

# 메타버스 산업 기술표준 현황

---

2022. 07. 29.

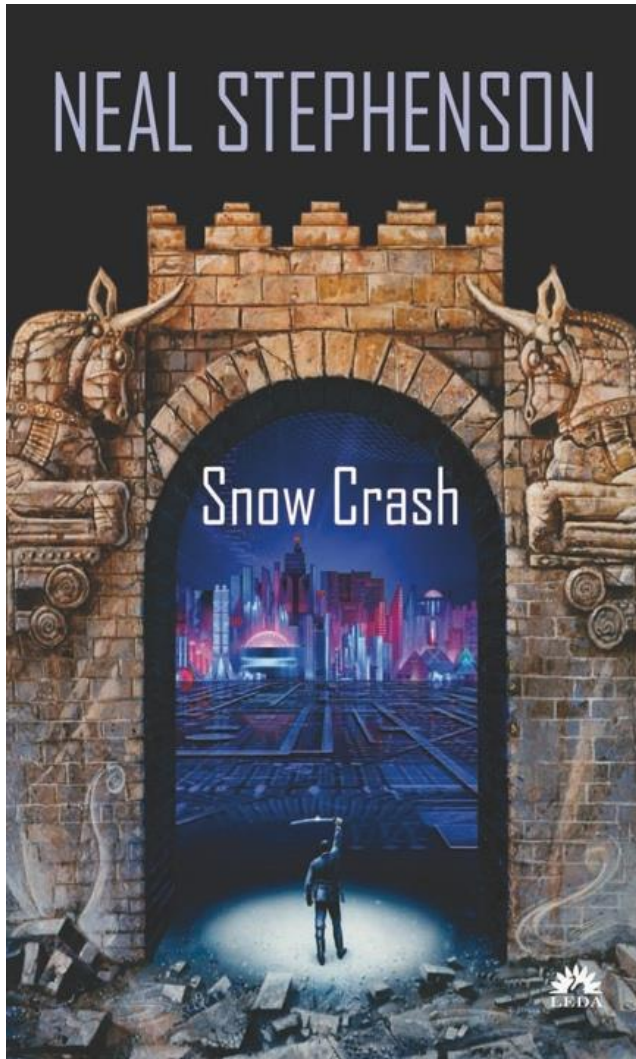
메타버스 얼라이언스 기술표준분과장  
건국대학교 교수 윤경호

# 목차

---

- 메타버스 Was
- 메타버스 To-Be (2.0)
- 메타버스 관련 표준들
- 결론

# 메타버스란?



“**양쪽 눈에** 서로 조금씩 다른 이미지를 보여줌으로써, **3차원 영상**이 만들어졌다. 그리고 그 영상을 일초에 일흔 두 번 바뀌게 함으로써 그것을 **동영상**으로 나타낼 수 있었다. 이 3차원 동영상을 한 면당 2K픽셀의 해상도로 나타나게 하면, **시각의 한계 내에서는 가장 선명한** 그림이 되었다. 게다가 그 작은 이어폰을 통해 디지털 스테레오 음향을 집어넣게 되면, 이 움직이는 3차원 동영상은 **완벽하게 현실적인 사운드 트랙**까지 갖추게 되는 셈이었다.

그렇게 되면 히로는 이 자리에 있는 것이 아니었다. 그는 컴퓨터가 만들어 내서 그의 고글과 이어폰에 계속 공급해주는 **가상의 세계**에 들어가게 되는 것이었다. 컴퓨터 용어로는 **메타버스**라는 이름으로 불리는 세상이었다.”

Neal Stephenson, "Snow Crash," 1992, Bantam Books, USA (Amazon.com)

# 메타버스 Was

AR/VR/MR/XR 등을  
모두 통칭

내가 참여하지 않고 있는  
순간에도 지속성을 갖는  
다는 것을 의미

“가상으로 향상된 물리적 현실과 물리적으로 지속되는 가상 공간의 융합으로 사  
용자에게는 이 중의 어느 하나로도 경험될 수 있도록 한다.”

Acceleration Studies Foundation (ASF), “Metaverse Roadmap Overview,” USA, **2007**

# 메타버스란? (Casual-개인적의견)

나 인 듯 내가 아닌 나 같은 다른 나 또는  
남 인 듯 남이 아닌 남 같은 내가  
살아가는 몰입 가능한 세상  
(가상일수도, 현실의 증강일 수도)

메타버스 콘텐츠 기술이란 가상현실(VR), 증강현실(AR), 혼합현실(MR) 등, **확장현실(XR)** 기술을 기반으로 구성된 가상공간이, 물리적 지속성을 가지고 현실 세계와 융합한 형태의 응용을 구현하는 데 필요한 요소 기술.

# 메타버스 To-Be

특징	내용
가상의 정체성(Identity)	- 메타버스에서는 록스타, 패션모델 같은 특정 정체성을 가진 아바타가 존재해야 함
친구들(Friends)	- 메타버스에서 실제 사람을 사귀고, 사교활동이 가능
몰입감(Immersive)	- 몰입감이 없으면 '내가 지금 이 공간 안에 존재한다'는 감각이 사라질 수 있음
어디서든(Anywhere)	- 국가나 지역, 문화권에 대한 제약 없이 언제 어디에서나 접속 가능
마찰이 적어야 (Low Friction)	- 한 예로, 학교에서 고대 로마 시대를 공부하다가 순식간에 메타버스 내 고대 로마 시대로 여행을 떠날 수 있을 정도로 마찰이 적어야 함
다양성(Variety)	- 다양한 취향을 가진 사람들을 만족시키려면 콘텐츠의 다양성이 확보되어야 함
경제(Economy)	- 메타버스에 참여 중인 구성원들이 경제적 이익을 얻고, 그 이익이 순환하며 더 커지도록 만드는 활력 있는 경제요소
시민의식(Civility)	- 메타버스도 사회인만큼, 기본적인 사회규범을 지켜야 안전하게 이용할 수 있고 '지속 가능한 세계'로 작동할 수 있도록 성숙한 시민의식 보유

# 메타버스 To-Be (3D4C)

---

1. 3D: 가상현실/혼합현실에 기반한 몰입형 가상/융합세계
2. Creation: User Created Content/3DAsset 의 지원
3. Commerce: 경제 활동이 가능한 가상/융합세계
4. Community: 사회 활동이 가능한 가상/융합세계
5. Convergence: 현실과 융합되는 가상/융합세계



## Metaverse

Realistic scene rendering



Sensory stimuli

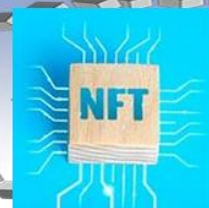


Real2Virtual world

interfaces



Big data AI



Metaverse Token Economy

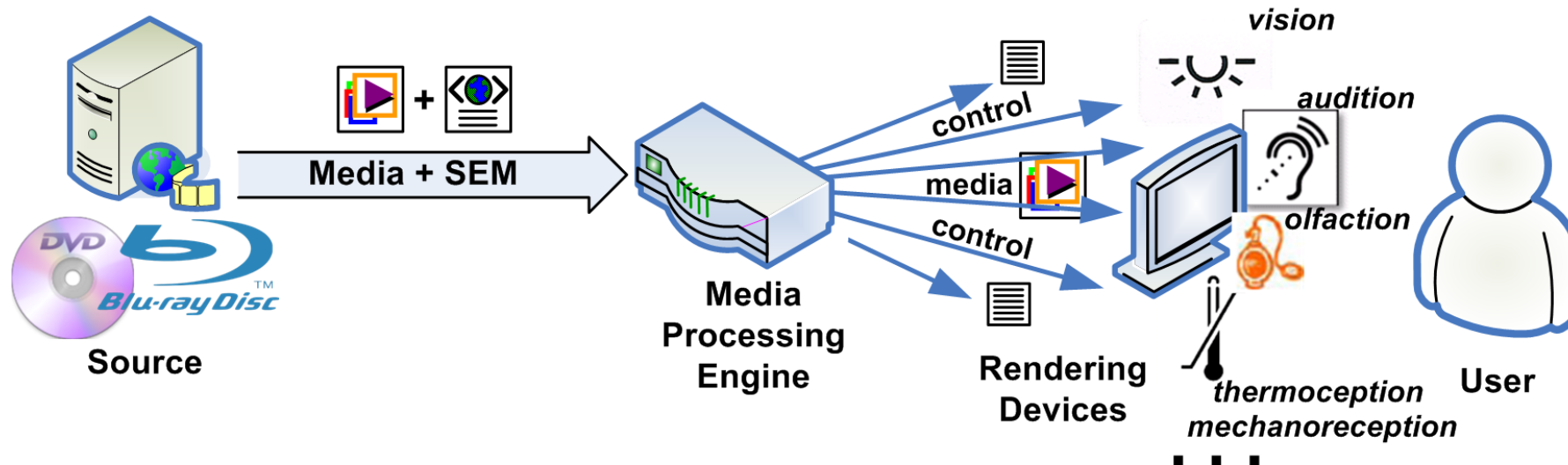


# 메타버스 기술 표준?

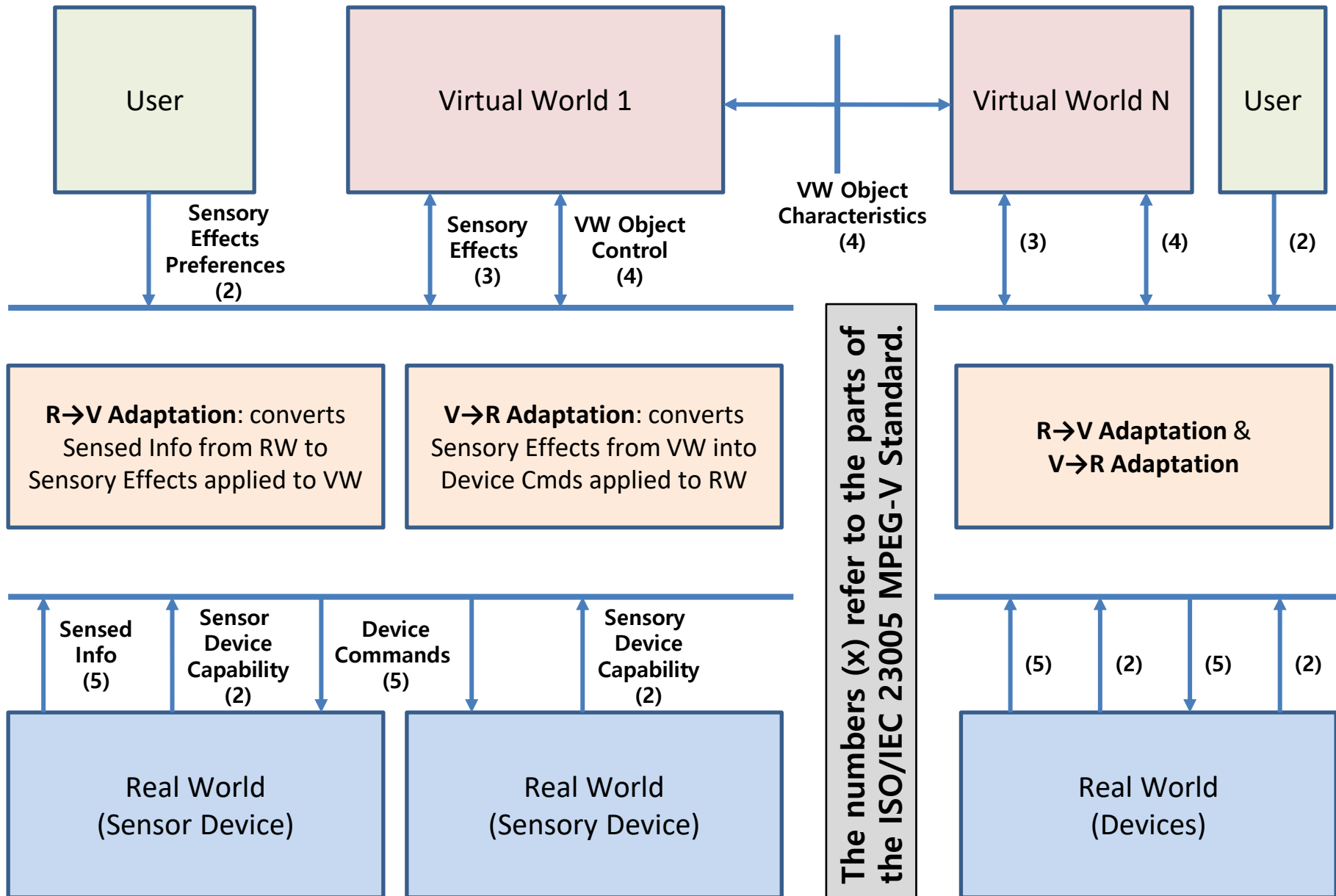
표준화 기구	표준명/범위	특징
JTC 1/SC 29	ISO/IEC 23005 MPEG-V	2007년 시작하여 2011년 1st Ed. 발표된 최초의 Metaverse 표준
JTC 1/SC 29	ISO/IEC 23093 IoMT	미디어 기반의 자율적 사물인터넷
JTC 1/SC 29	ISO/IEC 23090 MPEG-I	몰입형 미디어 (MiV, V-PCC, G-PCC 등)
JTC 1/SC 24	3D Graphics	X3D
IEEE 2888	Interfacing Cyber and Physical Worlds	센서 기반의 현실정보와 구동기 제어를 통한 현실과 가상세계의 융합
IEEE 3079	MR/XR Framework	Human Skeleton 기반 아바타 표현 및 제어기술 표준
Khronos Group	Open XR, WebGL, glTF	3D 그래픽스 기반, AR/VR 기기 지원 API, Graphics 가속 API 등
W3C	메타버스 연동	WebXR
IEEE C/SAB SC	PAR SG on Metaverse	Blockchain 기반 메타버스 표준 프로젝트 발굴 목적
Metaverse Standards Forum	Open Metaverse Interoperability	<a href="http://www.metaverse-standards.org">www.metaverse-standards.org</a> 기관회원 only Khronos Group, Meta, Nvidia 등등

# JTC 1/SC 29 MPEG-V

- From RoSE (Representation of Sensory Effects) from 2007
  - Sensory Effect Metadata, Sensory Device Capabilities, Sensory Device Commands, and User Sensory Preferences are within the scope of standardization and, thus shall be normatively specified. On the other side, the RoSE Engine as well as Provider entities and Consumer Devices are informative and are left open for industry



# JTC 1/SC 29 MPEG-V



# JTC 1/SC 29 MPEG-V Part4 Virtual world object characteristics



Onion  
-sound : cutting sound, parching sound  
-smell : raw onion, fried onion, etc  
-stiffness : 2nd level

Carrot  
-sound : cutting sound, frying sound  
-smell : carrot juice, carrot soup etc  
-stiffness : 4th level

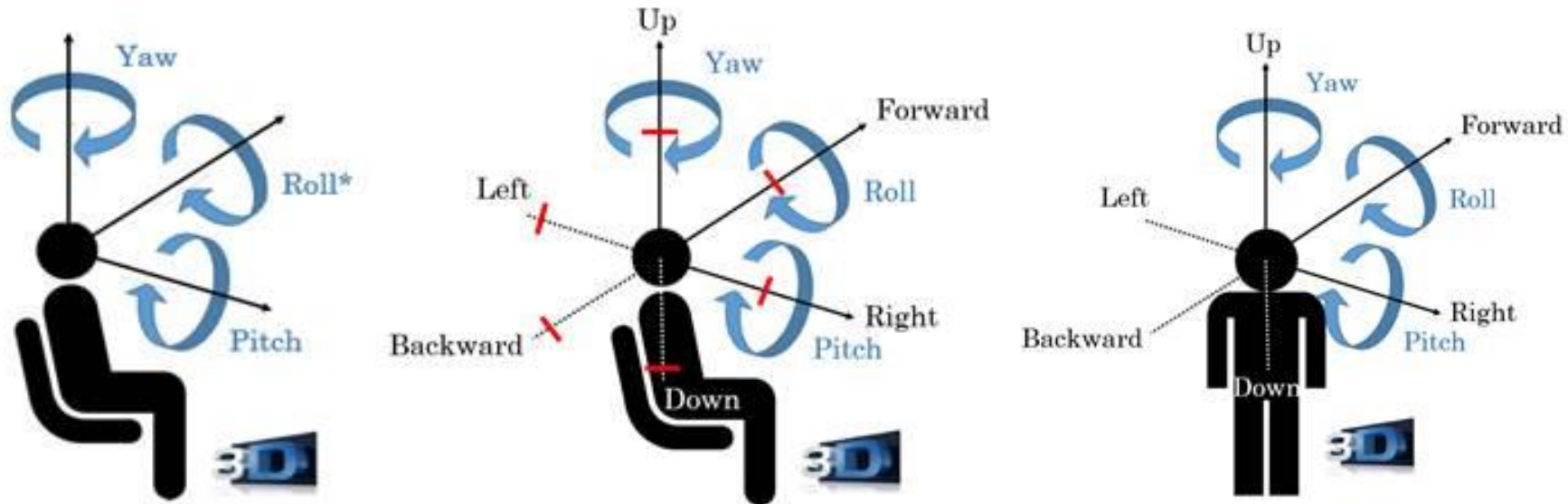
Golf club  
-sound : swing sound, crashing sound  
-weight : 1kg  
-texture : hand grip part, metal, etc  
-Stiffness: 2



- ISO/IEC 23090-2:2019 Information technology — Coded representation of immersive media — Part 2: Omnidirectional media format
- ISO/IEC 23090-5:2021 Information technology — Coded representation of immersive media — Part 5: Visual volumetric video-based coding (V3C) and video-based point cloud compression (V-PCC)
- ISO/IEC FDIS 23090-9 Information technology — Coded representation of immersive media — Part 9: Geometry-based point cloud compression (May 2022, FDIS text submitted)
- ISO/IEC FDIS 23090-12 Information technology — Coded representation of immersive media — Part 12: MPEG Immersive video (Dec. 2021, FDIS text submitted)

# JTC 1/SC 29 MPEG-I

- 3 DoF
- 3 DoF +
- 6 DoF



# JTC 1/SC 24 X3D ver. 4

---



- ISO/IEC 19775-1, Extensible 3D (X3D)
- Submitted to JTC1 SC 24 as a CD on Feb. 8, 2021 by Web3D Consortium
- Public draft available since Aug. 2020 from Web3D Home
- What happened???
- Declarative 3D for web programmers
- 3D Models can be embedded in HTML5 with Javascript APIs
- X3D Unified Object Model enables file encoding in XML, JSON, Binary, VRML and language binding (Javascript, Java, C#, C++, C, Python)
- Supports glTF 2.0 assets
- Physically Based Rendering (PBR) by PhysicalMaterial node



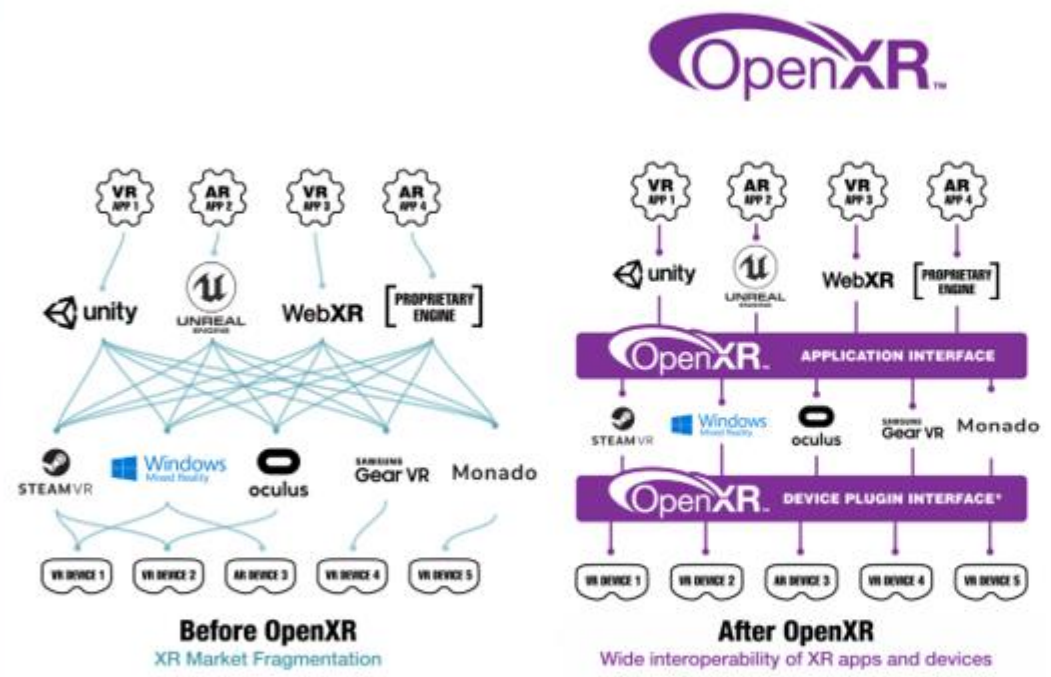
- ISO/IEC 19775-1:2013 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS, IMAGE PROCESSING AND ENVIRONMENTAL DATA REPRESENTATION — EXTENSIBLE 3D (X3D) — PART 1: ARCHITECTURE AND BASE COMPONENTS
- ISO/IEC 19775-2:2015 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS, IMAGE PROCESSING AND ENVIRONMENTAL DATA REPRESENTATION — EXTENSIBLE 3D (X3D) — PART 2: SCENE ACCESS INTERFACE (SAI)
- ISO/IEC 19776-1:2015 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS, IMAGE PROCESSING AND ENVIRONMENTAL DATA REPRESENTATION — EXTENSIBLE 3D (X3D) ENCODINGS — PART 1: EXTENSIBLE MARKUP LANGUAGE (XML) ENCODING
- ISO/IEC 19776-2:2015 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS, IMAGE PROCESSING AND ENVIRONMENTAL DATA REPRESENTATION — EXTENSIBLE 3D (X3D) ENCODINGS — PART 2: CLASSIC VRML ENCODING
- ISO/IEC 19776-3:2015 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS, IMAGE PROCESSING AND ENVIRONMENTAL DATA REPRESENTATION — EXTENSIBLE 3D (X3D) ENCODINGS — PART 3: COMPRESSED BINARY ENCODING

- ISO/IEC 19777-1:2006 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS AND IMAGE PROCESSING — EXTENSIBLE 3D (X3D) LANGUAGE BINDINGS — PART 1: ECMASCRIPT
- ISO/IEC 19777-2:2006 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS AND IMAGE PROCESSING — EXTENSIBLE 3D (X3D) LANGUAGE BINDINGS — PART 2: JAVA
- ISO/IEC CD 19777-3 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS AND IMAGE PROCESSING — EXTENSIBLE 3D (X3D) LANGUAGE BINDINGS — PART 3: PART 3: C (July, 2022 CD Approved)
- ISO/IEC CD 19777-4 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS AND IMAGE PROCESSING — EXTENSIBLE 3D (X3D) LANGUAGE BINDINGS — PART 4: PART 4 — C++ (July, 2022 CD Approved)
- ISO/IEC CD 19777-5 INFORMATION TECHNOLOGY — COMPUTER GRAPHICS AND IMAGE PROCESSING — EXTENSIBLE 3D (X3D) LANGUAGE BINDINGS — PART 5: PART 5 — C# (July, 2022 CD Approved)

# Khronos Group OpenXR

## OpenXR - Cross-Platform Portable AR/VR

### Working Group Participants

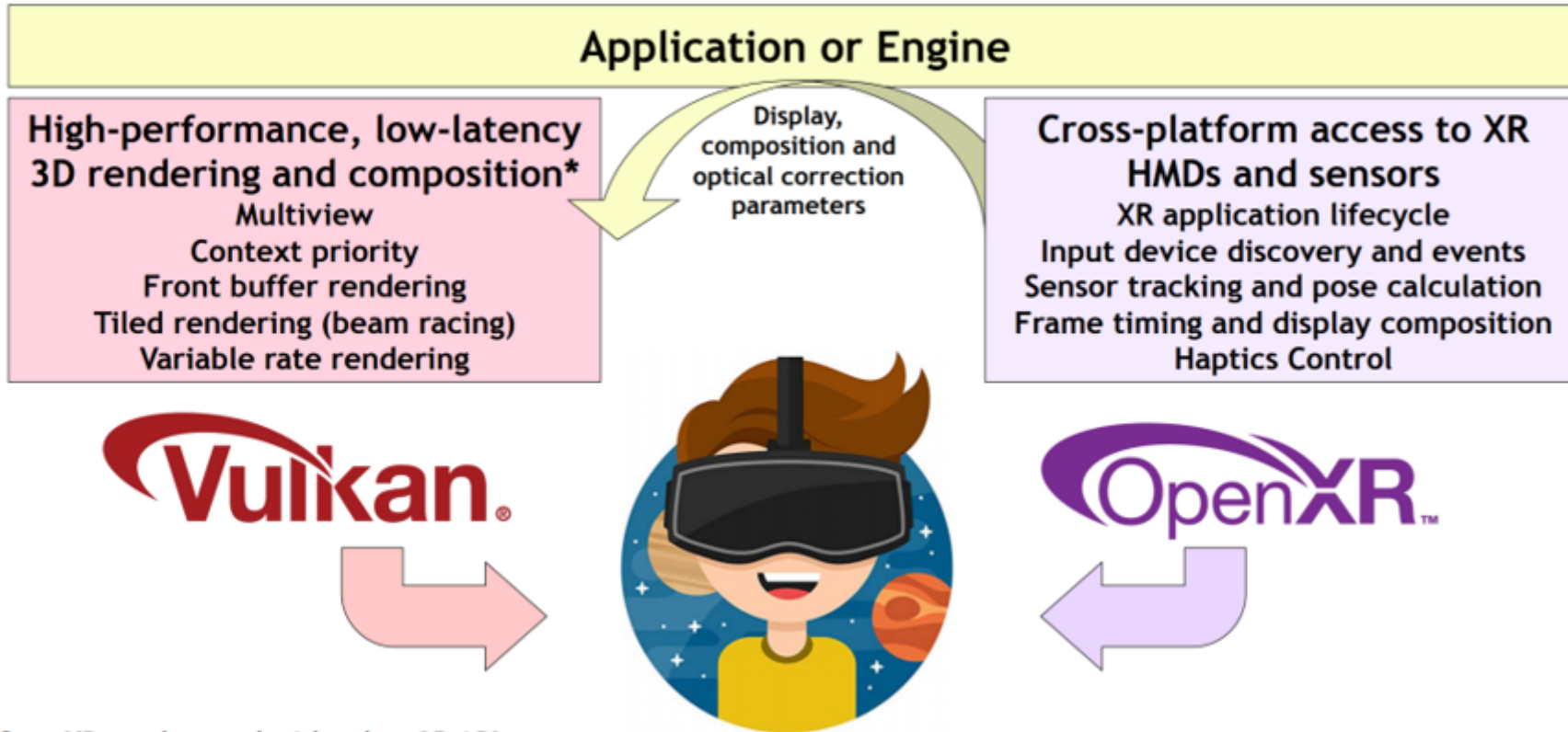


**OpenXR is a collaborative design**  
 Integrating many lessons from proprietary 'first-generation' XR API designs

\* OpenXR 1.0 is focused on enabling cross-platform applications. Optional device plugin interface will be supported post V1.0  
 This work is licensed under a Creative Commons Attribution 4.0 International License

# Khronos Group OpenXR

## OpenXR is used with a 3D API



\* OpenXR can be used with other 3D APIs such as Direct3D, OpenGL and OpenGL ES

# Khronos Group WebGL

---

- WebGL is a cross-platform, royalty-free web standard for a low-level 3D graphics API based on OpenGL ES, exposed to ECMAScript via the HTML5 Canvas element.
- WebGL 2.0 specification released on Dec. 2020

# Khronos Group WebGL

## WebGL 2.0 Universal Availability

- WebGL 2.0 is finally coming to all major operating systems
  - iOS in particular!
- Collaboration with Apple since June 2019
  - Integrated [ANGLE project](#) into [WebKit](#) as the WebGL backend
- Available for testing now (October 2020):
  - Safari Technology Preview on macOS
  - Safari in iOS 14.2 betas
  - [Follow progress](#) of the project
- Upgrade your applications to WebGL 2.0 now!

Lots of great WebGL sites and products archived on this [Working Group maintained Blog](#)

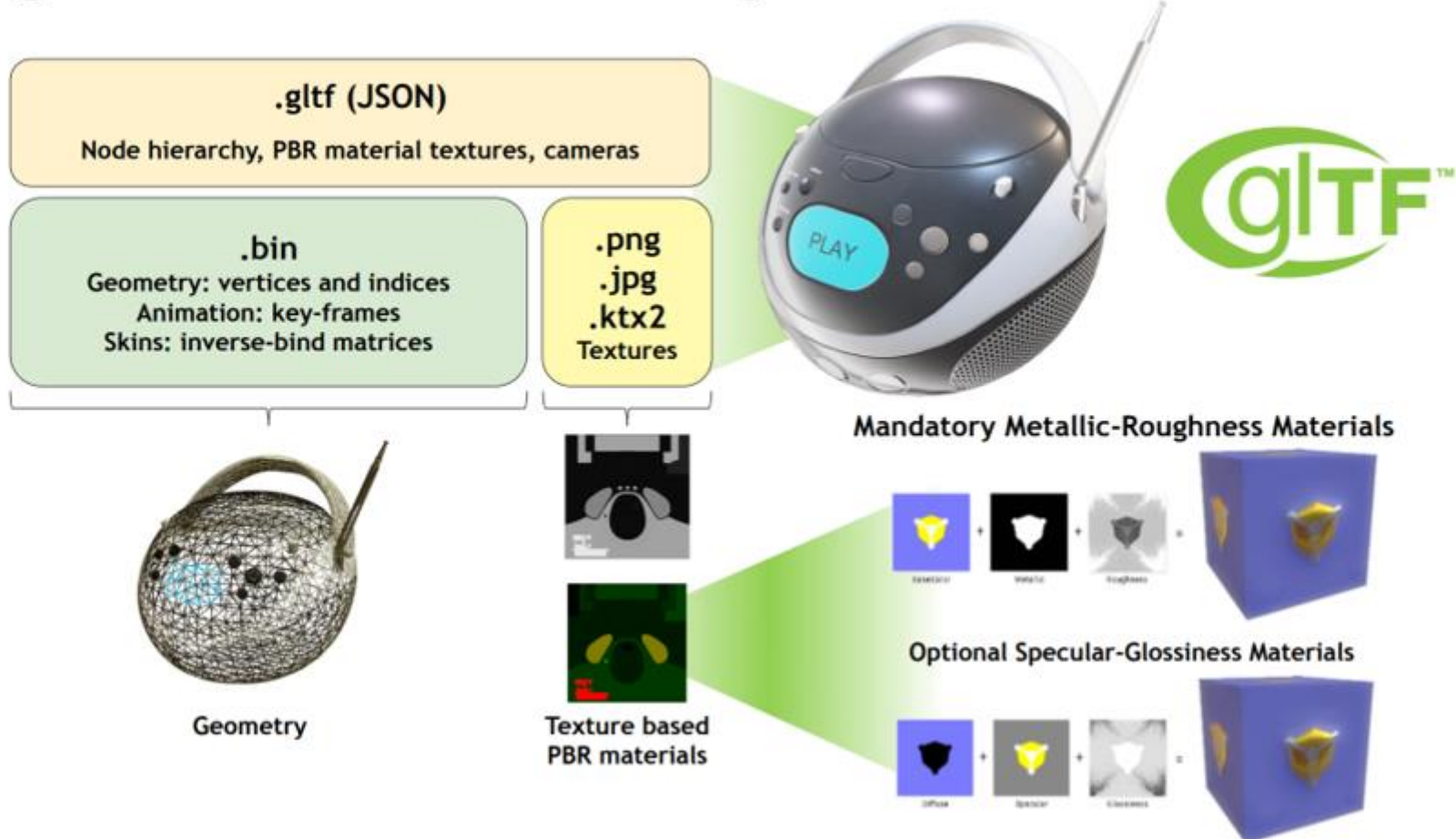


This work is licensed under a Creative Commons Attribution 4.0 International License

© The Khronos® Group Inc. 2020 - Page 9

# Khronos Group glTF

## glTF 2.0 Scene Description Structure



- 3D Asset Authoring and Delivery
- glTF 2.0 released on June 2017
- Specification for the efficient transmission and loading of 3D scenes and models

# W3C WebXR

---

- WebXR is a group of standards to support rendering 3D scenes for VR and AR to the web. (Mixed Reality or Cross Reality)
- WebXR is an API for web content and apps to interface with MR HW.
- WebXR manages the timing, scheduling, and the various points of view relevant when drawing the scene.
- WebXR Device API is the core of the WebXR feature set.
  - W3C Working Draft on Oct. 2021
  - Manage selection of output devices
  - Manage rendering 3D scene to the chosen device
  - Manage motion vectors from input controllers



# W3C WebXR

---

- WebXR is not a rendering technology and does not provide features for managing 3D data or rendering it to the display.
- WebXR does not know how to load and manage models, nor how to render and texture them, and so forth.  
=> WebGL does. But other 3D frameworks can be more convenient.

# IEEE 2888

➤ IEEE 2888 Interfacing Cyber and Physical World Working Group

➤ **센서/액추에이터를 통한 현실세계와 가상세계의 융합**

## IEEE 2888

## Interfacing Cyber and Physical World

**IEEE  
2888.1**

Specification of Sensor Interface for Cyber and Physical World

**IEEE  
2888.2**

Standard for Actuator Interface for Cyber and Physical World

**IEEE  
2888.3**

Standard on Orchestration of Digital Synchronization between Cyber and Physical World

**IEEE  
2888.4**

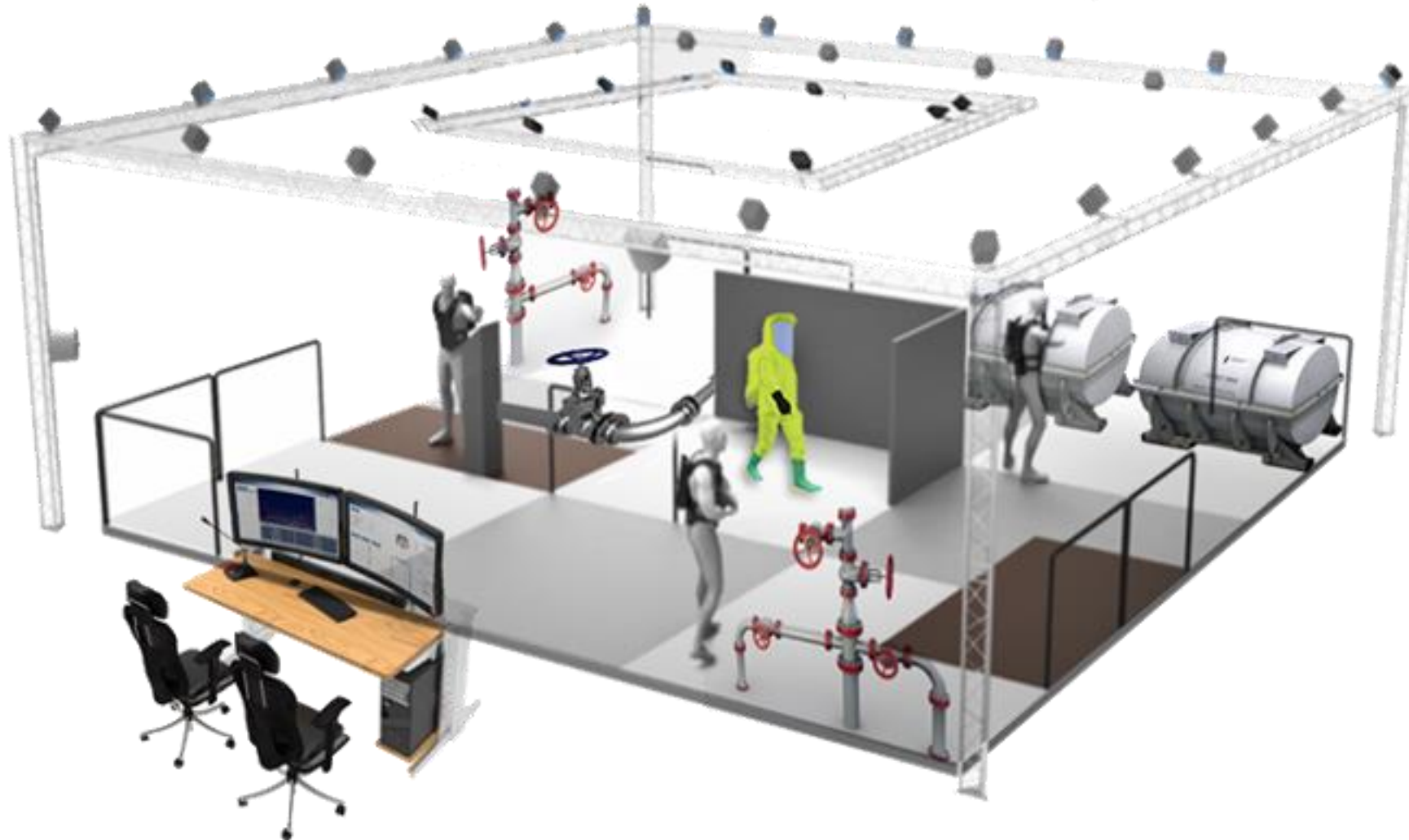
Standard on Architecture for Virtual Reality Disaster Response Training System with Six Degrees of Freedom (6 DoF)

**IEEE  
2888.5**

Evaluation Method of Virtual Training System

**IEEE  
2888.6**

Holographic Visualization for interfacing Cyber and Physical Worlds



# Ethereum NFT (Non-Fungible Token)

---

- Non-Fungible (대체불가능, 대체할 수 없는) Token
  - 각 토큰의 가치가 달라 1 대 1 교환이 불가능
  - 나눌 수 없음
  - Digital Asset 자체에 대한 메타데이터와 거래 정보를 포함
  - Digital Asset 자체는 다른 곳에 보관, 링크만 제공
  - Smart Contract 의 한 형태로 거래 조건의 명시 가능

# Ethereum NFT (Non-Fungible Token)

- Defined by Smart Contract of Ethereum standard
- Cryptocurrency asset developed based on ERC-721 and ERC-1155 Standard.
- Can assign a unique id to a digital asset with “conditions” and is stored in the Ethereum blockchain, like a cryptocurrency (coin)

# IEEE Metaverse PAR Study Group

**IEEE SA** STANDARDS  
ASSOCIATION

## CALL FOR PARTICIPATION

### IEEE Computer Society/ Standards Activities Board Standards Committee (C/SAB SC) Metaverse PAR Study Group Kick-off Meeting

[IEEE Standards Association \(IEEE SA\)](#) invites you to participate in the [IEEE C/SAB SC Metaverse PAR Study Group](#).

## WHY GET INVOLVED

The scope of this Study Group is to determine whether sufficiently diverse interest and adequate resources exist to develop an IEEE draft standard on Metaverse, and if so, to develop a draft PAR for the proposed project. The PAR Study Group follows individual based participation and operates following IEEE Computer Society Standards Activities Board Standards Committee P&P.

## MEETING INFORMATION

Date: Tuesday, 02 August 2022

Time: 8:00 AM - 10:00 AM ET

[JOIN THE MEETING](#)

## LEARN MORE

Indicate your interest in this working group to receive ballot invitations and other notifications about the project.

[LEARN MORE](#)

For additional information, contact the IEEE C/SAB SC Metaverse PAR Study Group Chair, **Ming Li**, at [1370138822@139.com](mailto:1370138822@139.com) or the IEEE SA Program Manager, **Jonathan Goldberg**, at [goldberg.j@ieee.org](mailto:goldberg.j@ieee.org).



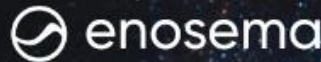
Lab

# Metaverse Standards Forum

## A Constellation of Standards

Building a pervasive, open and inclusive metaverse at a global scale will require cooperation and coordination between a constellation of international standards organizations, including the Khronos Group, World Wide Web Consortium (W3C), Open Geospatial Consortium, OpenAR Cloud, Spatial Web Foundation, and many others.

The Forum will not create standards itself but will coordinate requirements and resources to foster the creation and evolution of standards within standards organizations working in relevant domains.



# Metaverse Standards Forum

---

- Expected Projects
  - Interactive 3D assets and photorealistic rendering
  - Human interface and interaction paradigms including AR, VR and XR
  - User created content
  - Avatars, identity management and privacy
  - Financial transactions
  - IOT and digital twins
  - Geospatial systems



# Metaverse Standards Forum



# Conclusion

---

- 메타버스란 다양한 특성을 갖는 서비스/응용을 칭하는 용어
- 궁극적으로 웹은 메타버스의 형태로 진화
- 많은 부분에서 표준이 존재하거나 표준화가 진행 중
- 다양한 표준들이 개발자들의 진입장벽을 낮추고 개발된 메타버스 간의 호환성을 확보하는 데 도움을 줄 것으로 기대
- 메타버스의 확산은 물리적으로 체험하거나 함께 할 수 없는 제약들을 제거 함으로 다양한 사회/문화/경제적 변화를 가져올 것으로 기대

