

ICN Challenges for Metaverse Platform Interoperability

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Jungha Hong

ETRI

Objective and Goal of this draft

- Objective

- Explore how ICN can address key challenges for metaverse platform interoperability

- Goal

- Provide a foundation for ICN-based interoperability in the metaverse and promote further IETF collaboration

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Introduction to the Metaverse (1/2)

- Definition of metaverse, from [ITU FGMV-20](#)
 - An integrative ecosystem of virtual worlds offering immersive experiences to users, that modify pre-existing and create new value from economic, environmental, social and cultural perspectives
 - NOTE – A metaverse can be virtual, augmented, representative of, or associated with the physical world

Introduction to the Metaverse (2/2)

- Need for Interoperability
 - Metaverse platforms are developed by different companies, each with its own set of rules, protocols, and assets → creates a fragmented metaverse ecosystem
 - Interoperability allows users to interact, transfer assets, and share experiences seamlessly across platforms
- Challenges with Current Networks
 - Traditional host-based networks have limitations for interoperability
 - ICN offers a content-centric alternative focused on data, not location, ideal for cross-platform connectivity

Metaverse Platform Interoperability - Use Cases

- Cross-Platform Exhibition
 - Users access immersive exhibitions across platforms with AR/VR elements.
 - ICN enables efficient content distribution and caching, ensuring consistent experiences.
- Cross-Platform Shopping
 - Users buy, sell, and trade digital assets across platforms.
 - ICN supports secure, consistent access to digital assets regardless of platform.
- Cross-Platform Co-Working
 - Virtual offices allow users to collaborate across platforms.
 - ICN ensures smooth access to shared assets and real-time data streaming.

Why Information-Centric Networking (ICN)?

- ICN Overview
 - ICN focuses on content retrieval by name rather than by server location.
 - Enables efficient and flexible data access across platforms, making it a strong candidate for the metaverse.
- Benefits of ICN for the Metaverse
 - Content-Based Access: Users can request data by name, accessing content directly across platforms.
 - Reduced Dependence on Central Servers: Decentralized data storage enhances scalability and resilience.
 - Security and Efficiency: Built-in caching, multicast, and content security make ICN well-suited for secure, real-time cross-platform interactions.

ICN Strengths for Metaverse Interoperability (1/2)

ICN Features	Strength	Benefit
Content-Centric Communication	Data is accessed by name, not location	Simplifies asset sharing across platforms without reliance on central servers
Efficient In-Network Caching	Stores frequently accessed data closer to users	Reduces latency, allowing instant access to shared virtual assets across platforms
Seamless Multicast and Broadcast	Distributes data to multiple users simultaneously	Supports shared experiences (e.g., events) by delivering content to all participants in real-time

ICN Strengths for Metaverse Interoperability (2/2)

ICN Features	Strength	Benefit
Security and Data Integrity	Secures content with embedded encryption and authentication	Protects digital assets and ensures privacy as assets move across platforms
Dynamic Data Naming (NDOs)	Provides flexible, granular control over data	Enables asset management and rights tracking, critical for cross-platform interactions
Scalability and Resilience	Scales efficiently with a growing user base	Ensures smooth interactions as more users and platforms connect.
Decoupling Content from Location	Data storage and access are independent of physical location	Makes assets accessible across platforms, supporting an open and interconnected metaverse

ICN Challenges for Metaverse Interoperability

- Scalability
 - Managing large data volumes and simultaneous interactions across platforms without causing bottlenecks.
- Latency and Real-Time Interaction
 - Achieving ultra-low latency for real-time interactions, such as avatar movement and voice communication.
- Security and Privacy
 - Ensuring secure content distribution across platforms, including strong encryption and access controls.
- Data Ownership and Rights Management
 - Supporting complex ownership structures, with permissions and usage rights for assets across platforms.

Proposed Solutions for ICN in Metaverse Interoperability

- Adaptive Caching Strategies
 - Optimize caching to reduce latency and keep content readily available near users.
- Leveraging Multicast and Broadcast
 - Use ICN's multicast capabilities to improve content distribution for real-time, interactive experiences.
- Enhanced Security Layers
 - Implement advanced encryption, authentication, and access controls to protect digital assets and sensitive data.
- Rights Management via Named Data Objects
 - Enhance NDOs to manage ownership, permissions, and usage rights for assets in the metaverse.

Thank you!