IMAGO, The European Fedration of Cinematographers, Technical Committee

Documented and reported frame rate support of Digital Cinema Servers (JP2000 Playback) April 2015

DCS			2K 2D						2K 3D						4K 2D		
Brand	Model	Intf	24	25	30	48	50	60	24	25	30	48	50	60	24	25	30
Doremi	DCP2000/4K .	SDI	1	1	1	1	1	1	1	1	1	7	7	7	7	7	7
	ShowVault with IMB in projector	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	IMS1000	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NEC	IMS (rebranded Doremi IMS1000) .	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
USL	CMS2200 .	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sony	LMT-300 .	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	XCT-M10	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Barco	IMS Alchemy .	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Christie	IMB-S2 (V1.5.3) .	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dolby	DSS100	SDI	1	6	5	1	5	5	1	5	5	7	7	7	7	7	7
	DSS200 with CAT 862 MB	SDI	1	1	1	1	11	11	1	1	1	7	7	7	7	7	7
	DSS200 or DSS220 with CAT 745 IMB prior to V4.7.1	IMB	1	1	5	1	5	1	1	1	5	1	6	1	1	1	5
	DSS200 or DSS220 with CAT 745 IMB after V4.7.1	IMB	1	1	1	1	1	1	1	1	1	1	10	1	1	1	5
GDC	SA-2100A .	SDI	1	12	12	1	5	5	1	5	5	7	7	7	7	7	7
	SX2001A	SDI	1	12	12	1	5	5	1	5	5	7	7	7	7	7	7
	SX2000 with IMB	IMB	1	12	12	1	5	5	1	5	5	5	5	5	1	5	5
	SX2000AR/TR with IMB	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Stand alone IMB SX3000	IMB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Qube	XP-D	SDI	1	5	5	1	5	5	1	5	5	7	7	7	7	7	7
	Xi	IMB	1	8	8	1	8	8	1	8	8	1	4	1	1	8	8
Kodak	Server (discontinued brand)	SDI	1	6	5	1	5	5	1	5	5	7	7	7	7	7	7
XDC	Server (discontinued brand)	SDI	1	1	1	1	5	5	1	5	5	7	7	7	7	7	7

Status

1	Officially supported according to manufacturer documentation
4	Seemingly udocumented but reported to actually work
5	Not officially supported to our knowledge, no info yet on practical compatibility
6	Not officially supported to our knowledge and reported to indeed actually fail (The Kodak server does play a 25fps DCP but without sound)
7	Physically impossible speed for a non-IMB setup, limited by the physical data capacity of the Dual HD-HDI connection to the projector
8	Not officially supported to our knowledge, no response from manufaturer, but expected to probably work
10	Officially supported but reported to Fail. (UK, Okt 2014 V.8, ingest possible but no playback, a red icon stating 'error: incompatible video format')
11	Confidential report of failure, USA, March 2014
12	Info from manufacturer: DCP will play but will be cropped to HD
	Legacy product (discontinued, not produced or sold any more)

Explanations with the spreadsheet document:

Frame Rate support in Digital Cinema Distribution and Exhibition

IMAGO has been active since 2004 in requesting more choices in frame rates for distribution and projection of Digital Cinema.

The Hollywood studios, through their association named DCI, originally proposed 24 fps and 48 fps as frame rates for Digital Cinema distribution and exhibition.

The higher frame rates of 48 fps and above are essential to allow for spacial image resolution to be able progress in the future. Indeed, 24 fps imposes a very long exposure time per frame, which limits the spacial resolution of the moving image, regardless the number of "K"s that are used.

This can not be solved other than by presenting movies with higher frame rates than 24 fps or 25 fps. Because motion blur is essential to avoid the perception of separate images ar slow presentation speeds, also known as ‘strobing’ or ‘judder’, slow speed filming (24/25) must be done at long exposure times ($1/50^{th}$ or less) in order to avoid sharp images when movement occurs. As soon as the shutter times are shortened in order to obtain sharper images, disturbing judder will appear in 24/25fps presentation. As long as the blur is required for avoiding judder, spacial resolution (image sharpness) can not actually progress above a moderate degree, a degree that already has been met for quite some time.

A taking speed and projection speed of 48 fps or higher allows to avoid judder alltogether regardless if he images are blurred, sharp or even very sharp.

There are no other known acceptable methods for presenting sharp high resolution moving images than to present them at the higher frame rates.

The European Federation of Cinematographers, through the IMAGO Technical Committee, felt that 24 and 48 fps were not sufficient to cover the needs and introduced at the standards bodies SMPTE and ISO, Additional Frame Rates, next to those already proposed.

The main reason for this was that 48 fps as was proposed was not, and still isn’t supported by the after market media like Blu-ray or DVD. IMAGO feared that we (the cinematographers) would be held back from using higher frame rates as 48fps would possibly not look good on those media, which is of importance as these media account for an important part of the movie revenues. Both 50 fps and 60 fps are supported by these media and 60 fps is universally supported by all modern rendering devices on the entire globe. As frame rate coversion is detrimental to image quality, IMAGO prefers the

speed of 60 fps above all, because of its universal compatibility with virtually all screens, transport and recording media and projection equipment in the world.

IMAGO teamed up with other organizations like the EDCF and the BBC to start the project at the SMPTE in 2006 and as a result, the Additional Frame Rates (AFR) standard was published by SMPTE in 2009 (ST428-11:2009). It was later confirmed as an international standard by ISO in 2011. This standard adds the frame rates of 25, 30, 50 and 60 fps to the 24 fps and 48 fps proposed by the Hollywood studios, resulting in a total palette of 6 speeds: 24, 25, 30, 48, 50 and 60 fps. Next to the addition of 60fps as was requested by IMAGO, 25 and 50 were requested by the BBC and supported by IMAGO and the EDCF, while the addition of 30 fps was requested by the ASC.

The new speeds were implemented by equipment manufacturers soon after the publication of the standard. By the end of 2009, 80% of the digital presentation equipment installed in actual cinemas worldwide was capable of showing movies at all the 6 speeds.

Today the implementation of the six basic speeds is almost complete, although there are still a few legacy machines around from before 2009 which can not easily be upgraded. These machines are most often found with big chain ‘early adopter’ theatres, wich is unfortunate as these are the same people who have promoted the development of digital cinema in the early days. Once these machines will need replacement, support for all speeds will hopefully become universal. All major server manufacturers now exclusively sell equipment that supports all six speeds. All Digital Cinema projectors have always already supported all 6 speeds. Actually, only playback servers may have limitations eventually.

Because of this it may still be needed to check with your distributor if all cinemas you target support the frame rate you wish to use. Most of the ‘early adopters’ have multiple theatres and will have legacy servers in only some of the rooms. By warning in advance that you wish to use a frame rate other than 24, the cinema can often schedule your movie in a room that has a more recent or more complete playback server.

The 6 basic speeds are available for 2K movies only, 4K exhibition is limited to 24, 25, and 30 fps at this time.

In 2013, three new speeds were added as filmmakers showed interest for the higher speeds in 3D movies. However, when using 48, 50 or 60 fps per eye in 3D, the playback server and projector need to be capable of double that speed when the movie is shown on a single projector. So in order to allow for 48, 50 and 60 fps/eye 3D movies to be played on a single projector, the speeds of 96, 100 and 120 fps were added to the AFR standard, resulting in a new version of it: ST428-11:2013.

Contrary to the basic 6 speeds mentioned earlier, 96, 100 and 120 fps capability is not as wide spread and not available in all projectors. It is available only in those projectors

manufactured after January 2012, also know as 'Series II' equipment. Therefore the availability of these very high frame rates (also nicknamed "HFR" speeds) is estimated around 20% to 30% only at this time, which is much lower as for the 6 basic speeds, for which the support is almost a 100%. Equipment capable to show 96,100,120fps (48, 50,60fps 3D) is called ‘HFR capable’.

It is important to note though, that for showing movies in 2D at 48, 50 or 60 fps, the ‘HFR capability’ is not needed. It is only needed for 3D movies at those speeds. 2D at 48, 50 or 60 fps will play on any projector and on the vast majority of playback servers.

The table above is the result of a recent survey done by the IMAGO Committee for Creative Technology in Cinematography (CCTC), (previously named "Technical Committee") on the support for the additional frame rates in actual presentation equipemnt. It concentrates on server brands and models as all projectors seem to support all rates, only the playback servers seem to be a limiting factor, if any.

The table was obtained by using the official manufacturers documentation on the units or by contacting the server manufacturers by e-mail if such documentation was not found.

This table will allow you as a cinematographer, when preparing a movie with a different speed as 24 fps, to determine if a specific venue will be able to show your movie by requesting from them the brand and model of their DCP playback server.

Indeed, quite some projectionists and theatre owners are not always aware of the capabilities of the equipment they own and sometimes they may tell you that they can not show your movie at a speed other than 24 fps while in fact their equipment can do it without problems. Sometimes they may actually have been showing 25 fps movies f.e. without having even noticed it. Indeed, often the use of DCP's at other speeds than 24 fps is automatic and transparent to the operator.

So before you conclude as a filmmaker that your movie can not play at it's native speed in a certain theatre, ask for the brand and model of the installed Digital Cinema Playback Server and check it against the table above. That way you can confirm if you indeed may expect a problem or if you can inform the theatre projectionist or owner that in fact your piece will play. Often the theatre owners will be delighted to learn that their expensive equipment actually can do more than what they originally thought it could.

To be sure you may consider to sent a short test DCP with an excerpt of your movie to the theatre in order to confirm that the material indeed plays as expected.

If you see errors in the table above, or if you have experiences that do not correspond with what is stated there, please let us know. You can contact us using the e-mail address <cctc-box@imago.org>

Also the equipment manufacturers are invited to contact us if any of the data in the table above are incorrect, incomplete or might have changed.

For more information about what the possible use of the frame rates can be in our work as cinematographers, a more detailed article is in preparation.

Best regards,

For the IMAGO Committee for Creative Technologies in Cinematography,

Kommer Kleijn SBC, Committee Chairman.