Establishing a distributed NFT blockchain on Amazon Web Services

Abstract

The emergence of non-fungible tokens (NFTs) has created a demand for modern, powerful blockchain technology to support them. While NFTs are becoming increasingly valuable assets across a range of industries and business sectors, the evolving NFT landscape is proving difficult for organizations to harness and understand. This has created a new opportunity for organizations specializing in cloud-based system integrations and consulting to develop, host, and simplify the environment in which NFT transactions are conducted. Using Amazon Web Services (AWS) as the secure and scalable foundation, Tech Mahindra is leveraging Amazon Managed Blockchain to create and manage scalable, private blockchain networks for streamlined NFT transactions.

The emergence of NFTs

With the growth of NFTs both inside and outside the technology sector, understanding the supporting technology – from what it is and how it works, to how to widely adopt it – is increasingly important. NFT usage is growing beyond the digitization of rare assets, to having applicable business forward use cases. The evolution of NFTs has created a space for innovative technology that simplifies the selling and purchasing of NFT assets.

Blockchains

Blockchains are shared ledgers that facilitate the process of recording transactions and tracking asset trades. This is done through a program called smart contracts, which continually synchronizes peer-to-peer systems to maintain up-to-date transaction logs. Two types of blockchains exist, each with its own suitable purpose, and knowing the differences between the two is crucial for NFT transactions.

Public blockchains

are non-restrictive, permissionless ledgers, meaning anyone who has access to the internet can become an authorized node within the blockchain network.

Private blockchains

are restrictive, permission-based blockchains that only operate within a private, closed network. Often, private blockchains are leveraged across organizations in which selected users need to access a blockchain network.

While NFTs are more popular in public blockchains, they have a growing number of use cases and applications in private blockchains, especially with the emergence of distributed NFTs.

Understanding NFTs

The previously mentioned smart contracts within blockchains are designed to manage the tokens that are created (minted) to represent assets in a digital form. There are two types of tokens available: fungible and non-fungible (NFT).

Fungible tokens are easily divisible and exchangeable with any other asset of a similar kind. For example, a one-cent coin is interchangeable with another one-cent coin, as they hold the same value.

NFTs, on the other hand, are non-divisible and have unique attributes that make them unexchangeable with other assets, such as rare artwork, certificate of ownership, or one-of-a-kind baseball cards. Every NFT is unique, and as such, each asset within a blockchain represents a specific NFT asset that has certain metadata properties with a unique owner. A key feature of NFTs is that they are immutable, and cannot be changed, erased, misplaced, or removed from the blockchain.

NFT usage across industries

Organizations and consumers alike are capitalizing on NFTs due to the unique nature of each token. NFTs enable creators and owners to buy, sell, and trade a unique asset of value to profit directly from it, without a middleman. Because no two NFTs are the same, the resell value and investment opportunities go beyond what fungible tokens can provide. The value of NFTs spans multiple industries such as manufacturing and supply chain, as well as retail and the financial sector. Some of the industries and use cases that have seen the most value from NFT purchasing include:

Media & entertainment

Sports and entertainment focused organizations are leveraging NFTs to distribute and sell tickets to events, allowing them to issue a unique code and certify authenticity and ownership, while reducing the risk of fraud.

Digital collectibles

Art sellers, franchise owners, and musicians can issue or sell NFTs that represent exclusive collectibles, products, experiences, or voting rights for the future development of a product or service

Credentialing

Driver's licenses or professional certifications, such as cloud training and certifications from AWS can be issued as NFTs to reduce the burden of proof for these credentials.

The inherent complexity of NFT technology is a growing roadblock

The rapid introduction, implementation, and advancement of the new technologies that support NFTs present challenges to organizations looking to develop marketplaces. Supporting NFT technology is still in the formative stage, and inherently complex, leading to hesitant or slow adopters.

Because the NFT market is continuing to grow and evolve, organizations that have already adopted blockchain and NFT technology need to be able to quickly innovate and keep pace with demand, while also maintaining the security of private blockchain data. Additionally, the developing regulations and governance of the trade and acquisition of NFTs, including guidelines on taxation, can be ambiguous. This is driving a need for organizations to create a secure NFT environment that aligns with tax and security compliance regulations.

Another key factor playing into NFT complexity is the lack of certainty regarding the application of rights and ownership certification of original creators. While NFTs provide traceability of ownership, there is a growing need for tighter regulations to improve legitimacy and establish a strong buy/sell permission chain.

The uncertain regulatory nature of NFTs presents a major roadblock for organizations seeking to adopt and integrate NFTs into their blockchain solutions. On top of this, one of the biggest constraints facing the NFT landscape is the inherent nature of them being indivisible. But modern, cloud-based blockchain technology is changing the market opportunities for NFT owners.

Fractional ownership of NFTs

The underlying principle of NFTs is that they cannot be divided among multiple owners. Originally intended for unique assets, such as art or rare baseball cards, NFTs were designed to have sole owners. When you convert an asset into a digital representation of itself (for example, a car), that token (car) can only have one owner. But with the growth in popularity of digitizing larger assets (multi-housing properties) into token-formats, the need to split ownership among multiple parties is growing.

Fractional ownership is the process of converting NFTs and splitting it among multiple owners, thus creating a distributed NFT. This capability means larger assets and contract-based assets can be tokenized and shared among a broader group. For example, a large property that can fit multiple houses or a housing development, can be tokenized as a contract. Without a distributed NFT, the property would likely have a single owner, rather than multiple property owners or a larger company.

With fractional ownership, this digitized property can be split into, for example, 20% equal parts, allowing five people to hold ownership. If an owner wants to dilute their ownership, and invest elsewhere, they can sell or trade their 20 %, without requiring the other parties to forfeit their shares.

The ability to split NFTs has expanded NFT usage to an even broader set of industries and use cases:

Property royalties

NFTs can track fractional ownership or royalty entitlement for a piece of rare media, content, or art, without going through lengthy legal certification processes.

Real estate

Property managers can use NFTs to split ownership of a large piece of land across multiple parties, bypassing lengthy contracting processes.

The addition of fractional ownership in the realm of NFTs has opened opportunities on what can be digitized as a token and co-owned. However, as the NFT features and possibilities continue to grow, so does the complexity of the technologies that continue to support NFT transactions.

Creating distributed NFTs using Hyperledger Fabric on AWS

Tech Mahindra, an AWS Premier Consulting Partner, has conceptualized a cloud-based, distributed NFT marketplace using a private blockchain that allows creators to digitize and monetize their content in new ways. Using Amazon Managed Blockchain and private blockchain, the distributed NFT solution can enable secure, fractional NFT ownership across multiple organizations or parties. For this solution, Tech Mahindra is leveraging Hyperledger Fabric, one of the most commonly used protocols for private blockchains.

Hyperledger Fabric has a modular architecture and offers advanced privacy controls enabling "permissioned" sharing of data with known network participants. The smart contract functionality provides the business logic for the application and includes ownership terms between the parties written into lines of code. The code and the agreements are secured and hosted on a distributed, decentralized blockchain network. This process reduces overhead expenses for organizations, by allowing for seamless and secure access to the ledger and metadata to relevant parties upfront, rather than having to draw up legal contracts. Transactions made on the Hyperledger Fabric framework are trackable and irreversible, with full transparency to the participating organizations, creating trust between ownership parties.

Using Hyperledger Fabric, Tech Mahindra's NFT model enables transactors to instantly verify authenticity, prove ownership, monitor trading, and create unique, digital assets. The solution allows trading of fractional pieces of NFTs with any approved organization, from anywhere, at any time. This eliminates the need to purchase an entire NFT or go through complicated legal arrangements to determine proof of ownership. By leveraging Hyperledger Fabric and AWS as the foundation for the solution, Tech Mahindra can support a highly scalable, low-latency NFT marketplace with a pre-determined permission chain for buying and selling fractional NFTs on a private channel. The solution supports and implements enhanced privacy and confidentiality to meet compliance and governance regulations.

Benefits of managing NFTs with Tech Mahindra

1. **Fully managed**: The distributed NFT model on AWS enables a group of members to execute transactions and share data without a central authority. Unlike a self-hosted blockchain infrastructure, this solution eliminates the need for manually provisioning hardware, configuring software, and setting up networking and security components.
2. **Scalable and secure:** Easily scale a blockchain network as application use grows over time. When a network member requires additional capacity for creating and validating NFT transactions, members can add a new permission node. New network certificates are secured with AWS Key Management Service (AWS KMS) technology, eliminating the need to set up secure key storage.
3. **Reliable:** Confidently record transaction service to ensure accurate delivery of transactions across the blockchain network. The built-in change log accurately maintains the complete history of all transactions in the blockchain network, ensuring that critical data is saved.
4. **Flexible**: The distributed NFT model on AWS can handle applications that require stringent privacy and permission controls with a known set of members (Hyperledger Fabric).
5. **Privacy**: Smart contracts preserve privacy by hiding the inputs of private NFTs from everyone except the owner(s). The process outlined below helps ensure that NFT metadata properties remain private:
    - Each organization in the network has its own private data collection.
    - Asset metadata properties are stored in the owning organization(s) private data collection.
    - The log of the private properties will be stored on the public channel.
    - Random data is included in the private properties. This helps prevent other channel members from guessing the private data pre-image by trying to determine the properties with thousands or millions of likely possibilities. This is also known as a dictionary attack.
    - Query transactions for private data must originate from the client organization that is the legitimate asset owner.

Amazon Managed Blockchain

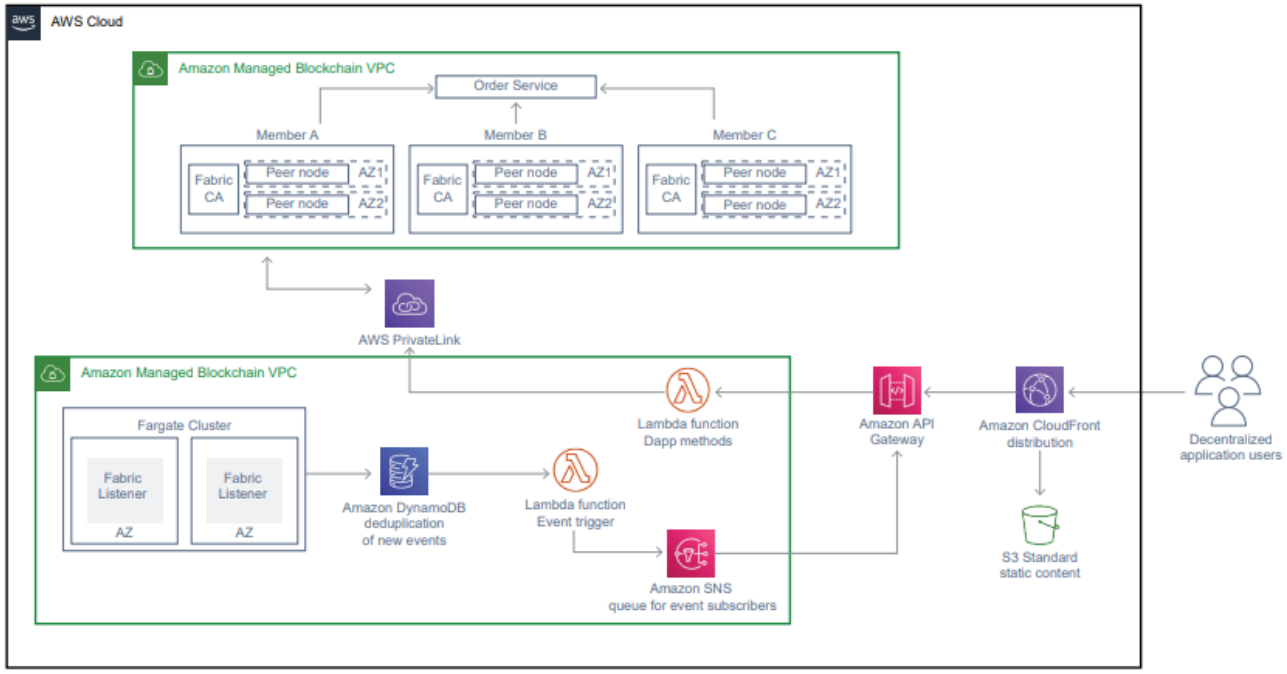

Fig. 1 – Amazon Managed Blockchain

Amazon Managed Blockchain is a fully managed service that allows organizations to easily create and manage private blockchains, or join a public blockchain network, in four simple steps:

1. Choose a framework: Organizations choose an open-source blockchain framework (in the case of the Tech Mahindra model, Hyperledger Fabric is the chosen framework). In a few clicks, organizations or users can join existing public networks or create a new private network.
2. Invite members: Organizations can invite other AWS accounts to join the private network.
3. Select nodes: Provision new nodes that store copies of the transaction ledgers.
4. Deploy applications: Deploy smart contracts and begin building decentralized applications.

Once the Amazon Managed Blockchain has been established as the foundation for a blockchain infrastructure, additional AWS services such as those for storage, databases, analytics, IoT, and machine learning can be leveraged to enhance the infrastructure and gain powerful insights.

Amazon Managed Blockchain (Fig. 1) extends the benefits from Tech Mahindra's conceptualized distributed NFT model as follows:

- **Fully managed**: Launch additional blockchain networks in minutes without additional configuration. The AWS Management Console enables organizations to choose and connect to a public network. Amazon Managed Blockchain enables a voting-based API in which network participants can vote to add or remove members attempting to connect to the network.

- **Choice of blockchain frameworks**: While Hyperledger Fabric is at the foundation of the Tech Mahindra conceptualized model, organizations have freedom of choice between two popular blockchain frameworks: Hyperledger Fabric and Ethereum.

- **Scalability**: AWS provides a breadth of Amazon Elastic Compute Cloud (Amazon EC2) instance types with varying combinations of CPU memory to support the blockchain workloads. AWS also provides APIs to quickly create new nodes to meet the changing demands of the application.

- **Security**: AWS KMS is used to secure Hyperledger Fabric's certification authority. Amazon Virtual Private Cloud (VPC) endpoints enable connectivity to services over AWS PrivateLink without exposing it to the internet.

- **Reliability**: Amazon Managed Blockchain is built using Amazon Quantum Ledger Database (Amazon QLDB) technology. It has an immutable change log that accurately maintains the complete history of all transactions in the blockchain network, ensuring the durability of the data. This improves the reliability of the "ordering service," which is a component in the Hyperledger Fabric framework that facilitates delivery of transactions across the blockchain network.

Tech Mahindra conceptualization of distributed NFTs on AWS

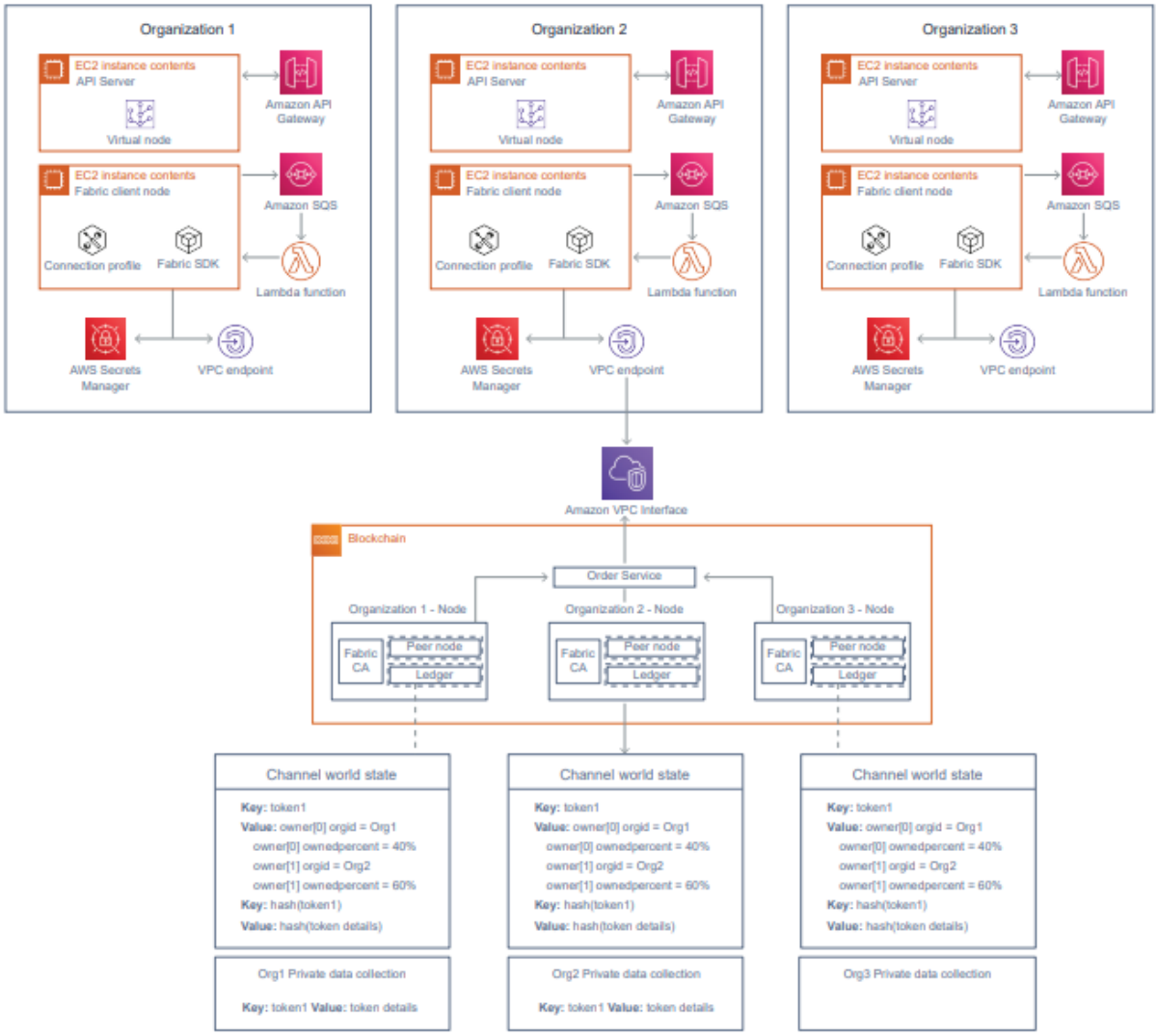

Fig. 2 – Tech Mahindra conceptualization of a distributed NFT solution using Amazon Managed Blockchain

Fig. 2 is a depiction of Tech Mahindra's distributed NFT solution using Amazon Managed Blockchain. In the scenario shown above, a three-organization blockchain network was created to run on Amazon Managed Blockchain. The NFT identifier and owner are stored in the public blockchain channel, and the asset metadata properties are securely stored in the private blockchain. As NFT transactions occur, the Amazon VPC end points that sit above the Tech Mahindra service, allow pre-defined domains and owners to communicate with the
Amazon Managed Blockchain service to validate metadata and ensure
all details of the transaction are logged. Within each participating organization or party, AWS Secrets Manager protects critical NFT data, allowing organizations to rotate, manage, and retrieve database and NFT credentials as needed.

The data structure consists of modifications to the standard structure and extensible attributes. Attributes will store all the owners of
the NFT and the fractional percentage of the NFT owned by them. Depending on the channel, extensible attributes (and uniform resource identifiers) can support various types of tokens by managing the extensible structure containing sub attributes.

Conducting NFT transfers

Creating the asset

To create a distributed NFT, a smart contract is deployed and distributed with a policy that requires endorsement from all parties or organizations that will have fractional ownership, allowing organizations to create NFT assets without endorsement from other channel owners. When the NFT is created, the managed service provider (MSP) IDs for the owning organization (seller), along with the percentage owned, is then recorded on the public channel. Any subsequent requests to update or transfer the asset will verify against the same MSP ID.

When the NFT is created, the smart contract will also set the endorsement policy, specifying that the fractional owners of the asset must endorse any requests to update or transfer the asset from the buyer to the seller. This measure helps to ensure that other organizations cannot update or transfer the asset without explicit permission from the owner. The owning organization can publish or advertise the sale of the NFT, but only for their percentage of the asset and with peer endorsement from within their organization. The buyer and seller must then agree on pricing and other terms, all of which will be stored as metadata in the private blockchain. The price is stored within the participating organizations' private data store, keeping it private from other members across the channel. A hash is then created and stored on the ledger. This process is used to determine whether the buyer and seller have agreed on the sale price. The hashes will only match if both parties agree to the transfer price and terms.

To keep the details of the transaction secure, random trade data is included in the agreement to prevent other parties from finding the details of the transaction.

Transferring the asset

Once the buyer and seller have agreed to the terms of the transfer, the seller can use the transfer function to initiate the sale. The term of the smart contract ensures that the selling organization is the only verified initiator of the sale. During the transfer, the NFT data on the public channel is verified with the data on the private data collection using the unique hash marks to ensure the owner is selling the correct, agreed upon NFT. If the hash data aligns, the NFT is moved to the buyer's private data store and deleted from the buyer's store. The transaction is then endorsed by both parties. Once the transfer is complete, the ownership on the public channel is updated and the endorsement policy across all fractional owners is updated to replace the buyer with the seller so the new owning organization can conduct transactions with their NFT. As a final step, the public pricing agreements are deleted, and sales receipts are logged in the private blockchain.

Tech Mahindra and AWS collaboration

Tech Mahindra is an AWS Premier Consulting Partner, AWS Managed Service Provider (MSP), and an AWS Migration Competency Partner. Tech Mahindra provides a unique cloud-native strategy and service delivery model to help customers become agile and build reliable platforms and applications on AWS. With reusable, configurable assets and frameworks, Tech Mahindra accelerates the journey to cloud.

With 1500+ accredited AWS employees and 500+ AWS certified engineers and architects, Tech Mahindra leverages its years of full-stack cloud experience to help customers reduce TCO, improve end user experiences, and deliver a strong adherence to governance and compliance regulations.

Tech Mahindra leveraged the computing power and scalability of AWS to create an optimal, high-performance distributed NFT model on Amazon Managed Blockchain, while continuing to improve and optimize the solution as the NFT landscape grows.

Getting started

To learn more about how your organization can benefit from NFTs and blockchain technology through fractional ownership and distribution, visit the Tech Mahindra blockchain solutions page or learn more about Amazon Managed Blockchain.