices derived from*

*public blockchain analytics; relative ranking indicative only.*

## Which sectors show lasting utility?

- **Gaming:**  
Players own in-game items independently of the game studio. Items can be traded on open markets or carried between compatible games. True digital property rights for the first time.
- **Music royalties:**  
Artists encode royalty splits into smart contracts. Every secondary sale automatically pays creators without a label intermediary.
- **Identity and credentials:**  
Universities, professional bodies, and governments are piloting NFT diplomas and licences – verifiable instantly, unforgeable, revocable on-chain.
- **Event tickets:**  
Programmatic royalties on resale cap scalping; attendance history builds a provable fan record.

The speculation in digital art captured headlines; the infrastructure being built for gaming, music, and credentials is what will last.

Source: DappRadar (2024). NFT Market Report Q3 2024. [dappradar.com](https://dappradar.com); Messari (2024). State of NFTs. [messari.io/report/state-of-nfts](https://messari.io/report/state-of-nfts)

# Three Tests to Determine Whether an NFT Has Lasting Value

Before buying, creating, or building on NFTs, apply three tests in order:

**Test 1 – Does ownership confer real utility beyond resale?**

If the only value is selling to a greater fool, the asset is pure speculation. Lasting NFTs unlock something: game access, royalty income, event entry, credential proof. Ask: “What can I do with this that I could not do without it?” **Test 2 – Is the metadata on a decentralised storage system?**

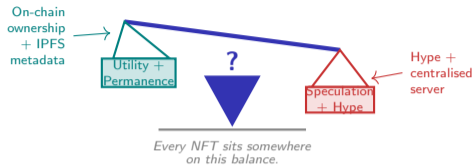
If the image or attributes live on a centralised server, the issuer can delete them. IPFS content-addressing or Arweave permanent storage means the asset survives even if the marketplace or company shuts down.

**Test 3 – Would the asset retain value if the marketplace closed?**

Ownership lives on-chain, but discoverability and liquidity depend on platforms. A robust NFT works in any ERC-721-compatible wallet or exchange. *YES to all three: potentially durable value.*

*NO to any one: the risk is structural, not just market.*

An NFT is only as durable as its weakest component – and that component is almost always the metadata storage, not the blockchain entry.



- Test 1: utility beyond resale?
- Test 2: decentralised metadata?
- Test 3: marketplace-independent?

**The metadata problem in one sentence:**

An NFT whose image lives on <https://company.com> is a certificate of ownership for a file that can be deleted at will.

Source: Kugler, L. (2021). “Non-Fungible Tokens and the Future of Art.” Commun. ACM 64(9). doi:10.1145/3474355; IPFS (2024). ipfs.tech; Arweave (2024). arweave.org