**Source: Xiaomi**

**Title: Inspiration for defining GPU capability for MeCAR**

## Document for: Discussion

## Agenda Item: 9.5

# 1 Introduction

At the 3GPP meeting #118-e, the Permanent Document for MeCAR v1.0 [1] and the draft TS of MeCAR [2] were approved.

As part of MeCAR work, the GPU capabilities will be defined. This contribution provides an example for inspiration by the Khronos Group that pertains to device certification. From this example, the relevant parts are extracted and translated to the MeCAR context.

# 2 Background on Khronos 3D Commerce conformance (glTF viewer)

# 2.1 General

The Khronos group defines many specifications that rely on hardware capabilities and, in particular, its specifications are largely powered by Graphics Processing Units (GPU). As a result, the deployment of Khronos specification depends significantly on the ability for a vendor to evaluate whether its products meets the requirement of those specifications.

To this end, Khronos offers the Khronos 3D Commerce Viewer Certification Program which “enables any company to demonstrate that their viewer is capable of accurately displaying 3D Products that have been created using the 3D Commerce asset creation guidelines”.

The relevant part in the context of MeCAR is the certification process described in [1].



Figure 1 - Khronos' 3D commerce certification process

# 2.2 Relevant steps in the MeCAR context

From this certification process only a subset of those steps are relevant for us which are:

* Viewer Test Package
	+ What does it contain? What are the file formats?
* Run Certifications Test
	+ How are those test described? Are the test objective or subjective? On which criteria and/or metrics do they rely on?
* Generates Results packages
	+ How are expressed, in format, the performance of a 3D viewer against the tests? Is the result binary, i.e. passed/not passed? Or a score on a given scale with a minimum threshold?

To answer, those questions more documentation is available at the Khronos Group 3DC Certification repository [2]. The following was found based on the available documentation.

* Viewer Test Package
	+ The package contains a list of glTF models [3]:
		- AnalyticalCubes
		- AnalyticalGrayscale
		- AnalyticalSpheres
		- GreenChair
		- Mixer
		- Shoe
		- TennisRacquet
		- WickerChair
* Run Certifications Test
	+ The test plan defines how the tested viewer must operate to render the test models:
		- “The Certification Program Test Plan document defines the detailed requirements for generating the certification images.”
	+ Some test are verified by mathematical functions some by humans.
		- “Certification renders will be evaluated programmatically and through human checks”
		- Example of subjective test:
			* “Strings should appear translucent outside of the blue star area”
		- Example of objective test:
			* “When scored by the evaluation tool included in the repository an SSIM or PSNR lower than their respective thresholds will automatically flag the image for review.”
* Generates Results packages
	+ To evaluate whether a glTF viewer is conformant, the tested renders must generate images from the glTF model and those images are programmatically verified against reference renders.
		- “All certification images must be 1024x1024 and displayed according to the embedded cameras. The five retail models have three cameras each. One of the analytical models (spheres) is displayed in four different IBLs. All certification images need to be created according to the rules specified in the Test Plan document.”
	+ How are expressed, in format, the performance of a 3D viewer against the tests? Is the result binary, i.e. passed/not passed? Or a score on a given scale with a minimum threshold?

# 2.3 Takeaways from the certification process

Here are some takeaways from the certification test:

* A set of test models is essential for defining the test and the evaluation criteria.
* Objective tests are a minimum to pass but subjective tests via human verification are here to confirm for hard cases, e.g. transparency, reflection, etc.
* For objective tests, PSNR or SSIM is used to evaluated the rendered images from the test models.
* The tests are limited to static images and not rendering of the models over time.

# 3 Possible translation to the MeCAR context

# 3.1 Capability evaluation framework

In the context of MeCAR, the goal is not to certify a device but to define the media capabilities that are required at minimum for a given device category. The figure below depicts a possible workflow for implementing the evaluation of graphics capabilities in rendering glTF models and scenes.



Figure 2 - Possible framework for defining graphics capabilities

The first type of requirements is the playback of the test vectors. The test vectors are composed of a set of glTF tests models and scenes as well as pose traces. The MeCAR UE is supposed to render views of those glTF test models under the given poses coded in the test pose traces). The second type of requirements is whether the playback of the test vectors is correct. To this end, the generated views could be considered as a rendered videos (similar to the rendered image in the Khronos example). Such videos could be then checked against a reference video for the given test vector. The video validator could verify for the entire video:

* correct number of frames
* correct frame rate
* correct coded resolution of frames
* correct chroma sampling
* correct bit depth
* correct disparity between left and right views
* correct timing with respect to real-time rendering constraints

For each frame, the video validator could verify that each rendered image does not deviate too much from the reference image in the reference video. To validate the real-time nature of the rendering, the test run environment should also limit the time allowed to run the test scene.

# 3.2 Possible scope of graphics capability

In contrast to the Khronos example, the goal in MeCAR is not to establish a certification process. As a result, we would define the scope of the MeCAR graphics capability that does not fully cover the framework described in clause 3.1. The possible scope would cover he following elements:

* The glTF test models (possibly included media assets).
* The test pose traces associated with the glTF test models. The pose traces could be specific to each glTF test model.
* The test plan that defines the criteria to evaluate the rendered video (resolution, number of frames, etc…)
* Optionally, the generation of the reference rendered videos could be included to facilitate the reuse of this framework. However, since MeCAR may not define the reference scene render, providing these reference rendered video may actually go beyond MeCAR scope. This should be further discussed.

# References

1. 3D Commerce Viewer Certification Program, <https://www.khronos.org/3dcommerce/certification/>
2. Khronos Group 3DC Certification documents, <https://github.com/KhronosGroup/3DC-Certification/>
3. Khronos Group 3DC Certification models, <https://github.com/KhronosGroup/3DC-Certification/tree/main/models>