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# Introduction

3D printing enables one to build real Three-Dimensional solid objects from digital 3D models stored on a computer. The process of 3D printing generally consists of laying down successive layers (slices) of material to build the real 3D object. Initially, 3D printing was mostly used to generate mockups for early validation in the design process. With more diverse types of printing materials available, ranging from titanium, strong plastics to chocolate and bio compatible material, 3D printing is more and more widely used throughout industries and on a consumer basis. In this context, MPEG has started a standardization activity to realize a common data interface and file format geared towards the specific requirements of 3D printing [1][2].

\*\* note: shall we remind the requirements here?

# Ongoing MPEG standard for 3D Printing

Several formats for storing digital 3D models on a computer are available, but they do not target the specific requirements of 3D printing, such as printer capabilities, the physical characteristics of the printing material [3], physical size of the printed object. In order to address these requirements MPEG is updating its 3D graphics representation to support printing of 3D assets and its set of actuators to support 3D printing devices.

## Cloud printing with MPEG Tools

MPEG has developed a standard to define communication interfaces between virtual worlds and devices in ISO/IEC 23005, under the name of MPEG-V. On top of this architecture, three new entities, 3D printer capability, user preference and device command to the 3D printer were introduced [4]. 3D printer capability allows specification of information such as the materials that can be printed, the supported colors and the printing speed and dimensions. In user preference, information on favorite/unfavorite materials is stored. The device command defines the 3D assets to be printed as well as printing configurations.

MPEG has developed AFX (Animation Framework eXtension) standard for representing and encoding the 3D graphics assets. A new 3D model representation, IPRS, for 3D printing was introduced [5]. The main design philosophy of IPRS is to apply the classical texture mapping concept to the printing material

The service scenario of 3D printing in MPEG-V is “cloud printing” described as follows:

* Set the user’s preference: e.g. “***I don’t like a glass-printed stuff because a glass is fragile***”.
* Set the capability of his/her 3D printer: e.g. “***I can print with glass, plastic and metal***”.
* Set the material property of the 3D object: e.g. “***print me with a heat-resisting material***” for a coffee dripper.

A user can specify a 3D asset represented in IPRS to the MPEG-V engine. MPEG-V engine gathers all this information and will search, in a cloud, for a 3D printer matching to the requirements of the scenario.

The new IPRS model representation is intended to replace the classical STL and obj representations, widely used in the industry, but recognized to have strong limitations.

# Standard under Consideration

One of the large advantages of MPEG standards for the 3D printing industry is the access to the large MPEG ecosystem that can provide additional functionality to 3D printing services. MPEG has defined methods for compression and transport of 3D asset, technology which can drastically reduce the bandwidth and sharing time when printing 3D objects in a network environment.

Some of the 3D printing requirements are not yet covered by MPEG tools [6]. This includes representation based on voxels with color and material information, which can be based on the point cloud representation defined by MPEG-4.

MPEG is currently looking forward to hearing from industry additional requirements for 3D printing as well as setting validation experiment for the already developed tools.

# References

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