



# DIGITAL IMMERSIVE GIANT SCREEN SPECIFICATIONS (DIGSS) V 2.0 January 2018

## A. Introduction

This is the third formal revision of the DIGSS 1.0 document that was the result of the Digital Immersive Screen Colloquium for Unified Standards and Specifications (DISCUSS), a three-day meeting organized by the White Oak Institute in Marblehead, MA, in June 2010. DISCUSS brought together a panel of 21 advisors, technical experts, and others involved in the giant-screen industry, plus 61 others who contributed via an online wiki site that was opened after the meeting. The original meeting was supported by a grant from the National Science Foundation.

The stated goal of DISCUSS was “to create specifications for immersive digital GS theaters that create a viewer experience as good as or better than the film-based GS theaters now in place in museums and science centers.”

DIGSS has followed the example of the Digital Cinema Initiatives (DCI), a research and development process funded by the major Hollywood studios to expedite the conversion of commercial motion picture exhibition from film to digital. DCI specified an open, non-proprietary system that met or exceeded the standards of image quality that 35mm analog film had achieved and established an encryption system that would prevent pirating and other unauthorized access to the studios’ films.

Like their counterparts in the conventional cinema industry, many in the giant-screen community were concerned that the digital conversion of GS theaters might damage the reputation of the entire industry if theaters installed digital systems that were substantially lower in quality than the film projectors they replaced. Experts from all segments of the business felt it was important that the unique features of giant-screen cinema be maintained in any digital system that replaced GS film projectors. DIGSS is the industry’s effort to codify those features, for the benefit of theaters, film producers and distributors, projector manufacturers, systems integrators, and all other stakeholders, including audiences.

By a unanimous vote on September 22, 2011, the board of the Giant Screen Cinema Association accepted the role of stewardship of DIGSS 1.0, with a goal of further developing the recommendations.

## **B. Background**

In the summer of 2010, when the DISCUSS meeting was held, no 4K digital cinema projectors had been publicly demonstrated, and based on the performance of existing 2K projectors, most participants were skeptical that 4K would be an adequate replacement for 15/70 film. Only four GS film theaters had converted to 2K digital at that time. Much discussion centered on how to obtain a digital image with an aspect ratio of 4:3 at resolutions of 6K (horizontally) or higher, including various methods of combining images from multiple projectors.

Later that year, the first 4K prototypes were revealed, and in January 2011, a side-by-side comparison of 4K and 15/70 film was held at Moody Gardens in Galveston, TX. Although the “shootout” was not technically perfect, the unexpected consensus of most GS industry participants was that 4K was, in fact, an acceptable replacement for 15/70. That opinion was confirmed by a similar demonstration at Moody Gardens a year later.

In September 2014, as part of the Giant Screen Cinema Association’s fall conference, Christie Digital arranged a demonstration of a dual-projector, six-primary (6P), laser-illuminated 3D projection system in a Toronto area multiplex theater. Most observers were very impressed with the image quality, which achieved levels of 14 fL in 3D and was capable of 120 fps.

In October 2014, the Science Museum of Virginia hosted a demonstration of Evans & Sutherland’s Digistar 5 fulldome system, with nominal 8K resolution. (As used by fulldome system suppliers, “8K” is a marketing designation that refers to the use of multiple 4K projectors in a tiled configuration. In such systems, the actual number of unique pixels across the dome is roughly 6200.) The presentation included the side-by-side comparison of 15/70 film and digital projection on a dome. The consensus of most at the meeting was that the image quality of fulldome 8K, especially at 60 fps, matched or exceeded film.

In January 2015, Imax Corporation hosted an invitation-only demonstration of its next-gen 4K laser projection system at its first installation in a Toronto multiplex. According to Imax’s David Keighley, the 2D light level of the system is 22 fL. (The 3D level has not been disclosed.) The overwhelming impression of most of the people who attended was that the system was a worthy replacement for 15/70 film. Imax has since installed its laser system in dozens of institutional and commercial IMAX theaters.

In one of the most talked-about demonstrations at CinemaCon in the spring of 2015, Dolby Labs and Christie presented Dolby Vision, a laser-powered system with a unique internal design that provides much higher contrast and brightness than other systems. The image, on a screen 50 feet (15 meters) wide, was 31 fL in 2D, with a stated projector sequential contrast ratio of 1,000,000:1, compared to approximately 2,000:1 for standard digital projectors. (It is not clear what the real-world, in-theater contrast ratio of the system is.) Dozens of Dolby Vision systems have been deployed in North America since. However, Dolby Vision was designed primarily for multiplex applications and although Dolby representatives have said there is no practical obstacle to its use in giant-screen theaters, as of the date of this report there have been no giant-screen installations.

## C. Goals

Although the commercial cinema industry delayed large-scale digital conversion until the DCI specs were released, the GS industry was not able to wait for the completion of the DIGSS process. Dozens of individual theaters installed the digital systems they felt best suited their needs before the original DIGSS document was released, and many more have done so since. The DIGSS process has taken this reality into account. DIGSS cannot function in the same manner as DCI. DIGSS is not, and cannot be, mandatory or exclusionary. It serves as a guide rather than a rule book.

One of the original goals of DIGSS was to create a giant-screen version of the DCI's digital cinema package (DCP). Unfortunately, the giant-screen industry did not have the technical or financial resources to create or enforce such a format. As a result, in addition to the open standard of the DCI DCP, several proprietary digital formats, created and controlled by various systems suppliers, are in use in GS theaters. These formats are mutually incompatible, and content to be played on each supplier's systems must be processed by that supplier. This is at odds with the principles of the DCI, which mandated an open digital format that could be created by anyone, without restriction.

Since it was not possible to create or mandate an open GS digital cinema package, that goal has been dropped from this version of DIGSS.

## D. Principles

The first fundamental requirement of the GS theater environment is creating an effective and satisfying immersive experience by filling the eyes and ears of the viewer with images and sounds that convincingly evoke a specific time, place, and/or situation outside of the theater.

The second fundamental requirement is reducing viewers' awareness of the theater's structure and the technical systems that produce the experience.

These requirements generate several principles:

- The image shall be projected on a screen that fills the front wall of the theater in the case of flat screens, and the entire "ceiling" in the case of domes.
- The viewers shall be physically oriented toward the center of the screen in a manner that is as intimate, comfortable, and natural as possible.
- The sound system shall be robust, dynamic, and clear; the theater shall be insulated from external sources of sound.

## E. The GSCA Giant-Screen Specifications

In September 2009, the Giant Screen Cinema Association adopted the following specifications defining a "giant-screen theater." Giant-screen theaters

- Have flat screens that are at least 70 feet (21.3 meters) wide, or 3,100 square feet (288 square meters) in total area and place all seating within one screen width of the screen plane, or
- Have dome screens that are at least 60 feet (18.3 meters) in diameter.

The DIGSS Specifications incorporate these characteristics as recommended, while recognizing that some theaters do not meet them.

## **F. Changes in DIGSS 2.0**

The rather complex table has been simplified by the removal of the Alternative Flat Displays, which represented three wide-screen aspect ratios for digital content. Those formats may be played by GS theaters, but their specs are not a necessary part of the DIGSS spec.

The four primary sections Image Quality, Digital GS Package, Audio Specifications, and Theater Environment, have been reduced to three by eliminating the Digital GS Package section (as noted above). In all sections, various specs have been changed to reflect changing technology, and additional details, notes, and references to external specifications (e.g. SMPTE) have been added to serve as a guide to theaters and producers.

Finally, since the final Specifications section of this narrative document was little more than a restatement of the details outlined in the table, and therefore largely redundant, it has been completely removed. Refer to previous versions of DIGSS for more information.

## **G. Changes in DIGSS 1.2**

DIGSS 1.2 makes relatively modest changes to the values of several specifications in Section 1 to reflect the latest advances in technology (e.g., laser-illuminated projection and object-based sound systems) and to accommodate other known practical technologies that may become economically viable in the next few years.

Specifically, changes have been made to the sections on dome resolution, 3D peak white luminance, narrow-angle luminance uniformity, 3D ghosting, and audio channels. The sections on white chromaticity and colorimetry have been renamed “Color Gamut” and reference made to the Rec. 709 (acceptable) and Rec. 2020 (recommended) standards.

All other elements of DIGSS 1.1 are unchanged.

## **H. Changes in DIGSS 1.1**

The DISCUSS process and the DIGSS 1.0 document had an ambitious scope and a set of goals that its participants recognized were probably too broad ever to be fully realized. In light of subsequent events, DIGSS 1.1 scales down the scope of the specs to technical aspects of digital image and audio

file formats and theater design.

DIGSS 1.0 specified a 1.33:1 (also referred to as 4:3) aspect ratio, reflecting the industry's long history with 15/70 and other film formats that used that ratio. Since most digital theaters use DCI-compliant projectors, which have a 1.9:1 aspect ratio, DIGSS 1.1 does not specify a single aspect ratio, leaving that choice to producers and theater operators.

The center of DIGSS 1.1 is the V 1.1 Summary table, which outlines specifications in those areas, listing them as "Acceptable," "Recommended," or "Aspirational." Acceptable refers to some early legacy systems. Recommended reflects specs which are generally achievable at present. Aspirational indicates possible future enhancements that would improve the GS experience even further.

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