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# Scope

This document provides information and agreed processes in order to support the development of ISO/IEC 23090-14, "Scene Description for MPEG Media" as well as ISO/IEC 23090-24, "Conformance and Reference Software for MPEG-I Scene Description".

# Time Plan

The work on MPEG-I scene description is part of MPEG-I phase 2a as defined in N18965, clause 3.

In order to address the proper completion of the first version of the standard for ISO/IEC 23090-14, the following time plan is considered:

* WD: 2020-01
* CD: 2020-10
  + With and editing period until end of November
* Potential Improvements of CD: 2021-01
  + It is expected that NBs comment on this document
* DIS: 2021-04
  + With a short editing period to meet FDIS ballot comments
* Potential Improvements of DIS: 2021-07
* FDIS: 2021-10
* Publication: 2022-01

The project was approved, and details are here: https://www.iso.org/standard/80900.html

ISO/IEC WD 23090-14 Information technology — Coded representation of immersive media — Part 14: Scene Description for MPEG Media

For ISO/IEC 23090-24, the conformance software, the following time plan is considered

* CD: 2021-07
* DIS: 2021-10
* FDIS: 2022-04
* IS: 2022-10

The scope of the proposed part 24 of ISO/IEC 23090 is to describe the reference software and conformance files for ISO/IEC 23090-14. The reference software enables users of the standard to establish and test conformance and interoperability.

# Extending Khronos glTF2.0

## General

Based on the agreement during MPEG#128, MPEG-I Scene Description is developed as an extension to Khronos' glTF2.0 specification. This specification can be accessed here: <https://github.com/KhronosGroup/glTF/blob/master/specification/2.0/README.md>

According to the specification, glTF defines an extension mechanism that allows the base format to be extended with new capabilities. Any glTF object can have an optional extensions property. For details see <https://github.com/KhronosGroup/glTF/blob/master/specification/2.0/README.md#specifying-extensions>. For more information on glTF extensions, consult the [extensions registry specification](https://github.com/KhronosGroup/glTF/blob/master/extensions/README.md).

glTF supports different ways on extending the specification as documented here: <https://github.com/KhronosGroup/glTF/blob/master/extensions/README.md#promoting-extensions>

The following principles are agreed:

* MPEG develops extensions to Khronos glTF2.0 under the *Vendor Extensions framework*. Contributing companies should be aware of this. If contributions do not provide a statement that says otherwise, it is expected that the proponents agree to this.
* MPEG has requested an extension with the prefix MPEG <https://github.com/KhronosGroup/glTF/blob/master/extensions/Prefixes.md>. Contact person is the MPEG convenor, the JTC1 SC29 WG3 MPEG Systems chair as well as the chair of the MPEG-I Scene Description BOG.
* If MPEG contributors are generally interested that their proposal may be considered as a KHR extension without any binding commitment, input contributions may state so. However, such a statement or the absence of such a statement does not impact the processing of a contribution in the context of the MPEG-I scene description work.

## MPEG Extensions submitted to Khronos

It is proposed that all MPEG agreed extensions after DIS and FDIS has been issued, are added to the Khronos repository as follows

* Contributors
  + Editor of MPEG spec, Affiliation, e-mail
  + Others as agreeable
* Status
  + Draft at DIS
  + Stable at FDIS
* Dependencies
  + Written against the glTF 2.0 spec
* Overview:
  + Two sentences should be provided on the extension
  + Pointer to ISO/IEC 23090-14 where the extension is defined
* glTF Schema Updates
  + Pointer to MPEG schema updates
* JSON Schema
  + Link to schema
* Known Implementation
  + Pointer to reference software
* Resources:
  + Pointer to all available resources
* Best Practices:
  + Implementation Guidelines, Fallback mechanisms, etc.

# Communication with Khronos

## Overview

Khronos has active work in the context of glTF2.0, see the KHR extensions under development here: <https://github.com/KhronosGroup/glTF/blob/master/extensions/README.md>. It is also identified that there is an overlap between MPEG members and glTF participants. Khronos and graphics experts meet in Khronos meetings, but also at developer and research conferences such as GDC and Siggraph. For meetings, please refer to <https://www.khronos.org/events/>.

Khronos Member Meetings occur 3 times per year and offer the opportunity for Khronos members to come together in a face-to-face environment to discuss technical work, industry feedback, network with colleagues and have some fun.

However, due to the COVID-19 situation, Khronos meetings have been put on hold and are only scheduled for later in 2022.

|  |  |  |
| --- | --- | --- |
| Meeting | Date | Location |
| F2F Phoenix 2022 | October 17-21, 2022 | Phoenix, Arizona |
| F2F Osaka 2023 | May 8-12, 2023 | Osaka, Japan |

MPEG targets the following

* to provide information to Khronos on the MPEG work latest in February 2021 by sending an LS from MPEG#133 in January 2021 including the CD text (or any potential improvements). Qualcomm or other MPEG members offered to present the LS at the Khronos F2F and provide any additional verbal information to Khronos on the ongoing MPEG work.
* to potentially engage with Khronos experts in a joint workshop or conference at a convenient location for MPEG and Khronos during the development phase of the MPEG-I Scene Description work, preferably in late 2021.
* Due to the COVID-19 situation, it is expected that an online webinar could replace the f2f meeting.

## Communication prior to MPEG#132

In preparation for the above communication, some initial exchanges with Khronos leadership has been taken place, in particular a call between MPEG Scene Description leadership and Khronos leadership (see document [m54843](http://wg11.sc29.org/doc_end_user/current_document.php?id=75900&id_meeting=183)). In this call, the following was provided:

* Background
* Overview on output documents, in particular N19447 on procedures.
* Explained why MPEG asked for vendor extensions and what we attempting to do and to clarify if and how we can formalize the process (see clause 3 of the document)
* Explain the rest of the procedures in the document
* Provided overview on considered extensions (attached are the provided slides)

Based on this initial communication, the following feedback was provided from the Khronos president Neil Trevit.

1. glTF’s priority is driving widespread adoption as a practical and pragmatic real-time 3D asset delivery format.
2. glTF 2.0 established use of PBR in a widely adopted real-time open standard delivery format for the first time in the industry. By necessity, that meant carefully selecting PBR functionality.
3. The glTF working group contains many of the industry’s leading PBR practitioners, who are designing the next wave of PBR functionality that can be widely deployed, avoiding functionality that would hinder pervasive adoption across current platforms.
4. Third party extensions can add any functionality needed for use cases not addressed by Khronos-defined core and extension specifications.
5. Communication and cooperation between Khronos and any entity defining significant extended glTF functionality is desirable to avoid confusion and fragmentation which would hurt all ecosystem participants. Some problems to avoid could include:
   1. definition of extensions that duplicate Khronos-defined, or upcoming Khronos-defined functionality
   2. definition of extensions that are not designed to co-exist with other extended functionality or future core specifications.

After the initial communication, Khronos experts joined our AHG call on August 17, 2020. The initial presentation was represented and discussed. We received the following feedback.

*Hello Thomas,*

*Thank you again for putting Khronos glTF on the MPEG-I August 17th call. We appreciated the discussion.*

*Good news, we have reviewed the updated MPEG-I roadmap presented at the meeting, and the Khronos glTF Working Group is in general agreement with the current design to use and extend glTF.*

*Consequently, we suggest the following ongoing communication channels between MPEG-I and Khronos:*

* + *if MPEG-I has any updated public roadmap information, we are happy to receive, review and provide feedback*
  + ***we encourage MPEG-I to make any glTF extension proposals, or raise issues and questions, directly on the*** [*Khronos public glTF GitHub*](https://github.com/KhronosGroup/glTF)
  + *we are open to attending MPEG-I meetings if needed , or arranging specific joint discussions or meetings*

*And of course, Qualcomm and other MPEG-I participants are Khronos members and are welcome at any weekly glTF meeting where we can put MPEG-I cooperative issues on the agenda as needed.*

*How does this sound? Any other suggestions welcome!*

*Thanks,*

*Neil*

We identified that before engaging with Khronos gltf on github, we need to clarify any IPR aspects when submitting and discussing comments on github and generally around sharing documents. We agreed to use the official liaison.

## Proposed Communication after MPEG#132

Based on the above communication it is proposed to

1. Unofficially inform Khronos about the timeline
2. Planning a workshop between MPEG and Khronos in early 2021
3. Officially inform Khronos from MPEG#133 about the CD text

## Communication during MPEG#133

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [MDS20159](https://dms.mpeg.expert/doc_end_user/current_document.php?id=78184&id_meeting=185) | WG 03 | 00180 | 2021-01-16 01:57:39 | 2021-01-20 07:05:53 | All | Liaison to Khronos on Scene Description for MPEG Media | WG 03 MPEG Systems | |  | | --- | | [MDS20159\_WG03\_N00180](https://dms.mpeg.expert/doc_end_user/documents/133_OnLine/wg11/MDS20159_WG03_N00180.zip) | |

|  |  |
| --- | --- |
| **Title** | **Liaison statement to Khronos on Scene Description for MPEG Media** |
| **Source** | **WG 03, MPEG Systems** |
| **Serial Number** | **20159** |

MPEG Systems would like to inform Khronos on the availability of the Committee Draft of ISO/IEC 23090-14 on MPEG-I Scene Description for MPEG Media in WG03N0026.

As part 14 of the MPEG-I project on "Coded representation of immersive media", MPEG developed use cases and requirements on 3D/immersive/6DoF media and concluded that a scene description is needed. MPEG decided to rather extend an existing format than starting from scratch. Khronos glTF2.0 was recognized by MPEG as the best candidate for a baseline. However, a few gaps were identified in gltf2.0, among others

* No support for Audio
* No support for timed media (dynamic meshes/point clouds, video textures, …)
* No support for scene updates
* No interfaces to media access functions

Based on these requirements, MPEG is defining extensions to address these gaps in ISO/IEC 23090-14. All extensions will use the MPEG\_ namespace which has been registered with Khronos.

Along with this standard, MPEG Systems is also developing test assets and reference software that verifies the extensions. We continue to improve the Committee Draft with expectation of a final first version by late 2021. We also anticipate a second phase, for example addressing support for interactivity.

MPEG Systems would appreciate feedback on the CD of ISO/IEC 23090-14 and on any other activities related to our MPEG-I project.

In addition, MPEG would like to invite Khronos to plan a joint workshop or conference at a convenient time for MPEG and Khronos experts during the development phase of the MPEG-I Scene Description, preferably in mid or late 2021. Due to the COVID-19 situation, an online webinar is suggested. Potential topics include

* Latest development in Khronos on gltf, openXR, OpenMAX and other immersive media centric topics
* Expected future work in Khronos
* Immersive video in MPEG: V-PCC, G-PCC
* MPEG-I Scene Description
* Immersive media and 5G: The role of Khronos and MPEG-I
* Ongoing and future work in both orgs
* Potentially other topics

If you would be interested in such possible event, please contact us.

For your information, our future meeting schedule is as follows:

* 134th MPEG meeting on April 26-30, 2021.

## Communication during MPEG#134

Incoming response from Khronos:

*Dear Mr. Lim,*

*I am replying to your Liaison statement to Khronos on Scene Description for MPEG Media (Serial Number 20159).*

*Khronos continues to value and support our cooperative relationship with SC 29/WG 3 over the reference to glTF from MPEG-I.*

*>> MPEG Systems would appreciate feedback on the CD of ISO/IEC 23090-14 and on any other activities related to our MPEG-I project.*

*Khronos is actively reviewing the CD and will communicate and feedback or concerns.*

*>> MPEG would like to invite Khronos to plan a joint workshop or conference in mid or late 2021*

*Khronos is willing to discuss planning a joint workshop for second half 2021. Please let us know the best way to progress those discussions.*

*>> For your information, our future meeting schedule is as follows: 134th MPEG meeting on April 26-30, 2021.*

*Please let me know if Khronos should attend any sessions of the MPEG meeting next week, we are happy to prepare any updates that are needed.*

*Also, as you may know Khronos has applied to be a JTC 1 PAS Submitter, the ballot closes on May 5th, 2021.*

*Finally, Khronos’ formal liaison with SC 29 was a Cat C liaison with the previous WG 11 and our PAS Mentor has confirmed that liaison is no longer listed since the SC 29 re-organization.*

*As Khronos has a Cat A liaison with SC 24, and we need a liaison with SC 29/WG 3 and SC 29/WG 7 and perhaps other SC 29 working groups, should we consider a Cat A liaison between Khronos and SC 29? We welcome any thoughts or feedback.*

*Thank you, and please let us know if you need any more actions or information from Khronos,*

*Best regards,*

*Neil*

***Neil Trevett***

*Vice President Developer Ecosystems | NVIDIA*

*President | Khronos Group*

*M: +1 (408) 464-7053*

*[ntrevett@nvidia.com](mailto:ntrevett@nvidia.com)*

Meanwhile during the week:

* Khronos completed application for a Category A liaison with SC 29.
* This form goes through ISO CS and they may contact you for further information. (though I assume this would not happen considering the liaison states Khronos Group has already established with other ISO organizations).
* After that, SC 29 does Committee Internal Ballot (CIB - 4 weeks) and JTC 1 does CIB (4 weeks).
* We hope the relationship is established before the 135th MPEG meeting in July.
* And Thomas and Young - please do let us know if our attendance would be helpful at SC 29/WG 3 meetings in the meantime.
* Workshop planning should start (Ask Imed to add this to slides for joint meeting)

No response, we will maintain informal communication.

# Requirements, Scenarios and Test Assets

## Requirements

The work of the MPEG-I scene description is based on the requirements defined in N18965, later revised to N19511. The coverage of the requirements and the progress is documented in WG3\_N0210.

## Scenarios

Providing Extension to MPEG-I Scene Description is based on well-defined and agreed scenarios. WG3\_N0210 also covers the mapping of requirements to scenarios.

Scenarios include:

* Description of the scenario
* A set of test assets that are needed for the scenario

Agreed scenarios and test assets can be accessed:

* <https://gitlab.com/mpeg-i/scene-description/scenarios/>

Agreed Test Assets can be can be accessed here.

* <http://mpegfs.int-evry.fr/mpegcontent/ws-mpegcontent/MPEG-I/Part14-SceneDescriptions>

Note: access and contribution to this requires an account. To request an account, please contact the test asset coordinators (see clause 9)

For adding new scenarios, please provide an input contribution to MPEG with the following information

* Description of the scenario
* A set of test assets that are needed for the scenario

A template for the scenario is provided in clause 5.4.

## Initial Example Test Scenarios

The following initial test scenarios are considered in scope:

* AR Sharing: overlay/composition of 2D and 3D content with local camera view
* Online Gaming: 2D and 3D content captured from a game session and streamed for rendering to the client
* VR Conferencing: composition of 2D and 3D live captured content and 2D and 3D generated content in a live conferencing session
* 6DoF Streaming: streaming of 6DoF cinematographic content

It is expected that other test scenarios will be provided.

## Template for Test Scenario

The following table should be used to propose test scenarios for scene description:

|  |  |
| --- | --- |
| Item | Description |
| Title | <give it a catchy title, e.g. as those listed in clause 2> |
| Description | * What is the basic use case? * How does it relate to MPEG-I Requirements and Use Cases? |
| Required test assets | * 3D scene, real-time assets for media (2D/3D) * Anything else * References to test assets |
| Current Support | * How can glTF Scene Description be used today * What are gaps/inefficiencies of glTF2.0 to address this scenario? |
| Criteria | * What are relevant criteria for the user experience/QoE? * What are relevant criteria for passing the test scenario? |

## Continuous Call for Test Data

Among others, we solicit the following material to be used as content for the creation and validation of MPEG-Scene Descriptions:

* 2D content that can server as overlays, video textures
* 2D and 3D content that is captured from a local camera, e.g. representing a conference room or flat surfaces for overlay
* 3D game content, e.g. provided in Unity, that can be used for the online gaming scenario
* 3D cinematographic content that includes complete scenes
* VR content and 3D mesh and point cloud content that can be used for VR scenes
* etc…

We welcome contributions of content that can be made available to the MPEG community for the sake of the MPEG-I Scene Description activity.

## Timeline

The data sets should be submitted as input contributions to the 135th MPEG meeting (July 2021), but early submission into AHG is welcome.

## Available Test Assets

The following table lists the [available assets](https://qualcomm-my.sharepoint.com/personal/tsto_qti_qualcomm_com/Documents/Standards/MPEG/Meetings/MPEG_131/Own-Contributions/Scene/•%09http:/mpegfs.int-evry.fr/mpegcontent/ws-mpegcontent/MPEG-I/Part14-SceneDescriptions) and provides a brief description:

|  |  |
| --- | --- |
| **Asset** | **Description** |
| conferenceroom.zip | a glTF asset that represents a conference room. |
| livingroom.zip | a glTF asset that represents a living room. |
| island.zip | a glTF asset that represents an island. |
| chair.zip | a glTF asset that represents a chair. |
| bbb.mp4 | Big Buck Bunny video file in mp4 format. |
| longdress\_frame.ply | a binary PLY file from the longress point cloud sequence. |
| Scenario 11 | Test Assets:  1. Pine Forest  "author": "fangzhangmnm (https://sketchfab.com/fangzhangmnm)",  "license": "CC-BY-4.0 (http://creativecommons.org/licenses/by/4.0/)",  "source": "https://sketchfab.com/3d-models/pine-forest-ece69535f7584e099488f65f2072264e",  2. woodland-5\_trim\_SN3D.wav  Obtained and modified from EigenScape.  EigenScape is a database of acoustic scenes recorded spatially using the mh Acoustics EigenMike. https://doi.org/10.5281/zenodo.1012809  Marc Green <marc.c.green@york.ac.uk> |

Note that the first 4 assets are downloaded from sketchfab and are available for download and usage under the Creative Commons license as describe in CC Attribution License: <https://creativecommons.org/licenses/by/4.0/>.

## Agreed Test Scenarios

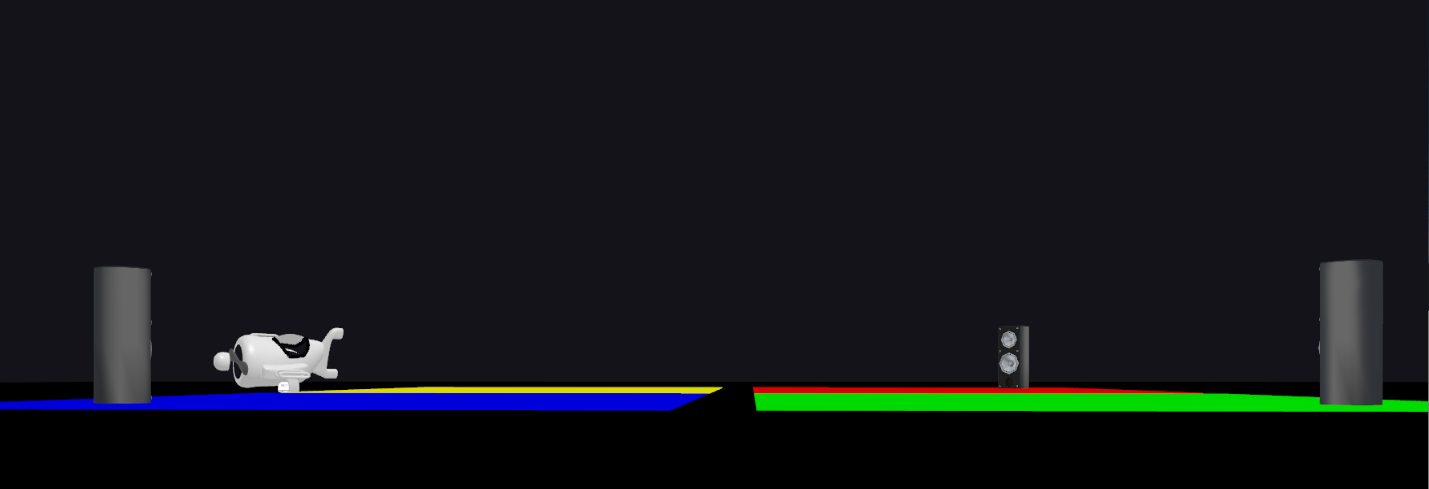
## Scenario 1: Spatial Audio

## Test Scenario

1. **Description of the use case/test scenario:**

The user is having headphones on and is able to walk around on a large floor. There are several loudspeakers placed in different places on the floor. As the user approaches a loudspeaker, the sound becomes clearer. Optionally, a fourth loudspeaker is being moved around the floor at different speeds.

The following picture depicts the setup of the scene:



Each loudspeaker will act as a sound source. The user is able to walk around the scene and listen to the sounds depending on the user’s position and orientation. Furthermore, an animated plane is used as a moving sound source.

1. **What are the required test assets?**

The following assets are required:

* a scene with a large floor,
* a loudspeaker asset,
* 3-4 different sound clips.

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

glTF 2.0 has no support for audio.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

It is important to verify that the user hears distinctive audio sources with different volume levels depending on the position of the listener with regards to the loudspeaker. The user should also be able to determine if the moving loudspeaker is getting closer or farther away from them.

## Test Scene

The glTF file with the corresponding MPEG\_spatial\_audio extension is attached to this document as dancefloor.gltf. The assets will be uploaded to the MPEG asset repository for Scene Description.

## Audio Rendering

The authors opted for the SoLoud library to provide the audio rendering integration into the Scene Description reference software. The SoLoud library comes with a very permissive license that allows to modify and distribute the code and binaries freely. It also comes with support for a large set of audio backends, which makes it portable to almost all platforms as shown in the following figure.

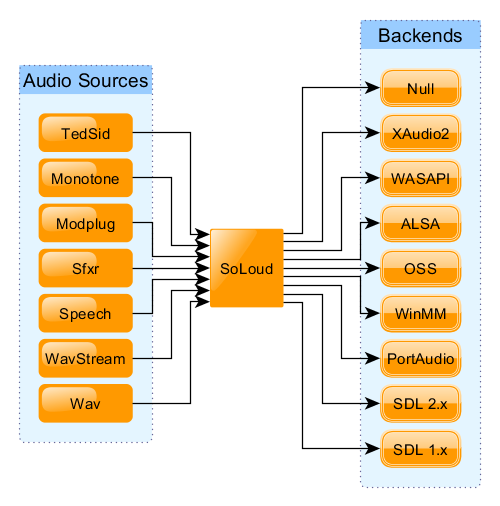


Figure 1 SoLoud library (picture courtesy of SoLoud)

The main feature of interest for the scene description is the support for 3D Audio. SoLoud uses a coordinate system that matches the one used by glTF. The engine has support for a reasonable set of audio effects, including attenuation and doppler. Finally, SoLoud comes with a Python wrapper, which makes it easily integratable into the MPEG Trimesh reference software.

## Source Code and Assets

The source code can be fetched using the following command:

|  |
| --- |
| git clone --branch MPEG\_spatial\_audio https://gitlab.com/mpeg-i/scene-description/mpegtrimesh.git |

All required assets are to be found in the content/dancefloor folder. These are:

* The glTF file of the scene, which is also attached to this contribution
* The binary data of the scene under audio.bin
* 3 audio clips that will be used as sources for the loudspeakers
* 1 audio clip that will be used as source for the plane

All audio sources and 3D assets are available under the CC license.

## Scenario 2: Living Room

1. **Description of the use case/test scenario**

In this test scenario, a scene is composed of a 3D living room with a TV on the wall, showing a movie. In the middle of the room, a lady is walking around.



The requirements that this test scenario pertains to are 2b, 2n, 4a, and 7a.

1. **What are the required test assets?**

The following assets are used for this test scenario:

|  |  |
| --- | --- |
| **Asset** | **Description** |
| livingroom.zip | a glTF asset that represents a living room. |
| bbb.mp4 | Big Buck Bunny video file in mp4 format. |
| longdress\_frame.ply | a binary PLY file from the longress point cloud sequence. |

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

Currently, glTF 2.0 has no support for timed media such as video textures and dynamic volumetric objects.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

This test scenario demonstrates the usage of timed media such as video and dynamic point clouds as well as meshes.

Passing this test scenario requires correct rendering of the living room, the video texture, and the dynamic point cloud. The corresponding glTF 2.0 file with the necessary extensions is attached to this document.

1. **Implementation in MPEG Trimesh Reference Software**

The implementation of the four extensions is described in this section. The parsing of the glTF file with the extensions is performed in the **gltf.py** module.

The extracted information are stored in the following dictionaries:

* medias: stores all structures extracted from MPEG\_media
* timedAccessors: stores all information about timedAccessors
* taBufferViews: stores location of the dynamic headers of the timed accessors
* circularBuffers: stores information about the circular buffers

This information is used by the application to fetch the media and pass it to the renderer through circular buffers. In particular, the decoded video frames and the point cloud frames are inserted into circular buffers that are used by the Presentation engine to update the scene.

The test scenario can be demonstrated by running: **python.exe ./renderer.py**

## Scenario 3: VR

1. **Description of the use case/test scenario**

In this test scenario, the scene is composed of 360 degree video and the corresponding audio. The 360 video is stereoscopic.



The requirements that this test scenario pertains to are 2b, 2n, and 4a.

1. **What are the required test assets?**

The following assets are used for this test scenario:

|  |  |
| --- | --- |
| **Asset** | **Description** |
| Dancing 360 | A stereoscopic 360 degree video. |
| Audio file | Asset provided by the test scenario |

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

Currently, glTF 2.0 has no support for video textures or 360 degree video. It also has no support for audio.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

This test scenario demonstrates the usage of timed textures and audio.

Passing this test scenario requires correct rendering of the VR content together with the related audio.

## Scenario 4: Simple AR

1. **Description of the use case/test scenario**

In this test scenario, the scene is composed of the user’s camera feed and a 3D chair located in the middle of the user’s surroundings.



The requirements that this test scenario pertains to are 2b and 5c.

1. **What are the required test assets?**

The following assets are used for this test scenario:

|  |  |
| --- | --- |
| **Asset** | **Description** |
| Chair | A static mesh model of a chair. |

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

Currently, glTF 2.0 has no support for local media.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

This test scenario demonstrates the usage of local media, captured through the viewer’s camera and/or microphone.

Passing this test scenario requires correct rendering of the 3D model as overlay on top of a camera captured view.

## Scenario 5: Live Scene Graph update

1. **Description of the use case/test scenario:**

A simple test scenario is a system updating the location of people in a scene, and the scene rendering updates based on real-time data in a timely fashion. An example setup can be as follows:

1. Blank scene is established in glTF with no child nodes
2. Based on sensor or synthetic data, a separate system (not within scope of the test scenario) generates a JSON patch document containing nodes describing the position of several people in the scene
3. The resulting glTF is updated with the new nodes
4. The scene is rendered showing the new objects
5. Based on sensor data, a separate system generates a new JSON patch document with changes to the nodes based on how the people have moved
6. Use a viewer to manually verify that people nodes have moved as expected

**Note 1:** The scene can be a floor plan, and the people represented as circles on the floor plan in 2D. 3D rendering is not required for this test.

**Note 2:** No interactivity capability on the scene description format is intended to be tested as part of this test scenario. The interactive location update is simply used as a mechanism to trigger the scene updates using JSON patches.

1. **What are the required test assets?**

The following assets are required:

* a glTF scene with one or more objects,
* sequence of patch documents containing changing translational information (e.g. location updates) of the objects
* renderer capable of updating the glTF object of the scene based on the sequence of patches and rendering the updated glTF object

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

glTF 2.0 has no support for dynamic scene updates.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

It is important to verify that the user is able to observe the updates of the scene in line with the content of the JSON patches.

1. **Source Code and Assets**

As part of a reference implementation of this test scenario, the following glTF source was used:

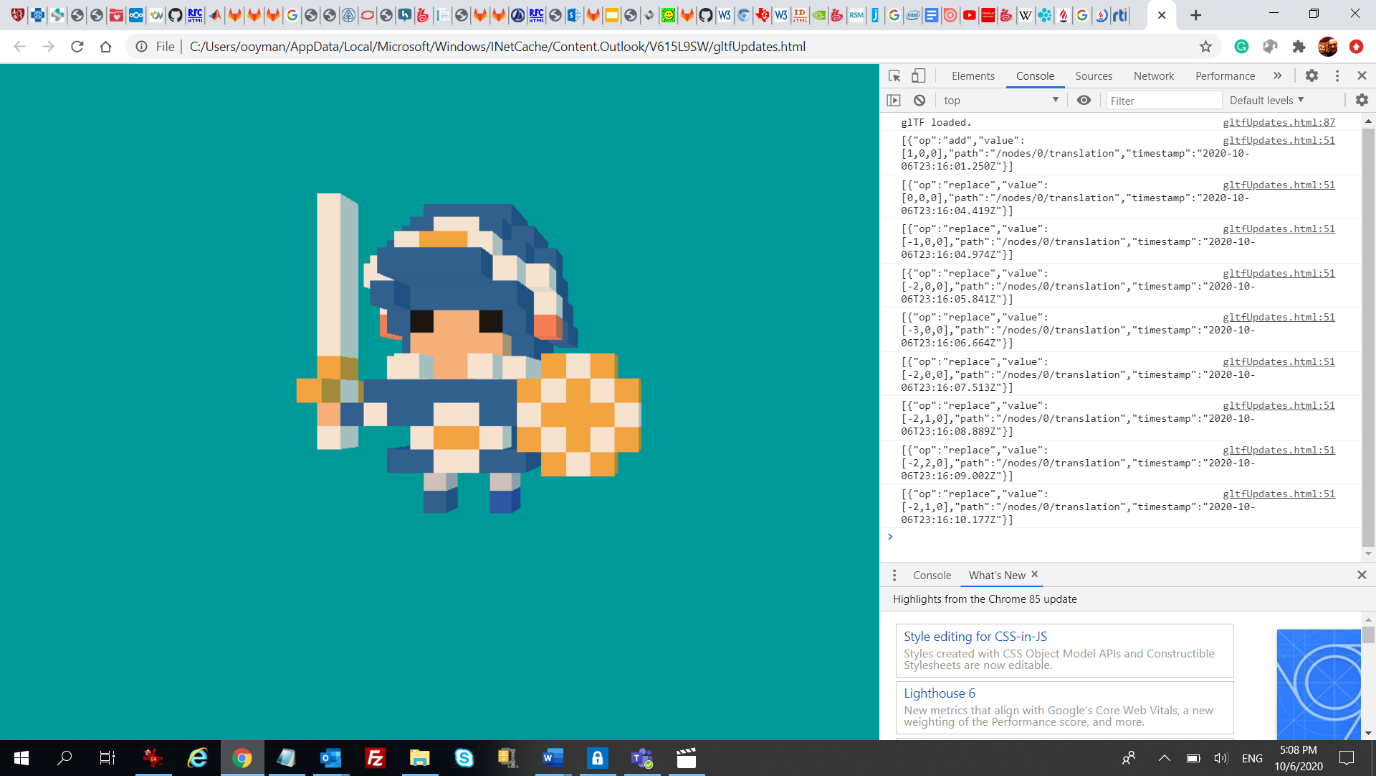
<https://cdn.rawgit.com/siouxcitizen/3DModel/a1c2e475/yuusha.gltf>

The glTF loader and renderer was based on three.js, which is completed Web-based and hence quite attractive to use for developers:

<https://cdnjs.cloudflare.com/ajax/libs/three.js/110/three.min.js>

<https://cdn.jsdelivr.net/gh/mrdoob/three.js@r110/examples/js/loaders/GLTFLoader.js>

As shown in the figure below, JSON patches update the position of the object.



The HTML file for reference implementation is attached as follows:



**Note:** While three.js was used as the renderer for the reference implementation toward the initial validation of the test scenario, it is planned to integrate this test scenario into Trimesh-based reference software.

## Scenario 6: Record and Playback based on UTC time

1. **Description of the use case/test scenario:**

This is a “DVR” style test scenario, where historical data is used to start playback of a scene from a specific absolute time.

1. Utilize a system that records scene glTF (including media) and a series of patch documents with absolute timestamps that reflect how the scene changes in time. (e.g. a basic database system and its associated github repo)
2. Utilize a system that takes as an argument an absolute time in ISO 8601 UTC format (e.g. 2020-08-03T19:33:05.406Z) to start playback and renders the scene starting at the provided time.
3. Verify that the scene plays back based on the provided UTC time.

**Note:** The scene can be very basic and shown in 2D. The playback system will likely need to have some mechanism to display the UTC time and scrub to an arbitrary UTC time within the glTF time window.

1. **What are the required test assets?**

The following assets are required:

* scene glTF (including media) and
* a series of patch documents with absolute timestamps that reflect how the scene changes in time
* a playback system that can replay the scene from a selected time in UTC

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

glTF 2.0 has no support for dynamic scene updates.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

It is important to verify that the user is able to observe the updates of the scene in line with the content of the JSON patches.

Secondly, it is important to verify that the user can go back to anytime in the recorded scene and replay the scene starting from a selected time. This includes the ability for the user to indicate an an absolute time in UTC format (e.g. 2020-08-03T19:33:05.406Z) to start playback and renders the scene starting at the provided time.

## Scenario 7: Bouncing Objects with Audio

1. **Description of the use case/test scenario**

A scene where the bass beat of background audio track controls jumping of objects within the scene. Jumping objects may be additionally rotated, in which case the rotation animation should be aligned with “vocal” audio track describing the direction of rotation.

1. **What are the required test assets?**

A glTF scene with

* a floor and two cube-objects (possibly using static textures),
* animation that can make an object jump, i.e. move up and come back down,
* animation that can make an object rotate up, e.g. x-channel rotation,
* animation that can make object rotate sideways, e.g. z-channel rotation,

MPEG audio tracks

* audio track containing a generic bass beat,
* audio track with vocal saying “rotate up”,
* audio track with vocal saying “rotate side”

1. **How can glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

Each animation in glTF file has their own timeline and each animation may be triggered several times during the playback of the narrated experience. Currently an implementation of the glTF does not understand when a “jump”-animation should be initiated based on the bass beat, without replicating the animation data for each “jump”-event.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

It is important to verify that the “jump”- and “rotation”-animations are aligned with audio. i.e. “jump”-animation should be applied to both objects according to bass beat.

1. **Test Scene**

A glTF file with the corresponding MPEG\_animation\_timing extension and MPEG audio extension should be provided. The glTF file should also contain animation that will be triggered by the MPEG animation timing in sync with audio. The assets will be uploaded to the MPEG asset repository for Scene Description.

## Scenario 8: Recommended Viewport

1. **Description of the use case/test scenario**

In this test scenario, a scene is composed of a 3D living room with a TV on the wall, showing a movie. Additionally, a lady is standing in the room. A camera which captures the recommended viewport is placed in the center of the room. In this test scenario, at first, a camera orientation is dynamically changed to look around the room from the center, and then orientation change is stopped, and a camera perspective is dynamically changed to zoom-up the TV screen. Fig. 1 shows an example of a scene.

人, 屋内, 暮らし, 持つ が含まれている画像

自動的に生成された説明

Fig. 1 An example of a scene

1. **Required test assets**

The following is the required test assets. These have already been uploaded to the MPEG asset repository for Scene Description.

|  |  |
| --- | --- |
| **Asset** | **Description** |
| livingroom.zip | a glTF asset that represents a living room. |
| bbb.mp4 | Big Buck Bunny video file in mp4 format. |
| longdress\_frame.ply | a binary PLY file from the longdress point cloud sequence. |
| timedmetadataxxx.bin | Binary data files with camera parameter (translation, rotation, perspective), 44 bytes per frame. |

1. **How an glTF Scene Description be used today and what are gaps/inefficiencies of glTF2.0 to address this scenario?**

The glTF2.0 has a camera object that defines the projection matrix transforms from view to clip coordinates, so this can be used to render viewport. However, the camera object is static data. Thus, the camera object cannot be used for rendering recommended viewport that is dynamically changed.

1. **What are relevant criteria for the user experience/QoE? What are relevant criteria for passing the test scenario?**

It is important to verify that the 6DoF content is correctly rendered according to the recommended viewport data (i.e. orientation, rotation and perspectives data of camera).

1. **Test Scene**

A glTF file with the corresponding MPEG\_recommended\_viewport extension should be provided. Note that the assets have already been uploaded to the MPEG asset repository for Scene Description.

## Scenario 9: MIV (draft)

This scenario is about integration of MPEG Immersive Video (MIV) into Scene Description.

The AHG will develop the test scenario.

## Scenario 10: V-PCC (draft)

This scenario is about integration of Video-based Point Cloud Coding (V-PCC) into Scene Description.

The AHG will develop the test scenario.

## Scenario 11: Spatial Audio Test Scenario with HOA Source

# Description of the HOA source test scenario

The Scene Description TuC includes HOA type as an audio source in the MPEG spatial audio extension. This contribution presents a test scenario with an HOA source. In the test scene, the HOA source is a soundfield which has wind, tree, and bird sounds to provide the listener with the ambience of a woodland experience.



Figure 1 - Screenshot of trimesh displaying the Pine Forest gltf visuals.

# Test Assets

## HOA Source Signal

The HOA source signal, woodland-5\_trim\_SN3D.wav, is a fourth order Ambisonics file with SN3D normalization recorded using an Ambisonics microphone [1].

## Visuals

The visuals use a gltf model of pine trees [2] and have been tested with trimesh python framework [3]. A screenshot of the scene is shown in Figure 1.

# MPEG\_spatial\_audio Extension

"extensions": {

"MPEG\_spatial\_audio": {

“source”: {

"id": 0,

"type": "HOA",

"timedAccessors": 0

}

}

},

"extensions": {

"MPEG\_spatial\_audio": {

"listener": {

"id": 0

}

}

},

"MPEG\_media": {

"media": [

{

"name": "hoa\_audio\_source",

"loop": true,

"alternatives": [

{

"mimeType": "audio/wav",

"uri": "https://example.com/woodland-5\_trim\_SN3D.wav"

}

]

}

]

}

# References

|  |  |
| --- | --- |
| [1] | *https://doi.org/10.5281/zenodo.1012809.* |
| [2] | *https://sketchfab.com/3d-models/pine-forest-ece69535f7584e099488f65f2072264e.* |
| [3] | *https://gitlab.com/mpeg-i/scene-description/mpegtrimesh/-/tree/MPEG\_spatial\_audio.* |

# Attachments

# Contributions for Extensions

## General

For every extension documented in ISO/IEC 23090-14 under the framework in clause 3 the following information is expected to be provided:

* The schema for the extension as part of the standard as well as a json document
* The semantics for the extension
* The processing model on the "Presentation Engine"
* The conformance description, i.e. conformance requirements for the Presentation Engine that supports the extension
* *A promise for example content that uses the extension that is finally available within 1 meeting after the technology was added. If not fulfilled, the feature is expected to be removed and this will be documented as a note in the draft standard.*
* *A promise of a reference implementation in one of the agreed reference software libraries as documented in clause 7, that is finally available within 2 meetings after the technology was added. If not fulfilled, the feature is expected to be removed and this will be documented as a note in the draft standard.*

Hence, contributions addressing extensions to glTF under the framework in clause 3 should include the following:

* The scenarios that this extension is addressing. The scenarios are documented in clause 5.8.
* All information from above

As long as not all the above information is available, a documented extension is not moved into the WD/CD, but is maintained in the Technology under Consideration (TuC) document. The status of the completed information and the missing one is documented in the TUC.

The following text processes is recommended, but needs final verification:

*To fulfill the requirement on the reference software, it is sufficient to demonstrate that the reference software is able to properly process the test scenario. The test scenario content shall at least have a scene description file in glTF textual format that makes use of the proposed extension. The test scene description glTF document should use one of the available assets. The proposal must indicate any dependencies on other extensions.*

*The following is an example of this procedure:*

* *A test scenario is defined around support for video textures*
* *The proposal is to make use of the MPEG\_video\_texture extension*
* *A sample content is proposed based on the "conferenceroom" glTF file, which is part of the assets. The glTF file is extended to include the MPEG\_video\_texture extension. The bbb.mp4 asset is used to describe the video texture, which is attached to a rectangular mesh in the "conferenceroom" scene.*
* *The reference software is run with the modified scene description document and the expected behavior is demonstrated, showing the video texture.*

The currently considered extensions

## Extension Principles

The following extension principles apply

* If the extension adds a new top-level array (by extending the root glTF object), its elements should inherit all properties of glTFChildOfRootProperty.schema.json.
* Other objects introduced by the extension should inherit all properties of glTFProperty.schema.json.
* By glTF 2.0 conventions, schemas should allow additional properties.
* Names MUST begin with an MPEG prefix, followed by an underscore.
* Names MUST use lowercase snake-case following the prefix, e.g. MPEG\_materials\_sand.
* Names SHOULD be structured as MPEG\_<scope>\_<feature>, where scope is an existing glTF concept (e.g. mesh, texture, image) and feature describes the functionality being added within that scope. This structure is recommended, but not required.
* Scope SHOULD be singular (e.g. mesh, texture), except where this would be inconsistent with an existing Khronos extension (e.g. materials, lights).

# Reference Software

The reference software for the scene description is hosted in the following repository:

<https://gitlab.com/mpeg-i/scene-description/mpegtrimesh>

Experts interested in accessing it should contact the coordinator (Imed Bouazizi) to request access to the repository by providing their GitLab member name.

In order to validate a new feature for Scene Description, a test scenario needs to be defined and an implementation needs to be provided to demonstrate that the solution achieves the desired behavior by proper rendering of the scene of the test scenario. The implementation should be provided as a new branch with a merge request to the mpegtrimesh repository.

Currently, the following branches are available:

* media-access-functions: an implementation of the specified Media Access Function with the MAF and Buffer APIs. A generic media pipeline template is provided, which can be used to implement more advanced media pipelines for a wide set of media formats.
* MPEG\_spatial\_audio: an implementation of the MPEG\_audio\_spatial extension, which also supports animations.
* clause\_2.10\_in\_N19446\_SONY: an implementation of the recommended viewport feature as defined by the MPEG\_viewport\_recommended

The corresponding technical solutions are already documented in the CD text of 23090-14. We recommend the following procedure to merge these branches:

* for each branch, identify the corresponding test scenario
* validate the test scenario and ensure proper functioning according to the test scenario definition and the specification
* Upon successful validation, merge the branch into the main branch

Verify overall proper function after the merge

# Gitlab Management

## Reference implementation software

Candidate Reference Software Libraries are documented in clause 7 . Each of these software projects are be forked at the start time of the project and the development of the MPEG extensions will be done in the 'mpeg' branch. This would ease future import from and export to the original repositories if this needs to happen.

One Git repository per library will be created. The reason is repositories are free to create and separation of different software, build platform, documentation, etc. is desirable. The names of the repositories are documented in clause 7.

## Conformance software

JSON glTF file are validated using JSON schema. For glTF binary files, it is proposed to define the binary structure in the [Kaitai](https://kaitai.io/) format (YAML based). This will allow the automatic generation of parsing libraries which can in turn be used to validate these binary files.

Both the JSON schemas and the Kaitai files, if needed, are proposed to be hosted on the same Git repositories here: https://gitlab.com/mpeg-i/scene-description/conformance.

## Scenarios

In order to provide use cases that are to be supported by the standard, scenarios are collected. Scenarios are described on what the basic setup an experience is expected to be and provides along with this test assets and test vectors (may be compressed or uncompressed) that may be used in the scenario. These test scenarios are collected the same Git repository with a folder at the root per library then a folder for each scenario inside each library. The name of this repository is https://gitlab.com/mpeg-i/scene-description/scenarios.

## Test assets

Test assets are not accessed on a frequent basis but usually requires protection by password to comply with the corresponding usage licenses, at least as it is commonly done in MPEG.

A folder in the MPEG content server will be created for the MPEG-I scene description standard. All the original "raw" test assets will be stored there along with the corresponding usage licenses.

## Test vectors

The test vectors are exercising the normative aspects of the specification. They will be stored in a single Git repository. When test vectors are binary, the LFS feature of the Git hosting service will be used in order to avoid polluting the Git tree with binary files. The location of the repository is here https://gitlab.com/mpeg-i/scene-description/test-vectors.

## Summary logistics

|  |  |  |
| --- | --- | --- |
| **Asset** | **Hosting** | **Location name** |
| Repository | Gitlab.com | https://gitlab.com/mpeg-i/scene-description |
| Candidate Reference software Diligent Graphics | Gitlab.com | <https://gitlab.com/mpeg-i/scene-description/reference-diligentengine> |
| MPEG Trimesh (mpegtrimesh) Reference software | Gitlab.com | https://gitlab.com/mpeg-i/scene-description/mpegtrimesh |
| Conformance software | Gitlab.com | https://gitlab.com/mpeg-i/scene-description/conformance |
| Scenarios | Gitlab.com | https://gitlab.com/mpeg-i/scene-description/scenarios |
| Test vectors | Gitlab.com with LFS for binary files | <https://gitlab.com/mpeg-i/scene-description/test-vectors> |
| Test assets | MPEG content | <http://mpegfs.int-evry.fr/mpegcontent/ws-mpegcontent/MPEG-I/Part14-SceneDescriptions> |

For access to the project, please register an account on GitLab.com at <https://gitlab.com/users/sign_in> and collect the following information:

* GitLab.com username
* GitLab.com email address

Please then send an email containing this information to the gitlab managers as listed in clause 9.

For uploading content to the Test Assets, please bring an input contribution to the MPEG meeting.

# Candidate Phase 2 Technologies

# This clause provides and overview of candidate phase 2 technologies

# Audio functionalities

# [m56007][41] [SD] On spatial audio for the web

# Support for AR in Scene Description

# Partial Access Support for Scene Description

# CoAP Support for IoT streaming devices in Scene Description

# Interactivity in Scene Description

# Nodes with External Transformation

# Coordinators for Efforts until MPEG#134

* BOG Chair:
  + Thomas Stockhammer (tsto@qti.qualcomm.com)
* AHG Chairs:
  + Thomas Stockhammer (tsto@qti.qualcomm.com)
  + Mary-Luc Champel (champelmaryluc@xiaomi.com)
* Editor of ISO/IEC 23090-14
  + Imed Bouazizi (bouazizi@qti.qualcomm.com)
  + Lukasz Kondrad ([lukasz.kondrad@nokia.com](mailto:lukasz.kondrad@nokia.com))
* Editor of Technology under Considerations Document
  + Lukasz Kondrad ([lukasz.kondrad@nokia.com](mailto:lukasz.kondrad@nokia.com))
  + Imed Bouazizi (bouazizi@qti.qualcomm.com)
* Test Asset and Scenario Coordinator
  + Emmanuel Thomas (emmanuel.thomas@tno.nl)
  + Imed Bouazizi ([bouazizi@qti.qualcomm.com](mailto:bouazizi@qti.qualcomm.com))
  + Shuai Zao (shuaiizhao@tencent.com)
* Gitlab Management
  + Emmanuel Thomas (emmanuel.thomas@tno.nl)
  + Imed Bouazizi ([bouazizi@qti.qualcomm.com](mailto:bouazizi@qti.qualcomm.com))
* Editor of ISO/IEC 23090-24
  + Ahmed Hamza (Ahmed.Hamza@InterDigital.com)
  + Imed Bouazizi (bouazizi@qti.qualcomm.com)

# Output from MPEG#133

## Documents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. **No.** | **Title** | **In Charge** | **TBP** | **Available** | **S/N** |
|  | **ISO/IEC 23090-14 - Scene Description for MPEG Media** |  |  |  |  |
| **207** | **[DoC on ISO/IEC 23090-14 Scene Description for MPEG Media](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/127)** | **Thomas Stockhammer** | **N** | **2021-04-30** | **20269** |
| **208** | **[Technologies under Consideration on Scene Description for MPEG Media](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/128)** | **Lukasz Kondrad** | **N** | **2021-05-07** | **20270** |
| **209** | **[Procedures for standard development, test scenarios and reference software for ISO/IEC 23090-14 (MPEG-I Scene Description)](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/129)** | **Thomas Stockhammer** | **Y** | **2021-04-30** | **20271** |
| **210** | **[Requirements Coverage of MPEG-I Scene Description](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/130)** | **Thomas Stockhammer** | **N** | **2021-04-30** | **20272** |
| **264** | **[Text of ISO/IEC DIS 23090-14 Scene Description for MPEG Media](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/131)** | **Imed Bouazizi** | **N** | **2021-05-07** | **20326** |
| **274** | **[Exploration Experiments for MPEG-I Scene Description](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/134)** | **Sungryeul Rhyu** | **Y** | **2021-06-09** | **20401** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **ISO/IEC 23090-24 - Conformance and Reference Software for MPEG-I Scene Description** |  |  |  |  |
| **272** | **[Request for Sub-division Request for subdivision of ISO/IEC 23090-24 on Conformance and Reference Software for MPEG-I Scene Description](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/132)** | **Ahmed Hamza** | **N** | **2021-04-30** | **20398** |
| **271** | **[WD on Conformance and Reference Software for MPEG-I Scene Description](http://mpegx.int-evry.fr/software/MPEG/Systems/SceneDescription/MPEG-Contributions/-/issues/133)** | **Gurdeep Bhullar** | **Y** | **2021-06-09** | **20396** |



## Mandate AHG until MPEG#135

|  |  |
| --- | --- |
| Name | AHG on MPEG-I Scene Description |
| Mandates | 1. Complete the analysis of the capabilities of glTF2.0 and the agreed MPEG Extensions against the requirements for MPEG-I Scene description ([#130](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\130" \o "N0210  Requirements Coverage of MPEG-I Scene Description) N0210) 2. Harmonize with the MPEG-I 3DG/video/systems work and integrate video/3D/systems relevant metadata into the Scene Description. 3. Collect/coordinate test assets that support the development of the MPEG-I Scene description work according to clause 5 of ([#129](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\129" \o "N0209   Procedures for standard development, test scenarios and reference software for ISO/IEC 23090-14 (MPEG-I Scene Description)) N0209). 4. Study the remaining open issues for phase 1 in the TuC ([#128](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\128" \o "N0208 Technologies under Consideration on Scene Description for MPEG Media) N0208) 5. For each technology in the DIS ([#131](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\131" \o "N0264 Text of ISO/IEC DIS 23090-14 Scene Description for MPEG Media) N0264) and the TuC ([#128](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\128" \o "N0208 Technologies under Consideration on Scene Description for MPEG Media) N0208) for phase 1, identify if it fulfills the requirements in ([#130](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\130" \o "N0210  Requirements Coverage of MPEG-I Scene Description) N0210), clause 6 and if not, progress the relevant aspects, including specification text, reference software and test scenarios. 6. Conduct the evaluation experiments on Random Access and Scene Updates as defined in ([#134](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\134" \o "N02XX Exploration Experiments for MPEG-I Scene Description) N02XX) 7. Collect relevant MPEG media types, add those to the registered media type in an update of the DIS ([#131](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\131" \o "N0264 Text of ISO/IEC DIS 23090-14 Scene Description for MPEG Media) N0264). 8. Start developing guidelines for integration of V-PCC, G-PCC and other MPEG 3D technologies into Scene Description. 9. Validate all reference software branches, merge them into a single branch, improve the description of the reference software and progress the WD ([#133](file:///C:\\software\\MPEG\\Systems\\SceneDescription\\MPEG-Contributions\\-\\issues\\133" \o "N0271 WD on Conformance and Reference Software for MPEG-I Scene Description) N0271). 10. Prepare a WD on Conformance Tools and Reference software for MPEG-I Scene Description. 11. Monitor ongoing scene description related work in the industry and in other groups and organizations, in particular Khronos and continue the collaboration with Khronos |
| Chairmen | Thomas Stockhammer (tsto@qti.qualcomm.com)  Mary-Luc Champel (champelmaryluc@xiaomi.com) |
| Duration | Until MPEG135 |
| Reflector(s) | mpeg-i-scene@lists.aau.at |
| Subscribe | <https://lists.aau.at/mailman/listinfo/mpeg-i-scene>    Please check gitlab discussions here:  <http://mpegx.int-evry.fr/software/MPEG/SceneDescription/MPEG-Contributions/issues> |
| Meeting | * Dates   + Tuesday June 1, 2021 13:30 – 15:00 UTC (15:30 – 17:00 CEST) (Monday May 31 is Memorial day)     - Submission deadline May 29, 22:00 UTC   + Monday June 14, 2021 13:30 – 15:00 UTC (15:30 – 17:00 CET)     - Submission deadline June 11, 14:30 UTC   + Monday June 28, 2021 13:30 – 15:00 UTC (15:30 – 17:00 CEST)     - Submission deadline June 25, 14:30 UTC   + Friday July 09, 2021 13:30 – 15:00 UTC (15:30 – 17:00 CEST) * Logistics   + Zoom: <http://iso.zoom.us/my/stockhammer>, Passwd as of MPEG#135   + Chairs create issue in gitlab to collect comments.   + If MPEG#135 repository is not yet available, use MPEG#134 repository. * Calendar   + Subscription link for MPEG AHG Calls:   + <http://mpeg.expert/live/nextcloud/remote.php/dav/public-calendars/HAwkATGsmc5bN3Qy?export>   + Public link for MPEG AHG Calls   + <http://mpeg.expert/live/nextcloud/index.php/apps/calendar/p/HAwkATGsmc5bN3Qy> |