

# ITU Focus Group Technical Report

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ITU Focus Group on metaverse  
(FG-MV)

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**FGMV-32**

**Overview of metaverse**

*Working Group 1: General*





# Technical Report ITU FGMV-32

## Overview of metaverse

### Summary

Metaverse is defined as 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 [b-ITU FGMV-20]. It serves as a virtual shared space accessible to everyone and also as a comprehensive term referring to the entire digital and virtual world. The metaverse represents the convergence of physical, augmented, and virtual reality within a shared online space. Key branches of the metaverse include CitiVerse, industry, power grid, tourism and so on. Within the metaverse, each user maintains their unique perspective on the virtual world, while the underlying environment ensures a consistent state for all users. This document presents an overview of metaverse technologies, encompassing overview, characteristics, metaverse elements and roles.

### Keywords

metaverse; overview; ecosystem

### Keywords

digital transformation; metaverse; CitiVerse; people-centred; smart cities

### Note

This is an informative ITU-T publication. Mandatory provisions such as those found in ITU-T Recommendations lie outside the scope of this Technical Report, which should only be referenced bibliographically in ITU-T Recommendations.

### Change log

This document contains Version 1.0 of the ITU Technical Report on “Overview of metaverse” approved at the 7th meeting of the ITU Focus Group on metaverse (FG-MV) held on 12-13 June 2024.

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Additional information and materials relating to this report can be found at: <https://www.itu.int/go/fgmv>. If you would like to provide any additional information, please contact Cristina Bueti at [tsbfgmv@itu.int](mailto:tsbfgmv@itu.int).

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# Technical Report ITU FGMV-32

## Overview of metaverse

### 1 Scope

The scope of this Technical Report includes:

- Overview of metaverse;
- Characteristics of metaverse;
- Building elements of metaverse;
- Stakeholders of metaverse.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Technical Report are, therefore, encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is published regularly. The reference to a document within this Technical Report does not give it, as a stand-alone document, the status of a Recommendation.]

None.

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Technical Report uses the following terms defined elsewhere:

**3.1.1 metaverse** [b-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.

#### 3.2 Terms defined in this Technical Report

This Technical Report defines the following terms:

None.

### 4 Abbreviations and acronyms

This Technical Report uses the following abbreviations and acronyms:

AD	Advertiser
AI	Artificial Intelligence
AR	Augmented Reality
CC	Content Creator
DAP	Digital Asset Provider
PM	Payment Manager
PP	Platform Provider

IoT	Internet of Things
MR	Mixed Reality
SP	Service Provider
TP	Third Party
UI	User Interface
VM	Virtual Market
VR	Virtual Reality

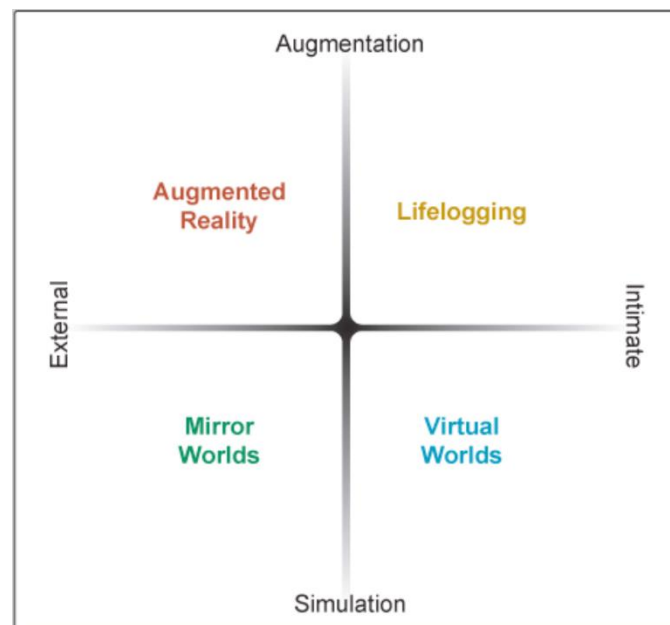
## 5 Conventions

None.

## 6 Overview of metaverse

According to [b-ASF-MVRM], the metaverse is a complex concept. In recent years, the term has grown beyond Stephenson’s 1992 vision of an immersive 3D virtual world to include aspects of the physical world objects, actors, interfaces, and networks that construct and interact with virtual environments. The metaverse is the convergence of virtually enhanced physical reality and physically persistent virtual space. It is a fusion of both, while allowing users to experience it as either.

The complexity of the metaverse suggests great uncertainty about how and when its forces and features will manifest in society. In such conditions, foresight professionals frequently use a scenario approach, creating a set of partly-unique and partly overlapping stories of future conditions. Scenarios are not a method of finding probable futures; instead, they are tools for exploring possible futures, and looking for less-obvious implications. To construct our scenario set we selected two key continua that are likely to influence the ways in which the metaverse unfolds: the spectrum of technologies and applications ranging from augmentation to simulation; and the spectrum ranging from intimate (identity-focused) to external (world-focused) [b-ASF-MVRM].



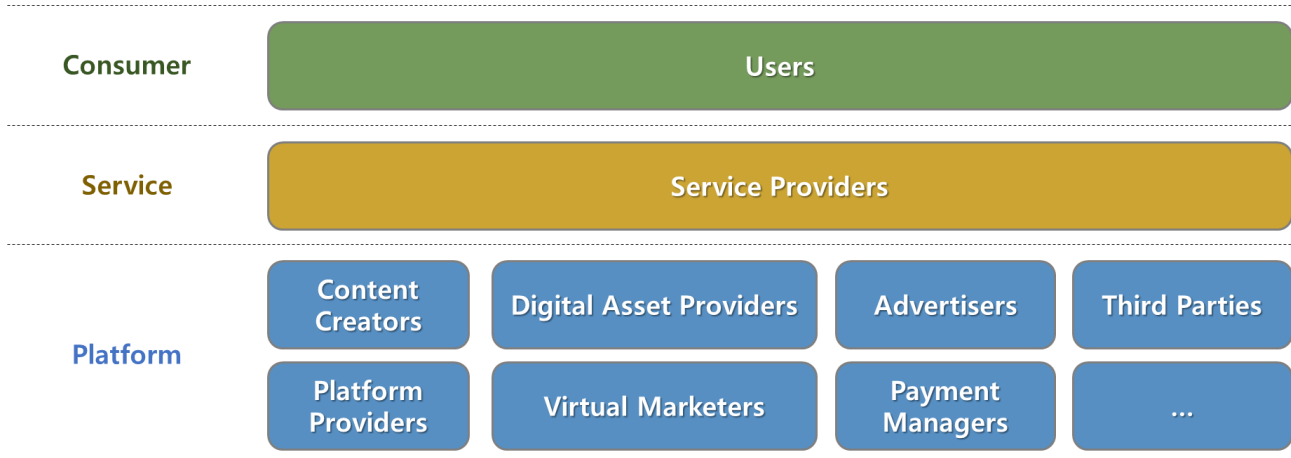
**Figure 1 Metaverse scenarios [b-ASF-MVRM]**

Combining the two critical uncertainties gives four key elements of the metaverse future: Virtual Worlds, Mirror Worlds, Augmented Reality and Lifelogging as shown in Figure 1. These key elements are defined by [b-ASF-MVRM] as follows:



- **Virtual Worlds (Intimate/Simulation):** Virtual worlds increasingly augment the economic and social life of physical world communities. In the future, the sharpness of many virtual and physical world distinctions will be eroded. In both spaces, issues of identity, trust and reputation, social roles, rules, and interaction remain at the forefront.
- **Mirror Worlds (External/Simulation):** Mirror worlds are informationally-enhanced virtual models or “reflections” of the physical world. Their construction involves sophisticated virtual mapping, modelling, and annotation tools, geospatial and other sensors, and location-aware and other lifelogging (history recording) technologies.
- **Augmented Reality (External/Augmentation):** In augmented reality, metaverse technologies enhance the external physical world for the individual through the use of location-aware systems and interfaces that process and layer networked information on top of our everyday perception of the world.
- **Lifelogging (Intimate/Augmentation):** In lifelogging, augmentation technologies record and report the intimate states and life histories of objects and users, in support of object- and self-memory, observation, communication, and behavior modelling. Object Lifelogs (e.g., “spimes,” and “blogjects”) maintain a narrative of use, environment and condition for physical objects. User Lifelogs, (e.g., “life-caching,” “documented lives,”) allow people to make similar recordings of their own lives. Object lifelogs overlap with the AR scenario, and both rely on AR information networks and ubiquitous sensors.

Figure 2 visually explains the conceptual arrangement of metaverse elements through a layered approach in metaverse ecosystem. These layers consist of the platform, service, and consumer. To break it down further, these layers encompass elements such as the foundational structure, the technology underpinning it, the central platform, the metaverse's functional components, and the individuals who engage with it.



**Figure 2: Example of stakeholders in metaverse**

The metaverse can be brought to life by employing essential technologies such as multimedia, artificial intelligence, digital twin, blockchain, and other innovations within its foundational infrastructure. This infrastructure encompasses components like the Internet of Things (IoT), high-speed, low-latency networks, as well as cloud and edge computing.

Furthermore, metaverse elements can be classified into three categories: platform, application (or service), and customer. The metaverse platform includes platform providers, virtual marketers, payment managers, content creators, digital asset providers, advertisers, and third parties. Further information, including descriptions, roles, and interfaces related to the metaverse elements, is provided in clause 9.

## 7 Characteristics

According to [b-Matthew Ball], metaverse is described as “A massively scaled and interoperable network of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments.” Each element of the description includes various characteristics of metaverse as follows:

- **Virtual worlds (or immersive):** Encompass a range of computer-generated environments from immersive 3D spaces to text-based realms, serving diverse purposes beyond mere entertainment such as education and urban planning, reflecting their growing importance and versatility in various applications.
- **3D (or inter-dimensional):** Represents a shift from traditional 2D interfaces to immersive, interactive 3D spaces that better reflect human experiences and interactions, significantly influencing how we engage with digital content and potentially transforming industries like education through more dynamic and engaging online experiences.
- **Real-time rendered:** Crucial for interactive virtual environments, allows a virtual world to respond dynamically to user inputs by continuously generating visuals at high speeds
- **Interoperability:** allows users to seamlessly transfer content like avatars and items across different platforms.
- **Massively scaled:** Metaverse, akin to the Internet, necessitates a massive scale with countless virtual worlds to truly embody its concept, surpassing the limited scope of a digital theme park with few attractions.
- **Persistence:** Extends the complexity of managing data and computational resources but enriches the user experience by making virtual interactions more meaningful and realistic.
- **Synchronicity:** Crucial for shared experiences in the metaverse, requiring high bandwidth, low latency, and continuous internet connections. It is necessary to manage data efficiently and reduce latency, ensuring that users can interact seamlessly in these immersive environments.
- **Unlimited users & individual presence:** Metaverse supports more than a few hundred concurrent users in functionality and quality.

In addition, metaverse is a unique and dynamic environment that offers new possibilities for social interaction, entertainment, and commerce. Its immersive and interactive nature, combined with its decentralized and collaborative infrastructure, make it a potentially transformative technology that could reshape interaction with the digital world.

- **Decentralized:** Metaverse is built on blockchain technology, which allows for a decentralized infrastructure that is resistant to censorship and manipulation. This enables users to have greater control over their digital identity and virtual assets.
- **Collaborative:** Metaverse is a collaborative environment, where users can work together to create and develop virtual content and experiences. This can range from building virtual real estate to creating new games or virtual art.
- **Virtual Economy:** Metaverse has its own virtual economy, where users can buy, sell, and trade virtual goods and services. These transactions are often conducted using virtual currencies and are secured through blockchain technology.
- **Social:** Metaverse is a social environment, where users can connect with each other and form communities around shared interests. This can include socializing, gaming, or participating in virtual events and activities.
- **Contribution-based:** Metaverse is an open-ended environment, where users have the freedom to create and explore in whatever way they choose. This level of creative freedom allows for endless possibilities and innovation.

## 8 Building elements of metaverse

The metaverse is introduced in this document through a model that breaks down its components into five core building elements: infrastructure, human augmentation, digital identity, economic enablers, and ecosystem. Consumers can seamlessly explore both virtual and physical worlds in the metaverse, thanks to advanced connectivity and computing infrastructure, along with various software and hardware platforms, and human interface technologies. With the support of digital identity and decentralized finance technologies, the metaverse is increasingly offering immersive experiences that significantly impact economic and social aspects, thereby continuously evolving and nurturing its ecosystem.

- **Ecosystem:** Economic, environmental, social and cultural perspectives
- **Economic enablers:** decentralized financial, blockchain, cryptocurrency, NFT, commerce, advertising, payment, transactions
- **Digital identity:** Digital identity, avatar, agent, multiuser and multitasking, social graphs, rating, social curation, security, privacy
- **Human argumentation:** Mobil devices, headsets (VR), smart glasses (AR), other wearables, haptics, holographic, brain-machine interface; creation platform, interaction platform, content moderation platform, 3D design/modelling, game engines, AI/ML services, creator tools, search/visual search; asset, 3D interoperable assets, asset market
- **Infrastructure:** Networks/connectivity, computing power, graphic processing units, storage capacity, sensing/perception, cloud/edge infrastructure, semiconductor (chips/processors)

The metaverse is a complex network of interconnected stakeholders who collaborate to create a persistent, immersive virtual world. These stakeholders include service providers, platform providers, content creators, users, digital asset providers, payment managers, advertisers, and other third-party developers.

## 9 Stakeholders of metaverse

### 9.1 Service provider (SP)

#### 9.1.1 Description

Service providers provide the applications and services for the metaverse. They create and operate the metaverse services and applications that users would like.

#### 9.1.2 Roles

The roles of service providers in the metaverse ecosystem are various with the other entities. The following are the roles of service providers:

- **Providing infrastructure:** Service providers provide the underlying infrastructure that supports the metaverse, such as the networks, data centres, and security systems that are needed to run it.
- **Providing financial services:** Service providers offer the financial services that are needed to support the metaverse economy, such as payments, lending, and insurance.
- **Providing content:** Service providers offer content that users experience in various metaverse services and applications. In addition, service providers add or merge new contents in their services and applications.
- **Enabling access to the metaverse:** Service providers develop and manufacture the hardware and software that users need to access the metaverse, such as VR headsets, AR glasses, and software platforms. In addition, service providers educate and train users on how to use the metaverse and its various services and applications.
- **Providing legal and regulatory framework:** Service providers provide the legal and regulatory framework that is needed to govern the metaverse, such as intellectual property laws and privacy regulations.

## 9.2 Platform provider (PP)

### 9.2.1 Description

Platform providers provide the technology and infrastructure for the metaverse. They create and operate the virtual metaverse platforms that users interact with.

### 9.2.2 Roles

The roles of platform providers are as follows:

- **Providing an open platform:** For users to create, experience, and interact with virtual worlds, platform providers offer the infrastructure and tools that users need to create their own content, as well as the space for users to interact with each other and with the virtual world.
- **Enabling user-generated contents:** Platform providers allow users to create and share their own content, such as experiences and avatars. This helps to make the metaverse a more dynamic and engaging place.
- **Providing marketing infrastructure:** Platform providers offer the infrastructure for users to make payments and transactions with rules for the creation and exchange of virtual goods and services.
- **Enforcing security and privacy measures:** Platform providers protect user data and ensure that they are safe from fraud and other malicious activity.
- **Promoting interoperability:** Platform providers ensure that different platforms can communicate with each other and that users can move their data and assets freely between different platforms.

## 9.3 Content creator (CC)

### 9.3.1 Description

Content creators are individuals or organizations that create and develop the virtual content and experiences that users can enjoy in the metaverse. These can include anything from virtual real estate and gaming experiences to virtual fashion and art.

### 9.3.2 Roles

The roles of content creators are as followings:

- **Creating and developing new content:** Content creators are constantly coming up with new ideas for content that will engage users in the metaverse.
- **Providing instructions on using content:** Content creators can educate users about the metaverse and how to use it. This will help to make the metaverse more accessible to users.
- **Promoting their content:** Content creators need to find ways to get their content in front of users. This could involve using social media, creating trailers or demos, or attending industry events.
- **Collaborating with other content creators:** Content creators often collaborate with each other to create even more engaging experiences. This could involve working together on event or social space.

## 9.4 Users

### 9.4.1 Description

Users are the individuals who participate in the metaverse, either as casual users or as active participants in various metaverse activities such as socializing, gaming or consuming contents.

### 9.4.2 Roles

The roles of users are as followings:

- **Experiencing the metaverse:** Users experience the metaverse, and they are able to interact with each other, create content, and explore virtual worlds.
- **Contributing to the metaverse:** Users are able to contribute to the metaverse by creating content, providing feedback, and helping to shape its development.
- **Governing the metaverse:** Users play a role in governing the metaverse by participating in decision-making processes and helping to ensure that it is a safe and fair place for everyone.
- **Influencing the metaverse:** Users are able to influence the metaverse by their actions and interactions to shape the future of the metaverse.

## 9.5 Digital asset provider (DAP)

### 9.5.1 Description

These are the companies and organizations that provide virtual assets such as virtual currency, virtual real estate and virtual goods. They play a crucial role in facilitating the growth of virtual economies and enabling users to monetize their content and creations.

### 9.5.2 Roles

The roles of digital asset providers are as followings:

- **Creating digital assets:** Digital asset providers create digital assets, such as NFTs, virtual land, and in-service items. These assets can be used to create virtual worlds, customize avatars, and participate in services and applications.
- **Trading digital assets:** Digital asset providers buy or sell digital assets to users. This can be done through virtual markets or the other means.
- **Managing digital assets:** Digital asset providers manage digital assets on behalf of users. This can include storing assets, tracking ownership, and resolving disputes.
- **Providing liquidity:** Digital asset providers offer liquidity to the market for digital assets. This means that they make it easy for users to buy and sell digital assets.
- **Ensuring security and safety:** Digital asset providers need to ensure that their platforms are secure and safe for users. This means protecting users' data and preventing fraud and other malicious activity.

## 9.6 Payment Manager (PM)

### 9.6.1 Description

These are the economic systems that exist within the metaverse, in which virtual goods and services can be bought, sold, and traded by payment managers. Virtual markets are often built on blockchain technology to ensure transparency and security.

### 9.6.2 Roles

The roles of payment managers are as followings:

- **Providing a secure and reliable payment system:** Payment managers need to provide a secure and reliable payment system that protects users' financial information.
- **Making payments easy and convenient:** Payment managers need to make payments easy and convenient for users. This means supporting a variety of payment methods and making it easy for users to find the payment method that best suits their needs.
- **Enabling cross-platform payments:** Payment managers need to enable cross-platform payments so that users can make payments between different metaverse platforms.
- **Providing and adhering to regulations:** Payment managers need to provide and adhere to all applicable regulations, such as those related to anti-money laundering and fraud prevention.

## 9.7 Advertiser (AD)

### 9.7.1 Description

Advertisers play a role in the metaverse economy by helping to generate revenue for businesses and create new opportunities for marketing.

### 9.7.2 Roles

The roles of advertisers are as followings:

- **Reaching new customers:** Advertisers can reach new customers who are not typically reached through traditional advertising channels. For example, they can target users who are interested in specific products or services.
- **Growing brands:** Advertisers can create immersive and interactive experiences that help to grow their brands. For example, they can create virtual stores, events, or games that allow users to interact with their brands in a new way.
- **Building relationships:** Advertisers can build relationships with their customers. For example, they can host virtual events, provide customer support, or simply interact with users in a friendly and engaging way.
- **Generating leads:** Advertisers can generate leads for their businesses. For example, they can collect contact information from users who are interested in their products or services.
- **Collaborating with other businesses:** Advertisers can collaborate with other businesses to create more engaging and effective advertising campaigns. This can help to reach a wider audience and achieve their marketing goals.

## 9.8 Third party (TP)

### 9.8.1 Description

Third parties in the metaverse are companies that provide services and products that are not directly related to the metaverse itself. However, they play an important role in supporting the metaverse and making it a more enjoyable and accessible experience for users.

### 9.8.2 Roles

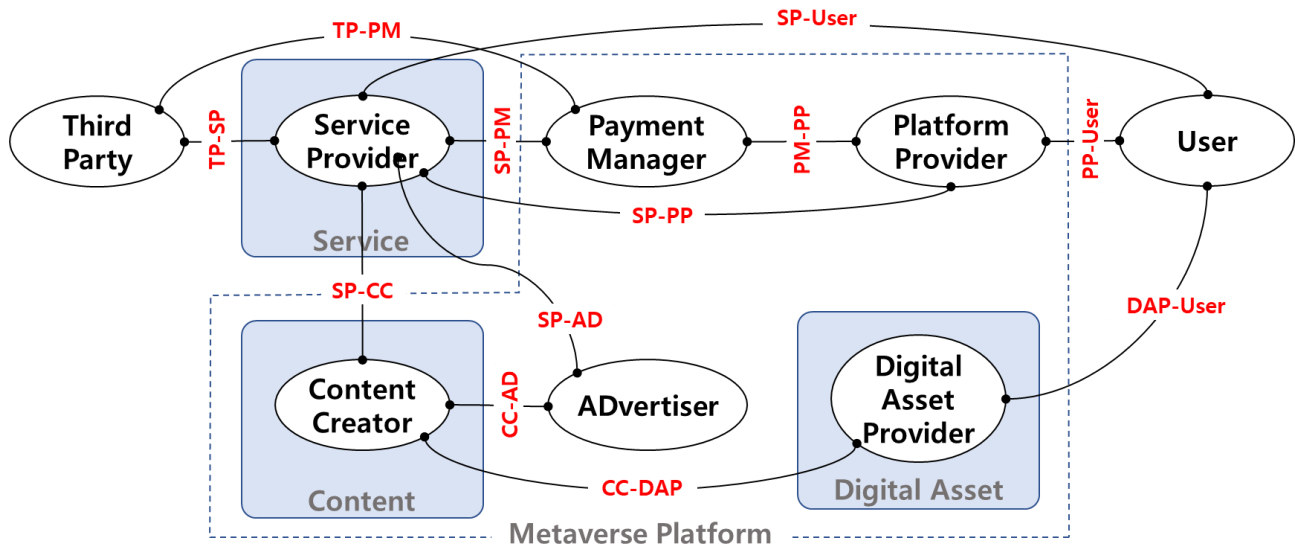
Third parties can support the following roles:

- **Supporting legal advice and regulations:** Third parties provide support to ensure that the metaverse is a safe and compliant environment for users and businesses. They give legal advice, develop regulations and enforce compliance.
- **Supporting financial services:** Third parties support the facilitation of financial transactions in the metaverse. They can provide payment processing, lending, and other financial services.
- **Supporting technology:** Third parties develop and maintain the underlying technology that powers the metaverse. They provide hardware, software, and networking infrastructure.
- **Supporting the other services:** There are many other types of third parties in the metaverse that provide services; these include marketing agencies, advertising platforms and security providers.

# Appendix I

## Example of interactions among metaverse stakeholders

(This appendix does not form an integral part of these Technical Reports.)



**Figure I.1: Metaverse elements and interactions**

Figure I.1 illustrates examples of interactions within the metaverse ecosystem, as described in clause 9. The figure depicts how users interact with various elements, including the metaverse platform (content, assets, marketplaces, advertising, and payment systems) and third-party providers, facilitated by service providers. Additionally, users can directly interact with some elements within the metaverse.

The followings provide a detailed analysis of the key features and functionalities governing these interactions among the metaverse ecosystem's elements.

### I.1 Service Provider–Content Creator (SP-CC)

SP-CC is responsible for developing and delivering content and experiences within the metaverse. These interactions are characterized by several key features and functional requirements, which are described in detail below.:

#### I.1.1 Key features

- **Collaboration and partnership:** SPs and CCs work together to create a shared vision for the metaverse and to develop and deliver high-quality content and experiences.
- **Technological interoperability:** The interface is based on standardized APIs and protocols that allow for seamless integration between SP platforms and CC content.
- **Shared infrastructure and resources:** SPs provide CCs with ways to monetize their content such as through in-app purchases, advertising or sponsorships.
- **Mutually beneficial agreements:** SPs and CCs enter into agreements that define their respective roles, responsibilities, and revenue-sharing models.
- **Continuous evolution and adaptation:** The SP-CC interface is constantly evolving to accommodate new technologies, trends, and user needs.

#### I.1.2 Functional considerations

- **Technical compatibility:** Ensuring that SP platforms and CC content are technically compatible to facilitate seamless integration and interoperability.

- **Data management and security:** Implementing robust data management practices and security measures to protect user data and privacy.
- **Fairness and transparency:** Establishing fair and transparent revenue-sharing models and agreements to ensure equitable distribution of earnings.
- **Intellectual property rights:** Clearly defining intellectual property rights and ownership of content and assets to protect the creative work of CCs.
- **Open communication and collaboration:** Maintaining open communication channels and fostering a collaborative environment to address challenges and optimize the content creation process.

The SP-CC plays a pivotal role in the development and growth of the metaverse. By fostering collaboration, promoting innovation, and adhering to ethical principles, SPs and CCs can work together to create a thriving and diverse metaverse ecosystem that enriches the lives of users worldwide.

## I.2 Service Provider–Advertiser (SP-AD)

SP-AD facilitate reaching new users and promoting offerings within the metaverse through immersive and engaging interactions. These interactions are characterized by several key features and functional requirements, as detailed below:

### I.2.1 Key features

- **Targeted and personalized advertising:** SPs leverage user data and preferences to deliver targeted and personalized advertising that resonates with individual users.
- **Immersive and interactive advertising experiences:** Advertisers can create immersive and interactive advertising experiences that allow users to engage with brands in a more meaningful way.
- **Measurable advertising Performance:** SPs provide advertisers with data and analytics to measure the performance of their advertising campaigns and optimize their strategies.
- **Diverse advertising formats:** A variety of advertising formats are available, including virtual billboards, product placements and sponsored events.
- **Dynamic and evolving interface:** The SP-AD interface is constantly evolving to adapt to new technologies, trends, and user behaviours.

### I.2.2 Functional considerations

- **User privacy and data protection:** Advertisers must adhere to strict data privacy regulations and ensure that user data is handled responsibly.
- **Transparency and user consent:** Users should have clear visibility into how their data is being used for advertising purposes and should have the option to opt out of targeted advertising.
- **Brand safety and quality assurance:** SPs implement brand safety measures to protect advertisers from inappropriate or harmful content and ensure the quality of advertising experiences.
- **Advertisement fatigue and user experience:** Advertisers need to strike a balance between effective advertising and maintaining a positive user experience, avoiding excessive or intrusive ad placements.
- **Measurement and attribution:** SPs and advertisers should collaborate to establish clear measurement and attribution models to track the effectiveness of advertising campaigns.

The SP-AD plays a vital role in supporting the metaverse economy by providing a platform for businesses to reach new audiences and promote their services in an engaging and immersive manner. By prioritizing user privacy, ensuring transparency, and maintaining a balance between advertising effectiveness and user experience, SPs and ADs work together to create a thriving and sustainable metaverse advertising ecosystem.



### I.3 Service Provider–Platform Provider (SP-PP)

SP-PP is responsible for creating and managing the core infrastructure and services that underpin the metaverse. These core functionalities are characterized by several key features and functional requirements, as detailed below.:

#### I.3.1 Key features

- **Complementary roles:** SPs and PPs play distinct yet complementary roles in the metaverse ecosystem, with SPs providing the applications and services and PPs providing the underlying technology and infrastructure.
- **Mutual dependency:** SPs rely on PPs to provide the platform for their services to operate on, while PPs rely on SPs to attract and engage users with their content and experiences.
- **Standardized APIs and protocols:** The SP-PP interface is based on standardized APIs and protocols that allow for seamless integration and interoperability between SP services and PP platforms.
- **Service-level agreements:** SPs and PPs enter into SLAs that define the performance, availability, and reliability expectations for the services provided.
- **Data sharing and privacy agreements:** SPs and PPs establish data sharing and privacy agreements to ensure the secure and compliant handling of user data.

#### I.3.2 Functional considerations

- **Technical compatibility and interoperability:** Ensuring that SP services and PP platforms are technically compatible and interoperable to facilitate seamless integration and user experience.
- **Data governance and privacy protection:** Implementing robust data governance practices and enforcing strict privacy measures to protect user data and comply with data privacy regulations.
- **Fair and equitable revenue sharing:** Establishing fair and transparent revenue-sharing models that ensure an equitable distribution of earnings between SPs and PPs.
- **Intellectual property rights and ownership:** Clearly defining intellectual property rights and ownership of content, assets, and data to protect the creative work of SPs and the underlying infrastructure of PPs.
- **Open communication and collaboration:** Maintaining open communication channels and fostering a collaborative environment to address challenges, resolve conflicts, and optimize the metaverse experience for users.

The SP-PP plays a fundamental role in the development and growth of the metaverse. By fostering collaboration, promoting innovation and adhering to ethical principles, SPs and PPs work together to create a thriving and diverse metaverse ecosystem that enriches the lives of users worldwide.

### I.4 Service Provider–Payment Manager (SP-PM)

SP-PM handles virtual purchases and financial management for users in the metaverse. These interactions have key features and requirements explained below:

#### I.4.1 Key features

- **Seamless payment integration:** SPs integrate PM services into their platforms to enable secure and convenient payments for virtual goods and services.
- **Support for diverse payment methods:** PMs support a variety of payment methods, including credit cards, debit cards, e-wallets and cryptocurrency, to cater to user preferences.
- **Secure and fraud-prevention measures:** PMs implement robust security measures to protect user financial information and prevent fraud.
- **Transparency and user-friendly interface:** PMs provide clear transaction details and a user-friendly interface for users to manage their virtual finances.

- **Compliance with regulations:** PMs adhere to all applicable regulations, such as anti-money laundering requirements.

#### I.4.2 Functional considerations

- **Technical compatibility and interoperability:** Ensuring that SP platforms and PM services are technically compatible to facilitate seamless payment integration and user experience.
- **Data governance and privacy protection:** Implementing robust data security practices and enforcing strict privacy measures to protect user financial information.
- **Fair and equitable revenue sharing:** Establishing fair and transparent revenue-sharing models that ensure an equitable distribution of earnings between SPs and PPs.
- **Fair and transparent fees:** Clearly disclosing fees and charges associated with payments and transactions to ensure transparency and user satisfaction.
- **Dispute resolution mechanisms:** Establishing clear dispute resolution procedures to address payment-related issues and protect user interests.
- **Collaboration and innovation:** Fostering open communication and collaboration between SPs and PMs to promote innovation and enhance the user experience.

The SP-PM plays a pivotal role in enabling a thriving metaverse economy by facilitating secure, convenient, and reliable payments for virtual goods and services. By adhering to security standards, maintaining transparency, and fostering collaboration, SPs and PMs work together to create a secure and frictionless payment ecosystem that supports the metaverse services.

#### I.5 Service Provider–User (SP-User)

SP-User is the primary interactions which encompass the various mechanisms and tools that SPs utilize to deliver their services and applications to users, enabling them to access, experience, and engage with the metaverse effectively. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

##### I.5.1 Key features

- **Intuitive and user-friendly design:** SPs strive to design interfaces that are easy to use and navigate, catering to a diverse range of users with varying levels of technical expertise.
- **Seamless integration with devices and platforms:** SPs ensure that their interfaces are compatible with a wide range of platforms and devices, including VR headsets, AR glasses, smartphones, and so on.
- **Personalized user experience:** SPs leverage user data and preferences to tailor the user experience, providing personalized recommendations, content, and features.
- **Engaging and interactive interactions:** SPs design interfaces that facilitate immersive and engaging interactions, enabling users to socialize, collaborate, and create within the metaverse.
- **Continuous improvement and adaptation:** SPs actively gather user feedback and usage data to refine their interfaces, ensuring they remain relevant, intuitive, and responsive to evolving user needs.

##### I.5.2 Functional considerations

- **Accessibility and inclusiveness:** SPs prioritize accessibility by designing interfaces that are inclusive of users with disabilities and diverse backgrounds.
- **Performance and reliability:** SPs implement robust infrastructure and optimization techniques to ensure the interface performs reliably and efficiently, minimizing latency and disruptions.
- **User feedback mechanisms:** SPs establish clear and accessible channels for user feedback, allowing them to gather insights, identify areas for improvement, and adapt their interfaces to meet user expectations.

The SP-User plays a pivotal role in shaping the overall user experience within the metaverse. By prioritizing user-centric design, ensuring seamless integration, and fostering a culture of continuous improvement, SPs create intuitive, engaging and secure interfaces that empower users to fully immerse themselves in the metaverse and enjoy its vast array of possibilities.

## **I.6 Third Party–Service Provider (TP-SP)**

TP-SP facilitates the integration of external services, products, and expertise into the metaverse, expanding its capabilities and enriching the user experience. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### **I.6.1 Key features**

- **Open and standardized architecture:** SPs adopt open and standardized APIs and protocols to enable seamless integration with a wide range of TP solutions.
- **Flexible integration mechanisms:** SPs provide various integration mechanisms such as plug-ins, APIs, and SDKs, to accommodate diverse TP offerings.
- **Comprehensive service discovery:** SPs implement service discovery mechanisms to allow TPs to advertise their services and capabilities to interested SPs and users.

### **I.6.2 Functional considerations**

- **Technical compatibility and interoperability:** Ensuring that SP platforms and TP services are technically compatible to facilitate seamless integration and interoperability.
- **Standardized service descriptions:** Establishing standardized service descriptions and documentation to enable a clear understanding and integration of TP offerings.
- **Transparent and fair partnerships:** Defining clear contractual agreements and revenue-sharing models to ensure transparency, fairness, and equitable distribution of profits.

The TP-SP plays a pivotal role in expanding the scope and capabilities of the metaverse by enabling the integration of external services and expertise. By adopting open and standardized approaches, prioritizing security and data privacy, and fostering collaborative partnerships, SPs and TPs work together to create a more versatile, engaging, and valuable metaverse experience for users.

## **I.7 Third Party–Payment Manager (TP-PM)**

TP-PM enables TPs to integrate their services and offerings with PM, enabling secure, seamless and convenient payment transactions for users. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### **I.7.1 Key features**

- **Standardized payment processing protocols:** TPs and PMs adhere to standardized payment processing protocols, ensuring compatibility and interoperability across different platforms.
- **Secure and reliable transaction handling:** The TP-PM interface employs robust security measures to protect user financial information and ensure the integrity of payment transactions.
- **Transparent and traceable transactions:** Transaction details are readily accessible to users, ensuring transparency and traceability.

### **I.7.2 Functional considerations**

- **Transparent fee structures and disclosures:** Clearly disclosing payment fees and transaction charges to users, maintaining transparency and avoiding hidden costs.
- **Collaborative problem-solving:** Fostering open communication and collaboration between TPs and PMs to address challenges, share best practices, and promote innovation in payment solutions.

The TP-PM plays a pivotal role in enabling a seamless and secure payment ecosystem within the metaverse. By adopting standardized protocols, prioritizing security, and fostering collaboration, TPs and PMs work together to create a user-friendly and trustworthy payment infrastructure that supports the metaverse economy.

## **I.8 Payment Manager–Platform Provider (PM-PP)**

PM-PP enables the integration of payment services into metaverse platforms, ensuring secure, convenient, and transparent monetary transactions for users. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### **I.8.1 Key features**

- **Standardized payment integration:** PMs and PPs adhere to standardized payment integration protocols, ensuring compatibility and interoperability across different metaverse platforms.
- **Secure and reliable payment processing:** The PM-PP interface employs robust security measures to protect user financial information and ensure the integrity of payment transactions.
- **User-friendly payment options:** Users can choose one of various payment methods, including virtual currencies, fiat currencies, and e-wallets.
- **Transparent and traceable payment history:** All transaction history and status of payments, promoting transparency and accountability are required to be accessible and trackable to users.

### **I.8.2 Functional considerations**

- **Compliance with regulatory standards:** Adhering to applicable financial regulations and anti-money laundering requirements to ensure a compliant and secure payment ecosystem.
- **Clear fee structures and disclosures:** Clearly disclosing payment fees and transaction charges to users, maintaining transparency and avoiding hidden costs.

The PM-PP plays a pivotal role in enabling a secure and user-friendly payment infrastructure within the metaverse. By adopting standardized protocols, prioritizing security, and fostering collaboration, PMs and PPs work together to create a trustworthy payment ecosystem for the metaverse economy.

## **I.9 Platform Provider–User (PP-User)**

PP-User serves as the primary interaction point within the metaverse ecosystem. It facilitates seamless onboarding, navigation, and engagement within the virtual world, ensuring a user-centric and intuitive experience. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### **I.9.1 Key features**

- **User-friendly registration and onboarding:** PPs implement straightforward registration processes and provide comprehensive onboarding tutorials to guide new users through the metaverse experience.
- **Intuitive navigation and UI design:** PPs employ intuitive navigation structures, clear visual cues, and consistent design patterns to enhance user orientation and ease of use.
- **Personalized content discovery and recommendations:** PPs leverage user preferences and data analytics to recommend relevant content, experiences, and social connections, fostering user engagement and satisfaction.
- **Seamless access to diverse virtual experiences:** PPs provide a unified platform for users to access and participate in a wide range of virtual experiences.
- **Responsive and proactive user support:** PPs establish responsive support channels and provide proactive assistance to address user queries, resolve technical issues, and enhance overall satisfaction.

## I.9.2 Functional considerations

- **Technical compatibility and accessibility:** Ensuring that PP platforms are accessible to users across a range of devices and operating systems and network conditions.
- **User data privacy and protection:** Implementing robust data management practices and enforcing strict data protection measures to safeguard user information and prevent unauthorized access.
- **User feedback and improvement mechanism:** Establishing clear channels for user feedback and incorporating it into the iterative improvement of the VM-User interface, enhancing usability and satisfaction.
- **User empowerment and customization tools:** Providing users with the tools and options to personalize their virtual experiences, create custom avatars, and express their individuality within the metaverse.
- **Community engagement and user empowerment:** Fostering a sense of community among users through interactive features, social networking tools, and shared experiences, encouraging active participation and shaping the future of the PP ecosystem.

The PP-User plays a pivotal role in shaping user perception, influencing adoption, and driving engagement within the metaverse.

## I.10 Digital Asset Provider–User (DAP-User)

DAP-User empowers users to discover, acquire, manage, and utilize digital assets, fostering a user-centric and secure marketplace experience. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### I.10.1 Key features

- **Intuitive asset discovery and search:** DAPs employ intuitive navigation structures and advanced search functionalities to enable users to easily find the digital assets they are looking for.
- **Comprehensive asset information and descriptions:** DAPs provide detailed and transparent information about digital assets, including their attributes, ownership history, and pricing data.
- **Secure and convenient asset transactions:** DAPs implement robust security measures and user-friendly transaction processes to ensure safe and reliable asset purchases and transfers.
- **Integrated asset management and tracking:** DAPs offer integrated asset management tools that allow users to track their digital asset holdings, view transaction history, and manage asset permissions.

### I.10.2 Functional considerations

- **Transparency and user education:** Providing clear and transparent information about asset ownership, transaction fees, and associated risks, and educating users about safe digital asset management practices.
- **User-centric design and usability:** Employing intuitive design principles and user testing methodologies to ensure a user-friendly and accessible interface that caters to diverse user needs and preferences.
- **Responsive support and dispute resolution mechanisms:** Establishing responsive support channels and implementing clear dispute resolution mechanisms to address user concerns, resolve issues promptly, and maintain user trust.

By prioritizing user experience, ensuring security, and fostering transparency, DAPs can empower users to navigate the digital asset landscape with confidence, contributing to the growth and adoption of the metaverse.

## I.11 Content Creator–Digital Asset Provider (CC-DAP)

CC-DAP facilitates seamless interactions to enable CCs to mint, manage and distribute their digital creations as virtual assets, fostering a thriving and sustainable creator economy. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### I.11.1 Key features

- **Seamless minting and asset management:** CCs easily create and mint their digital assets such as NFTs, virtual items, and virtual real estate, through the DAP interface.
- **Transparent asset ownership and rights management:** DAPs maintain clear records of asset ownership and provide CCs with secure control over their creations, ensuring proper attribution and protection of intellectual property rights.
- **Efficient asset distribution and monetization:** DAPs facilitate the distribution of CC-created digital assets across various metaverse platforms, enabling CCs to reach a wider audience and monetize their content effectively.
- **Integrated data analytics and insights:** DAPs provide CCs with data analytics and insights into asset performance, user engagement, and market trends, enabling informed decision-making and optimization of their content strategies.

### I.11.2 Functional considerations

- **Fair and equitable revenue-sharing models:** Establishing transparent and fair revenue-sharing models that align the interests of CCs and DAPs, ensuring equitable distribution of earnings from asset sales and utilization.
- **Continuous evolution and adaptation:** Actively incorporating feedback from CCs and adapting to emerging technologies and market trends to ensure the CC-DAP interface remains relevant and supportive of the evolving creator economy.

By fostering a collaborative and supportive environment, promoting fair and transparent practices, and continuously adapting to the needs of the creator community, CC-DAPs empower CCs to thrive and contribute to a vibrant and diverse metaverse ecosystem.

## I.12 Content Creator–Advertiser (CC-AD)

CC-AD facilitates seamless interactions to enable CCs to monetize their creative endeavours by providing opportunities to integrate sponsored content and advertising into their creations, fostering a mutually beneficial relationship between content creators and businesses. These interactions are characterized by several key features and functional requirement issues, as illustrated below:

### I.12.1 Key features

- **Transparent and collaborative partnerships:** CCs and ADs establish transparent and collaborative partnerships, ensuring alignment of goals, expectations, and revenue-sharing models.
- **Creative integration and brand awareness:** CCs seamlessly integrate sponsored content and advertising into their creations, enhancing brand awareness and promoting products or services in a non-intrusive manner.

### I.12.2 Functional considerations

- **Intellectual property rights protection:** Clearly defining intellectual property rights and ownership of sponsored content, ensuring the protection of CCs' creative work and brand reputation.
- **Content quality and brand safety:** Implementing brand safety measures to protect ADs from inappropriate or harmful content, ensuring that sponsored content aligns with brand values and maintains a positive user experience.

The CC-AD plays a pivotal role in bridging the gap between content creators and advertisers within the metaverse, fostering a mutually beneficial ecosystem that drives innovation, promotes creativity and enhances user engagement.

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