



Metaverse Standards Forum

NFT Metadata for the Metaverse (General)

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Reviewer	Due Date	Status	Contact
Digital Asset Management Working Group	September 24, 2025	Complete	digital_asset_management@lists.metaverse-standards.org
MSF Domains (Peer Review)	October 30, 2025	Complete	oversight@lists.metaverse-standards.org
Use Case Taskforce	October 31, 2025	Complete	use_case_task_force@lists.metaverse-standards.org

The purpose of this template is to provide a structured framework for collecting and documenting use cases within the Metaverse Standards Forum (MSF). Use cases are essential for understanding real-world scenarios where metaverse technologies are applied and where interoperability challenges may arise. This template guides MSF members in providing a concise yet comprehensive description of a use case, including its title, identifier, and summary. It also encourages contributors to list the benefits of the use case, identify actors or entities involved, and describe the use case scenario in detail, emphasizing interactions, challenges, and requirements. Additionally, it prompts the inclusion of relevant technical information, such as implementations, success metrics, and challenges faced. This template aims to facilitate the gathering of valuable use-case data to inform standards development and foster collaboration within the MSF community.

MSF members and MSF Domain Groups are invited to submit use cases.

NOTE: Organizations such as SDOs who want to submit and add a use case would need a sponsor that is an MSF member. This process is established in order to have a contact person in MSF that can handle discussions and resolve open issues within regular meetings.

Eligible submitters:

- MSF Domain Groups
- MSF Members (Principal and Participant)
- External Organizations with Liaison Agreements (with the support of a MSF member that acts as sponsor)
- Standard Development Organizations (with the support of a MSF member that acts as sponsor)

Minimum Requirements for MSF Member Submissions not part of a Domain Group:

- Minimum required number of proposers: 3
- Minimum required number of supporters: 5

NOTE: Use cases submitted by SDOs and Liaison Organizations would also need to fulfill the same requirements (and would need a sponsor) unless they are submitted by a Domain Group.

MSF: Metaverse Standards Forum

POG: Pre-qualified Organizations and Groups

SPP: Standards Related Publications and Projects

DWG: Domain Working Groups

WG: Working Group

SDO: Standards Development Organization

Use Case Title
NFT Metadata for the Metaverse (General)
Use Case Identifier
MSF2025-NFTG-001 • Version 1.0 • Year of Release: 2025
Summary of Use Case
Description: This use case describes the general needs and considerations for NFT metadata that enable assets to be discoverable, portable, and verifiable across diverse metaverse Platforms. The core challenge is reconciling how different Platforms interpret the same asset data, particularly when Platforms have different technical capabilities, rendering systems, and business models. The focus is on interoperability outcomes such as consistent interpretation, rendering, and provenance rather than any particular schema or chain. Benefits: • Ensures consistent cross-platform functionality and visual fidelity of NFT assets. • Improves discoverability and categorization of assets through standardized metadata tagging. • Supports asset ownership and provenance tracking, enhancing security and user trust. • Facilitates compliance with industry standards, benefiting creators, users, and Platform providers. • Reduces user friction by enabling cross Platform portability of assets.



- Supports ecosystem growth for creators and Marketplaces through consistent metadata and discoverability.

Contributors and Supporters

- Digital Asset Management Working Group
- MSF Domains (Peer Review)
- Use Case Taskforce

Keywords

NFT, Interoperable Metadata, Metadata Standards, Metaverse, Digital Assets, Interoperability, Cross-Platform Interoperability, Asset Portability, Blockchain, Blockchain Standards, Web3, ERC-721, ERC-1155, Asset Provenance, Ownership Verification, Asset Authentication, 3D Assets, 3D Models, Collectibles, Games, Digital Items, Avatar, Wearables, Accessories, Props, Virtual Environments, Virtual Worlds, Asset Bridging, JSON-LD, Schema.org, glTF, FBX, USD, OpenUSD, Storage, Asset Discovery, Asset Categorization, Standardized Metadata Schemas, Licensing, Usage Rights, Royalties, Creator Attribution, Asset Rarity, Edition Management, Asset Attributes, Marketplace, Trading, Asset Exchange, Virtual Reality (VR), Digital Identity, User Profile, Achievement System, Asset Rendering, Display Fidelity, Cross-Platform Compatibility, Performance, NFT Display, Asset Visualization, Digital Wallet, Asset Management, Collectibles, Asset Tracking, Asset Creation, Asset Minting, Asset Verification, Asset Utilization, Semantic Interoperability, Metadata Integration, API Standards, Asset Interaction Standards, Virtual Spaces, Digital Asset Management, Asset Metadata, Platform-Agnostic Assets

Actors/Entities

- **NFT:** Represents the digital asset with its metadata securely recorded on a blockchain, containing essential information about the asset's properties, provenance, and compatibility.
- **NFT Creators:** Individuals or organizations responsible for designing and minting NFTs with standardized metadata to ensure cross-platform compatibility.
- **NFT Minting Tool:** Software used to mint NFTs, facilitating metadata creation, schema adherence, and export in a standard format for interoperability.
- **Metaverse Platforms:** Virtual environments that enable users to access, use, and transfer NFT assets. These platforms rely on standardized metadata to ensure consistent rendering and functionality.
- **Users/players:** End-users who own, equip, or interact with NFTs across platforms. Users expect consistent functionality, ownership verification, and easy access to their NFTs across metaverse environments.



- **Chain:** A blockchain network that maintains immutable NFT ownership records and a pointer (URI) to the asset's metadata, while ensuring the underlying data security and verifiability of all maintained records
- **Marketplace Providers:** Platforms that facilitate the discovery, sale, and/or exchange of NFTs, relying on standardized metadata to enhance asset discoverability and classification.
- **Wallet:** A secure user-controlled digital tool for storing, managing, and interacting with NFTs, enabling seamless access, transactions, and interoperability across platforms.

Detailed Description of Use Case/Scenario

Preconditions:

- **Metadata Provision:** Creators provide metadata that the intended Platforms can parse for import.
- **Metadata Support:** Metaverse platforms must support the metadata they intend to consume for Cross-Platform use.

Main Flow:

1. **Create NFT Asset:** Creators develop digital assets i.e. NFTs (e.g., art, collectible) and define essential metadata properties (e.g., file format, resolution, usage terms) using the governing metadata model.
2. **Mint NFT Asset:** The minter mints the NFT along with metadata that is sufficient for cross-platform interpretation, enabling recognition and appropriate rendering by participating Platforms. This metadata is inclusive of the creator's digital identity, asset details, usage rights, and a unique identifier (e.g., contract address, token ID).
3. **Import NFT and Verify Ownership:** Platforms read the imported standardized metadata (e.g., tags, categories, format specifications) to identify and integrate the NFT asset, thereby ensuring cross-platform display fidelity and expected behavior. This standardized integration supports asset discoverability and provides users with intuitive access for easier location and import of their digital items. Ownership Verification is conducted by the Platform on the Chain (via the User's Wallet), confirming only legitimate owners can use the asset.
4. **Use NFT Asset Application:** Users equip or apply their NFT assets within virtual spaces. The Platform interprets the metadata which specifies interoperability details (e.g., model format, scaling, position adjustments) to ensure correct rendering and interaction. This process allows NFT assets to achieve display fidelity and behave as designed across varying virtual environments, delivering a smooth, platform-agnostic experience.
5. **Track Ownership and Provenance:** Platforms verify NFT ownership on the Chain (e.g., via the User's Wallet), ensuring assets are legitimate and possess a clear ownership chain. The Chain maintains this information, allowing Platforms and Marketplaces to confirm asset provenance and authenticity. This process of verified ownership and clear provenance enhances user trust and provides creators with credit for their work.
6. **Facilitate NFT Exchange and Exporting:** Marketplaces utilize metadata to NFT assets, which facilitates sale and transfer by improving discoverability and accessibility. When exporting NFTs between Platforms, metadata compliance ensures that assets retain fidelity in appearance and behavior. This process makes NFT assets easily traded or



moved between environments, maintaining their original specifications and ensuring functionality in each Platform.

7. **Trade Exported NFT Assets:** Users trade exported NFT assets by transferring them across Platforms without losing customizations. Metadata ensures that all asset attributes retain and recognize across different Platforms, facilitating seamless portability and cross-platform functionality.
8. **Enable Personalization of NFT Assets:** Users customize NFT assets further within Platforms. The Platform stores these changes in metadata extensions or separate companion NFTs. The customizations adhere to metadata standards to maintain cross-platform compatibility and fidelity.
9. **Disclose Licensing and Rights:** This use case anticipates that metadata references licensing or usage terms. Specific license taxonomies or enforcement mechanisms are out of scope for this document.

Postconditions

- **Seamless Functionality:** NFT assets have been seamlessly integrated across compatible Platforms, retaining their visual and functional integrity.
- **Verifiable Ownership & Standards Compliance:** Ownership and provenance remain verifiable via blockchain, while assets adhere to discoverability and categorization standards, ensuring seamless integration and compliance across platforms.

Implementations and Demonstrations or Technical Feasibility

Implementations and Demonstrations

- [OpenSea](#): A marketplace that facilitates the creation, buying, and selling of NFTs with metadata for a broad range of digital assets. While it supports cross-platform discovery and transactions, a unified metadata standard would enhance asset portability between Platforms.
- [Decentraland](#) and [The Sandbox](#): Both platforms allow users to import and interact with NFT-based assets. However, full interoperability across these Platforms requires standardized metadata to ensure consistent rendering and functionality.
- [OpenVoxels](#): Users can create, display, and use NFT-based assets within the platform; without cross-platform standards, these assets are not universally compatible with other environments.
- [Spatial](#) (powered by Unity): Spatial allows users to import and use 3D NFTs in virtual spaces, emphasizing compatibility with glTF formats, a step toward universal asset integration.

Technical Feasibility:

- **File Formats:** Adoption of glTF and FBX for 3D models, as well as PNG or JPEG for textures, makes standardization technically feasible, ensuring that NFT metadata can be recognized and displayed consistently across Platforms.
- **Blockchain Standards:** The Ethereum standards [ERC-721](#) and [ERC-1155](#) provide a foundation for metadata storage and transfer. These standards facilitate ownership verification and ensure that metadata extensions for compatibility, creator details, and usage rights are embedded within the NFT structure.



- **API and Metadata Schemas:** APIs that support standardized metadata schemas enable Platforms to import, render, and apply NFT assets without additional configuration. Metadata schemas compatible with industry standards (e.g., Schema.org) further support discoverability.

Challenges:

- **Interoperability Across Platforms:** Ensuring assets behave as intended across different rendering engines, physics, and asset management systems may pose a challenge. This includes physics-based interactions and platform-specific constraints, while recognizing NFT metadata standards (ERC-721 and ERC-1155) across all Platforms.
- **Complex Assets Metadata:** Current NFT metadata conventions only support basic image display (name, description, image URL), lacking a standardized approach for the complex data required by metaverse assets (e.g., 3D models, animations, physics properties, or interactive behaviors).
- **Economic Barriers Disincentivizing Adoption:** Platforms have strong economic incentives to lock users into their ecosystems through proprietary assets. The challenge lies in overcoming this disincentive where Platform A would lose revenue by accepting assets from Platform B, and failing to establish clear business models for cross-platform infrastructure.
- **Security of Metadata Integrity:** While blockchain technology secures ownership records, Platforms handling user metadata face multiple challenges, including preventing unauthorized access and data breaches in shared environments. The complexity lies in seamlessly integrating ownership verification for non-technical users without compromising security or exposing sensitive personal data.
- **Double-Spending and Asset Duplication:** Ensuring that the metadata and asset uniqueness remain intact to prevent scenarios where duplicate assets appear or are used across multiple Platforms is key, even as assets move across various metaverse spaces.
- **Universality of Attachment Systems:** Establishing universal attachment point standards is required to allow any NFT asset to connect properly across different virtual worlds, given that different Platforms use incompatible systems for attaching assets to environments, characters, or other objects.
- **Defining Asset Boundaries:** Establishing standardized asset boundaries between primary assets, sub-components, and accessories in a way that maintains consistency across Platforms is crucial as it would help address the lack of clear definitions for what constitutes a single NFT asset.
- **Content Sensitivity and Regulation:** The global nature of the metaverse complicates the management of Content Sensitivity, which is subject to diverse Cultural Norms and Governmental Regulations. The vast array of individual Ideological and Social Concerns makes it exceedingly difficult for platforms to unilaterally control all potential issues associated with user-created NFT assets.
- **Physiological and Dimensional Constraints:** Managing the Physical Limitations of an NFT asset requires standardized scaling and physics rules. Decisions must be made on whether an NFT should Automatically Scale if its dimensions are inappropriate and if it



should be assigned Simulated Properties such as Weight, Mass, or Volume to maintain realism and system integrity.

- **Interactivity and Physics Engine:** The seamless interaction of an asset with the Platform's Scene and its underlying Physics Engine while preserving functionality is essential for user experience. Failures in Interactivity Management or improper application of Simulated Physics can lead to visual glitches, clipping issues, and a fundamental breakdown in the Platform's Scene/World disrupting Immersion and Credibility aspects.
- **Lack of Uniform NFT Metadata Standards:** Establishing uniform standards for NFT metadata that can be universally applied across metaverse Platforms is a crucial challenge. These standards must be flexible enough to accommodate diverse Platform requirements while maintaining absolute consistency.
- **Lifting Technical Barriers:** Overcoming the adoption barriers created by users' lack of understanding of NFT assets and management is essential. The challenge involves addressing security, privacy, and technical complexity concerns to make ownership and management accessible to non-technical users.
- **Common Accessibility Standards:** Ensuring Universal Access to NFT assets and their management interfaces to support users with disabilities is critical. This necessitates the establishment of common accessibility standards for NFT metadata that ensure assets and interfaces respond to the unique requirements of people with various disabilities and irrespective of the Platform in use.
- **Semantic and Contextual Incompatibility:** The loss of an asset's meaning and functionality during cross-platform transport is highly likely, raising the importance for developing metadata schemas that effectively express context dependencies and functional requirements without distorting the underlying asset metadata.
- **Bridging Core Platform Gaps:** Current metadata approaches often assume technical compatibility that may not exist between fundamentally different rendering engines and physics systems. It is essential to address the core Platform differences that cannot be bridged by metadata alone.
- **Governance and Evolution:** A lack of clear authority to define, update, and enforce metadata standards across independent Platforms and chains is a critical barrier. The challenge is establishing legitimate governance structures that can evolve standards over time while maintaining backward compatibility and achieving consensus among competing stakeholders.
- **Performance and Scalability:** Supporting millions of NFT assets across platforms poses significant technical challenges. The primary concern is minimizing computational costs for large-scale ownership verification while ensuring responsive rendering and real-time updates. Future standards should support dynamic adaptation of asset complexity, resolution, and rendering to maintain consistent performance without degrading visual quality. Advancements in AI, machine learning, and augmented reality (AR) can further optimize real-time processing of NFT metadata, automate asset generation and contextual adjustment, and enable seamless interaction between digital and physical environments.
- **IP Rights and Derivative Work Governance:** Establishing clear Intellectual Property frameworks that protect creator rights while allowing necessary Platform modifications and user customizations is a challenge. This is complicated by unclear ownership boundaries between original NFT creators, Platforms, and users (regarding derivative works and



modifications), all while navigating conflicting international laws and platform-specific Terms of Service conflicts.

Requirements:

Technical and Functional Requirements

- **Standardized Metadata Schema:** Adoption of a standardized metadata schema (e.g., aligned with ERC-721 and ERC-1155 for NFTs) is essential. Common metadata fields may include: file format (USD, MOV, JPG, GLB), asset category (environment, avatar, accessory, prop), material specifications, creator attribution, rights holder, usage permissions, rendering hints, and level-of-detail references. Metadata may be organized into profiles such as Basic (core properties), Attachable/Wearable (equipment systems), Scene (environments), Interactable (object behaviors), Vehicle (movement), Royalty (revenue/rights), and Identity (authentication), as demonstrated by integration frameworks like MVMD.org. This facilitates seamless cross-platform usage and enhances asset discoverability by providing a consistent format for all metadata.
- **API Integration for Metadata Management:** Development of APIs that allow Platforms to read, validate, and implement NFT metadata dynamically is crucial for real-time updates and interoperability. This enhances user experience by allowing real-time modifications (e.g., dynamic textures or animations) and ensures assets remain synchronized across Platforms.
- **Ownership and Provenance Verification:** Systems need to support verification of asset ownership and provenance tracking through blockchain-based mechanisms. This establishes trust and authenticity while preventing fraudulent ownership claims and enabling transparent transaction histories.
- **Discoverability and Tagging System:** Standardized tags and categories must be used within metadata to improve asset searchability within Platforms and across Marketplaces. This enhances user experience by enabling accurate, intuitive search and filtering functions.
- **License Management Systems:** The system must track license types, usage permissions, temporal constraints, and enforcement mechanisms. Metadata needs to express license terms including permissions for viewing, using, or sublicensing assets, with optional support for token-gated access. This ensures proper rights management, usage compliance, and intellectual property protection while facilitating seamless license verification across Platforms.
- **Digital Asset Rarity System:** The system must utilize systems for describing editions, total supply, and trait combinations must remain aligned when assets transfer between Platforms. Cross-platform rarity descriptors ensure edition numbers and trait uniqueness maintain consistency. This enables accurate valuation and authenticity verification while preserving scarcity metrics and asset value integrity across different ecosystems.
- **Environmental Impact Tracking:** Optional environmental impact descriptors and sustainability disclosures should be included in standardized formats compatible with blockchain-verifiable initiatives. This provides transparency regarding environmental costs, enables cross-platform sustainability tracking, and supports sustainable practices in digital asset creation and trading.



- **Access Control and Permissions:** Metadata must include permissions specifying who can view, edit, or transfer an NFT, as well as any token-gated access requirements. This ensures that only authorized users interact with NFTs, securing asset usage and protecting intellectual property.
- **Audio Asset Standardization:** Audio metadata specifications must include format requirements, quality metrics, accessibility features, collaborative credits, synchronization data, and integration with visual elements. This ensures consistent audio asset behavior and accessibility across Platforms while maintaining proper attribution.
- **Notifications:** The system must deploy real-time alert mechanisms to notify users of critical metadata changes (e.g., changes to the asset's attributes, permissions, or core URI). This ensures transparency and prevents loss of trust due to unexpected changes to the asset's utility or appearance.
- **Regulatory Compliance Frameworks:** The system must ensure that the use, storage, and sharing of NFT Metadata complies with all relevant Legal and Regulatory Requirements, including data protection, intellectual property, and privacy laws, preventing legal issues and enhancing user trust.
- **Scalability Solutions:** The system must develop scalable solutions that handle large volumes of real-time requests for NFT Metadata without leading to Performance Degradation, ensuring reliable and efficient asset loading and rendering across all platforms.
- **Verification Services:** The system must utilize robust, decentralized methods to continuously validate the integrity and authenticity of the NFT Metadata prior to rendering or transaction finalization. This explicitly protects against fraudulent data injection and asset misrepresentation.
- **User-Friendly Interfaces:** The NFT Metadata Standard must be designed to facilitate the creation of Intuitive and User-friendly Interfaces for viewing and managing the asset's attributes. This directly improves User Satisfaction and encourages broad platform adoption.
- **Audit and Reporting Tools:** The system must implement tools for Auditing and Reporting on all critical changes to the NFT Metadata (e.g., updates to rendering hints, material specs, or usage permissions). This provides transparency and accountability, helping verify asset integrity and usage compliance.

Interoperability Requirements:

- **Standardized Protocols:** The system must establish common protocols for rendering, physics, and interactions to align the functional behavior of NFTs across Platforms. This prevents functional discrepancies between Platforms, allowing users to experience assets as designed across environments.
- **Cross-Platform Compatibility:** Participating Platforms commonly support open 3D asset formats (for example glTF and FBX) and consume the metadata they intend to render across environments, including bridging between Web2 and Web3 ecosystems. This ensures the asset's rendered geometry and material properties maintain visual and functional consistency, regardless of the Platform's rendering engine or avatar system.
- **Device and Software Compatibility:** Validation of asset import and rendering must occur across device classes (VR headsets, mobile, desktop) and engine stacks. This

encourages portability across heterogeneous runtimes without requiring any specific platform.

Other Key Considerations:

- **Privacy:** NFT Metadata systems must avoid storing sensitive user data, especially when shared across Platforms, to comply with privacy regulations. This protects user privacy and maintains Platform compliance with data protection laws.
- **Cybersecurity:** Robust cybersecurity measures, securing access to user data, NFTs, and metadata with appropriate protections, reducing risks of unauthorized access. This protects users' personal and asset data, mitigating risks of data breaches and unauthorized duplication of NFTs.
- **Identity Verification:** The system must integrate identity verification with blockchain-based ownership verification to authenticate user interactions with NFTs. This builds user trust by preventing identity fraud and ensuring that users can securely prove asset ownership.
- **Networking and Latency:** Network and infrastructure optimization is required to reduce latency for loading assets and enable real-time metadata updates. This ensures that NFTs load and respond quickly, preserving quality and performance for the user.
- **Ownership:** The system must provide granular user controls that allow owners to limit the disclosure of optional, platform-specific NFT Metadata across Platforms and contexts. This supports compliance and user expectations for data sovereignty without prescribing any mechanism.
- **Digital Ethics:** The system must uphold ethical standards by establishing clear governance mechanisms—such as affiliation with an Ethics Board and transparent data practices—to ensure the proper, unbiased, and responsible use of NFT metadata and user interaction data.
- **Provenance:** The system must maintain accurate and immutable tracking of data sources, creation history, and every critical change to the NFT Metadata (e.g., version control, attribute modifications) to uphold the integrity and trustworthiness of the digital asset over its entire lifecycle.
- **Accessibility:** The system must ensure that NFT metadata and its management controls are accessible to all owners, regardless of technical expertise, by adhering to recognized accessibility standards such as WCAG. Platforms should prioritize inclusive design, ensuring usability for people with different abilities and providing customizable features—such as text-to-speech and visual customization options—to promote broad participation and equitable access.

Relevant Domain Working Group (WGs):

- MSF WGs:
 - 3D Asset Interoperability using USD and glTF WG
 - Interoperable Characters/Avatars
 - Digital Fashion Wearables for Avatars
 - Privacy, Cybersecurity and Identity
 - 3D Web Interoperability



- Standards Register
- OMA3 NFT Standards WG
- Khronos Group WGs:
 - 3D Commerce
 - 3D Formats
 - Web GL
 - OpenXR
- W3C WGs:
 - Immersive Web
 - GPU for the Web

Relevant Pre-qualified Organizations and Groups (POGs):

- **W3C (World Wide Web Consortium):** Plays a key role in developing web standards that enable rendering and interoperability for NFT avatars in browser-based metaverses, particularly through standards such as Khronos's WebGL for GPU-accelerated 3D graphics, and glTF for efficient model transmission and metadata integration.
- **Schema.org:** Provides a shared vocabulary for describing internet-based resources, allowing search engines and platforms to parse metadata efficiently.
- **Khronos Group:** An open consortium creating royalty-free standards for 3D graphics and XR to enable seamless avatar rendering, customization, and interaction in metaverses. Key WGs include: 3D Commerce (refines 3D avatar model compatibility/streaming); WebGL (browser-based 3D rendering without plugins); WebGPU (high-performance web API for complex avatar graphics/computation); and OpenXR (unified VR/AR API for cross-device deployment).
- **Alliance for OpenUSD (AOUSD):** An open, non-profit organization dedicated to the standardization, development, evolution, and growth of the OpenUSD (Universal Scene Description) technology.
- **Open Metaverse Alliance for Web3 (OMA3):** Directly involved in creating fundamental metaverse interoperability standards, including those driven by its NFT Standards WG for Metadata and Wearables, among its other working groups.
- **Open Geospatial Consortium (OGC):** An international voluntary consensus standards organization dedicated to advancing open standards that enable the discovery, exchange, fusion, and application of geospatial (location) information and services
- **Virtual Reality Model (VRM) Consortium:** The VRM Consortium focuses on standardizing 3D humanoid avatar models for virtual and augmented reality applications, ensuring interoperability across various platforms.
- **Academy Software Foundation (ASWF):** A non-profit organization that hosts core open-source software for the film industry. It standardizes digital material exchange by governing **MaterialX** and its unified shading model, **OpenPBR**, ensuring consistent visual fidelity across content pipelines.



- **International Press Telecommunications Council (IPTC) Photo Metadata:** An industry standard for embedding essential administrative, descriptive, and copyright information (such as creator, keywords, and usage rights) directly into digital image files.
- **Dublin Core Metadata Initiative:** An international standard that promotes a simple, cross-disciplinary set of 15 core elements, **including Title, Creator, and Subject**, to ensure broad resource discovery and interoperability for nearly any digital or physical resource, from documents to images.
- **Coalition for Content Provenance and Authenticity (C2PA):** An open, cross-industry standard that creates Content Credentials—a tamper-evident, cryptographically signed metadata manifest. This manifest is bound to digital content (images, video, audio, and documents) to provide a verifiable record of its origin, history (including Generative AI use), and changes, allowing consumers and publishers to make informed trust decisions
- **Ethereum Foundation:** As the major blockchain platform for NFTs, the Ethereum Foundation's involvement ensures that NFT metadata aligns with core blockchain token standards, specifically **ERC-721**, and **ERC-1155**.

Relevant Specifications, Publications and Projects (SPPs):

- **W3C JSON-LD Specification (JSON for Linking Data):** Enhances NFT metadata with semantic context for machine readability in RDF systems, aiding interoperability in cases like cross-chain NFTs or provenance tracking. However, it's not the primary standard (ERC-721 relies on plain JSON) and isn't universally vital for discoverability across marketplaces or dApps.
- **W3C WebXR Device API:** Standardizes the rendering of VR and AR experiences within a browser. It is capable of displaying 3D models linked to NFTs (such as glTF files fetched from a URI) using standard web technologies like the Fetch API and WebGL. It enables seamless, open-web rendering that relies on external systems for those specific Web3 functionalities.
- **ERC-721 and ERC-1155:** Ethereum token standards (Non-Fungible and Multi-Token, respectively) that establish the foundational on-chain ownership model for unique or limited-edition digital assets, providing the initial structure for NFT metadata.
- **Graphics Language Transmission Format (glTF 2.0):** An open, royalty-free specification often called the "JPEG of 3D." It defines an efficient, compact file format for transmitting and loading 3D scenes and models. For NFT avatars, it supports linked 3D assets—both dynamic and static animation—enabling vendor-neutral, low-overhead experiences across browsers, metaverse platforms, and AR/VR devices.
- **Khronos Texture (KTX 2.0):** Khronos container for GPU textures using Basis Universal supercompression, enabling efficient runtime transcoding and minimal file sizes. It complements glTF-based NFTs by compressing textures for faster loads and lower GPU use, ideal for complex 3D assets across varied devices.
- **Basis Universal:** An open-source texture supercompression codec, fundamental to the KTX 2.0 GPU texture format. It radically shrinks texture files (by 6x or more) by storing them in an intermediate format that is transcoded at runtime to native GPU standards like ASTC or ETC2.



Related Use Cases

- NFT Metadata for Avatars in the Metaverse (MSF2025-NFTA-001)
- NFT Wearables Metadata for the Metaverse (MSF2024-NFTMW-001)
- Metaverse Universal Manifest (MUM) (MSF2025-MUM-001)
- Proof of Fairplay & Verifiable Integrity (MSF2025-PoFVI-001)

Additional Comments

- This document is a living artifact and may be subject to revisions on a periodic basis to reflect the future state of NFT Metadata for the Metaverse, and or based on feedback received from MSF stakeholders that warrants an update in the future.