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| A picture containing graphics, logo, font, symbol  Description automatically generated | INTERNATIONAL TELECOMMUNICATION UNION  **TELECOMMUNICATION STANDARDIZATION SECTOR**  STUDY PERIOD 2022-2024 | | | | TSAG-TD673 |
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| **TD** | | | | | |
| **Source:** | | Chair, WP2/TSAG | | | |
| **Title:** | | LS/o on FG-MV deliverables: allocation and guidance for future work | | | |
| **LIAISON STATEMENT** | | | | | | |
| **For action to:** | | | - | | | |
| **For information to:** | | | ITU-T SG2, SG3, SG5, SG9, SG11, SG12, SG13, SG15, SG16, SG17, SG20 | | | |
| **Approval:** | | | TSAG meeting (Geneva, 2 August 2024) | | | |
| **Deadline:** | | | N/A | | | |
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| **Abstract:** | This liaison statement informs ITU-T Study Groups of the allocation of the FG-MV deliverables (approved from January to June 2024) as agreed by TSAG. Additionally, it provides guidance concerning the FG-MV outputs (the deliverables approved and the documents which could not be completed). |

TSAG would like to inform you that it has agreed to allocate the deliverables approved by the FG-MV from January to June 2024 as shown in the table below.

In addition, TSAG offers the following guidance on future work based on the ITU-T FG-MV outputs:

* For *unfinished documents* any interested party can access the document from the public version of the ITU website and develop it further.
* For *completed deliverables*:

1. Study Groups with an existing mandate to commence standardization efforts may establish a new Work Item within their scope.
2. If more than one SG is interested in any of the deliverables and the topic falls within their mandates, they may start the work within their respective scopes. The SGs are encouraged to use the normal collaboration process to ensure no overlaps between the work (e.g. exchange of liaison statements).
3. SGs will report their progress to TSAG as part of their usual activity reports and are requested to identify subjects where overlap is not resolved, and where further advise, and coordination are needed.
4. The Study Groups identified in the allocation of FG-MV deliverables are welcome to start work based on the deliverable at their discretion. However, it is not mandatory and does not constitute a request from TSAG.
5. SGs interested in starting a work, based on, or taking in account the FG-MV deliverables are requested to thoroughly review the deliverable and conduct a gap analysis to scope the work within the remit of their terms of reference (ToR).

It should be noted that the above guidance applies also to the FG-MV deliverables approved before January 2024.

TSAG looks forward to being informed on the use of the material elaborated by the FG-MV and associated collaborating efforts within ITU-T Study Groups.

**Allocation of FG-MV approved deliverables (from January to June 2024)**

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| **No.** | **Title** | **Approved** | **Allocation** | **Summary of the deliverable** |
| [FGMV-23](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-23.pdf) | Technical Report on Considering online and offline implications in efforts to build confidence and security in the metaverse | March 2024 | SG17 | Summary:  If the metaverse continues to progress towards the digital twinning of the world (possibly the universe), then presumably “everyone” is (or should be) represented in the metaverse and therefore the absence of participation (whether involuntarily or by choice) is not necessarily a path to opting out of the implications.  With the metaverse still in its nascent phase, implications for participants and for non-participants alike are a new consideration; although early data would suggest that these range from issues relating to security, confidence, and trust, to ethical and other related issues.  New frameworks on building confidence and security in the metaverse may be able to pre-empt negative outcomes by drawing on existing knowledge and trends around Trust and Safety, as well as digital inclusion and exclusion. Specifically, accounting for the broad spectrum of populations and related assets, actions, attitudes, relationships, and outcomes that is likely to characterize engagement with the metaverse.  This Technical Report explores this further using the “User Confidence Framework” introduced in ITU FGMV-06 Technical Report on “Guidelines for consideration of ethical issues in standards that build confidence and security in the metaverse” (which was approved at the third meeting of the ITU Focus Group on metaverse, held from 3-5 October 2023 in Geneva, Switzerland), and its related framework for metaverse participation. |
| [FGMV-24](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-24.pdf) | Technical Report on A framework for confidence in the metaverse | March 2024 | SG17 | Summary:  Still in its nascent phase, even as it rides the downward swing of a highly visible hype curve; the concept of “metaverse” remains undefined. Yet, the metaverse is emerging as a new frontier of social and economic interaction with the potential to transform the way we live, work and play.  Given its potential to be highly disruptive, there is some urgency to develop a general understanding of the metaverse in this nascent phase, especially to avoid the pitfalls that continue to afflict its predecessors including Web 2.0 platforms like social media.  To address this urgent need, the International Telecommunication Union (ITU) established the first  Focus Group on metaverse (FG-MV) in December 2022. A year later, in December 2023, FG-MV experts (brought together from around the world to shape the development of metaverse technology standardization for the benefit of all) proposed a baseline definition for the metaverse.  This Technical Report (also a product of FG-MV) outlines an approach to pre-standardization of confidence in the metaverse by:  1. Expanding the “User Confidence Framework” introduced in ITU’s FGMV-06: Technical Report on “Guidelines for consideration of ethical issues in standards that build confidence and security in the metaverse” (which was approved at the third meeting of the FG-MV, held on 3–5 October 2023, in Geneva, Switzerland), to include Security and Safety Dimensions in user confidence.  2. Developing a new framework for metaverse participation that defines new user centric terms related to metaverse use and non-use as an approach to understanding user metaverse engagement.  3. Discussing the concept of personhood for metaverse contexts to contextualize user presence  in the metaverse. |
| [FGMV-25](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-25.pdf) | Technical Report on Near-term and long-term Implications for people in the metaverse | March 2024 | All SGs | Summary:  Given that the industry has not yet converged on a precise understanding of what is commonly referred to as the “metaverse”, there is general confusion between definitions of this term based on Facebook’s transformation to Meta in 2021 and definitions that evolved from the concept that was popularized by Neal Stephenson’s novel, Snow Crash, in 1992. This has led to conflicting declarations of the metaverse as being both in its nascent phase and already dead.  Nevertheless, as the world becomes increasingly digital, the metaverse (no matter the definition ascribed to it) is emerging as a new frontier of social and economic interaction; allowing people to create, connect, and collaborate in ways that were previously thought impossible.  The promise of a post-COVID-19 metaverse is rapid acceleration of an already super-charged global digital transformation with the potential to transform our lives, livelihoods, and interactions, in the near-term and long-term, in ways that cannot be overstated. Neither can our lack of clarity around the implications.  This Technical Report explores the near-term and long-term implications for people in the metaverse as a framework for understanding potential impacts and a guide for maximizing the benefits and minimizing associated risks. |
| [FGMV-26](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-26.pdf) | Technical Specification on Requirements for communication between human-avatar languages in the metaverse | March 2024 | SG16 and SG13 | Summary:  This Technical Specification provides requirements on how to develop the architecture for communication between humans, digital humans/avatars, and systems in the metaverse. This document considers language modalities, language writing systems, AI language communication technologies, co-linguistic communication, and language prevalence in terms of use. It provides guidance on a wide array of communication workflows for the metaverse. The document also makes recommendations on how communication modalities can be considered in the design of any scenario. |
| [FGMV-27](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-27.pdf) | Technical Report on Guidelines for metaverse application in power system | March 2024 | SG20 | Summary:  This Technical Report provides the connotation, mapping mode, and implementation logic of the power metaverse, provides the application framework and key technical details. For the convenience of understanding and use, it also lists three typical application scenarios aligned with power system business needs. This Technical Report provides reference for decision-making, technical research and application practice in power metaverse. |
| [FGMV-28](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-28.pdf) | Technical Specification on Requirements for the metaverse based on digital twins enabling integration of virtual and physical worlds | March 2024 | SG20 | Summary:  This Technical Specification provides service scenarios and requirements for the digital twin-based integration of virtual and physical worlds. Three categories of use cases and their service scenarios are introduced, and requirements with respect to digital twin, metaverse, and system interaction are defined. |
| [FGMV-29](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-29.pdf) | Technical Specification on Reference model for the metaverse based on a digital twin enabling integration of virtual and physical worlds | March 2024 | SG20 | Summary:  This Technical Specification provides the reference model for the metaverse based on digital twins enabling the integration of virtual and physical worlds. In order to realize this integration of the virtual and physical worlds, a reference model for interaction is necessary, with digital twins serving as a key component of this model. This Technical Specification aims to establish the reference model for the metaverse based on digital twins, enabling the seamless integration of virtual and physical worlds. |
| [FGMV-30](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-30.pdf) | Technical Report on Overview of the application requirements of metaverse on emergency management in chemical industrial parks | April 2024 | SG20 | Summary:  Chemical industrial parks, as the main sites of chemicals and chemical production, are confronted with a high safety risk. Once an accident occurs, it may result in large-scale loss of life and property. However, the application of metaverse can improve the efficiency of risk management and emergency management in chemical industrial parks. This Technical Report introduces the application requirements and scenarios of metaverse in emergency management within chemical industrial parks. The aim is to identify metaverse platform requirements and address potential issues, as well as enhance the emergency response capability of responders in chemical industrial parks. |
| [FGMV-31](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-31.pdf) | Technical Specification on Requirements, functional framework and capability of IoT for metaverse | April 2024 | SG20 | Summary:  This Technical Specification provides requirements, functional framework and capability of IoT for metaverse, including general requirements, high-level reference framework and associated capabilities. |
| [FGMV-32](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-32.pdf) | Technical Report on ​ Overview of metaverse | June 2024 | All SGs | 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. |
| [FGMV-33](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-33.pdf) | Technical Specification on Glossary for metaverse | June 2024 | All SGs, SCV | Summary:  This Technical Specification provides a set of core terms and associated definitions to reflect the basic concepts used in the metaverse. The document aims to encourage a mutual and consistent understanding of, and a coherent approach to, activities relating to the metaverse, and the use of harmonized terminology. It includes terms and definitions for the metaverse, which have been widely used in the FG-MV deliverables, including terms already defined in relevant standards development organizations (SDOs). This document is intended to be relevant for: a) people engaged in metaverse activities; b) people involved in metaverse activities at ISO, IEC, ITU-T, and other international standards bodies; and c) developers of national or sector-specific standards, guides, procedures, and codes of practice relating to the metaverse. |
| [FGMV-34](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-34.pdf) | Technical Report on Definitions of CitiVerse | June 2024 | SG20 | Summary:  This Technical Report contains proposed definitions of CitiVerse for further consideration at ITU Study Groups. |
| [FGMV-35](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-35.pdf) | Technical Report on ​Building a People-centred CitiVerse | June 2024 | SG20 | Summary:  This document presents the concept of the “CitiVerse” as the cross-sectoral adoption of the metaverse within cities, involving the interaction of digital and physical world objects with a given city’s envisioned digital ecosystem. It explores the CitiVerse’s potential to drive people-oriented urban digital transformation.  The document provides real-life examples of the application of metaverse technologies in different cities, focusing on cases where cities have put the needs of their inhabitants at the heart of all the services offered in their versions of the CitiVerse.  Despite the expanding application scenarios and potential of the CitiVerse, there is limited literature and research available on the topic as cities continue to grapple with issues relating to interoperability, digital identity, and jurisdiction.  Global platforms such as the International Telecommunication Union (ITU)’s Focus Group on metaverse are paving the way for standardization within this domain to enable stakeholders to receive the required guidance for the adoption of the CitiVerse in their city in alignment with the Sustainable Development Goals (SDGs). |
| [FGMV-36](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-36.pdf) | Technical Report on The future of travel in the metaverse: landscape and use cases | June 2024 | SG16, SG20 | Summary:  This Technical Report provides an in-depth background and a comprehensive view of the emerging nexus between the metaverse and tourism. This report highlights current tourism trends, devices used to enable the metaverse and explore promising areas of tourism. A comprehensive section of use cases, including case studies of successful implementations, provides practical insights into how the metaverse is being utilized for tourism around the world. This report also explores standardization issues of the metaverse in tourism, highlighting adoption challenges, security concerns and economic and social implications. |
| [FGMV-37](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-37.pdf) | Technical Report on Landscape and Use cases for the Industrial metaverse | June 2024 | All SGs | Summary:  This Technical Report offers an in-depth background and a comprehensive view of the current landscape on the industrial metaverse, by exploring its current development stage, market analysis, key players, emerging technologies, challenges and opportunities. A section of applications, including case studies of successful implementations, provides practical insights. The report also focuses on standardization issues of industrial metaverse, covering technical difficulties, ethical, legal, and security concerns, and economic implications. |
| [FGMV-38](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-38.pdf) | Technical Specification on Framework and requirements for the construction of human-driven 3D digital human application system for metaverse | June 2024 | SG16 | Summary:  In the future, the idea of 3D digital human will become familiar to people as “super agents”. Three-dimensional digital humans can display human characteristics such as facial appearance, gestures, and even a biological brain. Anthropomorphic behaviour of 3D digital humans can be generated through different driving technologies, which can be divided into intelligent-driven technology and human- driven technology.  With the popularization of human-driven 3D digital human applications and the advancement of image recognition technology such as posture and facial expressions recognition algorithm, inertial or optical motion capture devices are no longer essential tools for driving the 3D digital human. Instead, ordinary cameras, combined with ideal recognition algorithms, can achieve accurate driving of the 3D digital human. This approach not only benefits from the inherent flexibility and interactive capabilities imparted by human operators but also substantially lowers the barriers to entry and cost associated with generating virtual content. Consequently, it facilitates the intelligent transformation of the content creation industry.  This technical specification provides the framework and requirements of the 3D human-driven digital human application system for metaverse. |
| [FGMV-39](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-39.pdf) | Technical Specification on Use case and requirements for virtual and real fusion coding in metaverse application | June 2024 | SG16 | Summary:  Metaverse is an emerging research and application field with the combination of multiple technologies including digital twin, Internet of Things (IoT), digital assets, multimodal data fusion and artificial intelligence generated content (AIGC). Users need immersive experience such as playback of camera-captured 3D scenes with 6DoF of viewer position and orientation. The current video coding standard is optimized by 2D videos and the coding efficiency may not be enough. Therefore, the metaverse applications need an efficient virtual and real coding technology to support low-delay and immersive experience for users. The virtual and real coding technology can support affordable coded bit rate and high coding efficiency for immersive videos, omnidirectional videos, as well as the source content with high quality depth information. The interaction between digital human and users, online meetings, gaming, sports viewing can be the use cases benefiting from this coding technology.  This Technical Specification provides the related requirements, reference model of application system and use cases of the virtual and real fusion coding in metaverse applications. |
| [FGMV-40](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-40.pdf) | Technical Specification on Multimedia aspect of metaverse architecture | June 2024 | SG16 | Summary:  This Technical Specification provides reference architecture and functional blocks for multimedia aspect of metaverse architecture.  The scope of this Technical Specification includes:   * 1. Metaverse domain,   2. Reference architecture and its functional blocks of metaverse   The metaverse functional architecture is based on the use of existing network components and technologies, as well as on IoT architectures and digital twin. This leads to three possible options for the architectural representations in this Technical Specification. |
| [FGMV-41](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-41.pdf) | Technical Specification on The reference framework of industrial metaverse | June 2024 | SG20 | Summary:  This Technical Specification provides the main framework to implement the industrial metaverse (IMV) from the overall and technical perspectives, including the elemental composition, specific modules, and entities of IMV. At the same time, starting from the infrastructures required by IMV, the industrial perception, industrial control, industrial network, industrial computing and storage, IMV platform, assets, and IMV identity management in IMV domain are included in detail. In addition to the above content, the Technical Specification also involves the digital security, privacy protection, and so on, in order to provide a reference for the development of IMV. |
| [FGMV-42](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-42.pdf) | Technical Report on Interoperability of identity of things across metaverse platforms | June 2024 | SG20 | Summary:  With regard to Internet of Things (IoT) [ITU-T Y.4000], each IoT device may have a single or multiple unique identities in multiple IoT systems. Similarly, each IoT device also may have a single or multiple identities in multiple metaverses. An identity of an IoT device usually includes a unique identifier and a corresponding identity object [ITU-T Y.4811].  Although, it may take advantage of one IoT device having one unique identity in multiple metaverses, there are challenges; how those metaverses identify, authenticate and authorize the IoT devices when they roaming across metaverse platforms, and how the trustworthy shared storages interact with each other to support identity interoperability across storages.  This Technical Report describes identity interoperability for IoT devices across metaverse platforms, and provides relevant technical features and reference framework. |
| [FGMV-43](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-43.pdf) | Technical Specification on High-level interoperability architecture for cross-platform metaverse | June 2024 | SG16 | Summary:  This deliverable specifies the high-level interoperability architecture for cross-platform metaverse, highlighted for seamless integration and collaboration across different metaverse platforms. It provides a high-level functional architecture, outlining the key components and their interactions. Additionally, this identifies the reference points and information flows that enable interoperability between platforms. |
| [FGMV-44](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-44.pdf) | Technical Report on Security for things across metaverses in aspects of data processing and management | June 2024 | SG17 | Summary:  In Internet of Things (IoT) [ITU-T Y.4000], each physical/virtual thing (such as sensors, IoT devices, IoT systems, IoT gateways) manages and processes its data independently, directly by itself or via relevant IoT systems. If a thing is mapped into a metaverse, actively or passively, its data will be transferred into the target metaverse. Usually, a metaverse may manage and process data of its entities by itself. And when there are a large number of entities and data, it may use external computing resources and services to manage and process relevant data. A thing may be mapped into multiple metaverses. In this case, there are more challenges to manage and process the data of things, including to protect data security.  This Technical Report analyses and provides solutions about security for things across metaverses in aspects of data processing and management, including at least relevant technical features, requirements and reference frameworks of security for things across metaverses in aspects of data processing and management. |
| [FGMV-45](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-45.pdf) | Technical Report on Challenges to achieving trustworthy metaverse | June 2024 | SG17 | Summary:  The metaverse is an integrative ecosystem of virtual worlds, where participating entities may have one or more identities. Its essential enablers are cutting-edge technologies including Artificial Intelligence (AI), Web 3.0, Blockchain, Augmented Reality (AR), Virtual Reality (VR) and Internet of Things (IoT). When all these important and advanced technologies are applied and used in some scenarios, it will bring a serious of concerns and problems, such as the concerns of safety, security, ethics and problems of privacy, Intellectual Property Rights (IPR) and violence. In the metaverse, all these concerns and problems will occur and even other unexpected problems, and considering all these concerns and problems, trustworthiness and relevant issues become very important key issues for the metaverse and its development. Therefore, this deliverable presents key concepts, challenges and a reference model for a trustworthy metaverse including standardization landscape and roadmap. |
| [FGMV-46](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-46.pdf) | Technical Report on The essential components of trusted data use in building a trustworthy metaverse | June 2024 | SG17 | Summary:  In an era in which digital realities are increasingly as significant as physical ones, the rise of the metaverse offers exciting opportunities as well as formidable challenges. As users delve into these expansive virtual worlds, the foundation element of their interactions – trust – becomes crucial for seamless integration into daily activities. The nature of data usage within the metaverse can vary greatly; it can be trusted, untrusted, or not utilized at all. Employing trusted data involves the responsible, ethical and secure management of information. This not only enhances the confidence of users and stakeholders but also enriches the overall metaverse experience, fostering a community where trust is paramount.  This technical report is dedicated to establishing a comprehensive understanding and outlining the essential components necessary for integrating trusted data within the metaverse to ensure its trustworthiness. The report starts by discussing three key aspects required to understand a trustworthy metaverse and conducts a comprehensive examination of characteristics of trusted data. It then outlines the essential groundwork needed to understand the symbiotic relationship that facilitates the use of trusted data in establishing and maintaining a trustworthy metaverse. Essential components proposed include strategies for the construction of trusted data, trusted data interactions, trusted execution environments, and trusted management policies. |
| [FGMV-47](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-47.pdf) | Technical Report on Economic Value Creation and Competition in metaverse | June 2024 | SG3 | Summary:  Metaverse is a nascent concept and potentially encompasses a broad set of technologies to create economic value. In this context, the identification of economic aspects is critical and imperative to capturing economic value. This Technical Report takes an economic perspective of metaverse to illustrate economic value creation and competition related aspects.  More specifically, it provides an approach to:   * Metaverse Value Chain * Metaverse Economic Value Creation * Competition Issues and Assessment for metaverse * Metaverse Economy and Ecosystem Enhancement |
| [FGMV-48](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-48.pdf) | Technical Report on Guidance on how to build a metaverse for all: Part II - Survey | June 2024 | All SGs | Summary:  The primary objective of this Technical Report is to report on the findings from the first UN survey of government, business and academic leaders on metaverse development. This document offers an initial understanding of the current metaverse development. The document also identifies the key challenges that hinder the achievement of equity, accessibility and inclusivity within the metaverse, and proposes suggestions to ensure equity, accessibility, and inclusivity are incorporated in metaverse development by default. |
| [FGMV-49](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-49.pdf) | Technical Report on Metaverse Sustainability: Driving energy efficiency and GHG emissions reduction | June 2024 | SG5 | Summary:  This Technical Report explores the environmental impact of using metaverse applications and related devices. It offers guidance on how to make ICT devices and applications that support the operation of the metaverse more energy-efficient and sustainable. The goal is to reduce future greenhouse gas emissions.  In addition, the document examines the current and potential ways by which the metaverse fosters the green and low-carbon development of different economic sectors and industries.  The Technical Report recognizes the rapid development of digitalization, which has enabled and contributed to the growth of many sectors. The increasing use of the metaverse is deemed an additional tool empowering industries and impacting society and the economy. The document recognizes that among the horizontal priorities that need to be mainstreamed in metaverse development and usage is the environmental sustainability dimension, along with accessibility and inclusion.  This document addresses the environmental sustainability of the metaverse and related technologies for a smooth and energy-efficient development of the metaverse. To realize the full benefits of technological innovation, including metaverse usage, rapid technological development should be anchored in the ongoing efforts towards achieving the UN Sustainable Development Goals, including environmental impact mitigation. |
| [FGMV-50](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-50.pdf) | Technical Specification on Methodology on assessment of GHG emissions of metaverse | June 2024 | SG5 | Summary:  This Technical Specification deals with the environmental impact assessment of metaverse applications and solutions, including metaverse service, ICT networks, supporting ICT infrastructure and digital devices. This technical specification will complement existing Recommendations [ITU-T L.1410] “Methodology for environmental life cycle assessments of information and communication technology goods, networks and services”. |
| [FGMV-51](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-51.pdf) | Technical Report on Standardization roadmap for metaverse | June 2024 | All SGs | Summary:  Recently, metaverse has become one disruptive area of innovation with great potential to enhance our economy, and change the way of living. In this nascent phase of the metaverse, the industry is not yet clear about the direction and steps of technical development. This Technical Report is intended to outline a concise roadmap of metaverse standardization. In clause six, a framework of metaverse standards is provided. It is structured in four categories (i.e., General standards, Application and service standards, Enabling technology standards, Interoperability and ICT related infrastructure standards). In clause seven, the report presents the motivation of standardization and lists each metaverse-related standardization tasks, as well as relevant study groups of SDOs, consortium and forums that are working on the topic.  This technical report will be beneficial to the standardization activities of ITU-T study groups, other SDOs, consortium and forums. |
| [FGMV-52](https://www.itu.int/en/ITU-T/focusgroups/mv/Documents/List%20of%20FG-MV%20deliverables/FGMV-52.pdf) | Technical Report on Metaverse standardization landscape for gap analyses | June 2024 | All SGs | Summary:  This technical report assists in the development of a gap analysis on metaverse standardization by examining existing standards and standards under development in key standards development organizations (SDOs). Its aim is to facilitate the development of comprehensive and interoperable metaverse-related standards. |

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