Technology,
What's new after ISE 2018?

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BIOGRAPHIES
Damien Pelisse is Technical Director at RSA Cosmos. He took part in the design and setup of the first full digital planetariums with RSA Cosmos more than 15 years ago. He still like technology a lot and never avoid to go on field and work on systems all night long!

ABSTRACT
ISE (Integrated Systems Europe) is the largest AV and systems integration show in the world. It took place from 6th to 9th February 2018 in Amsterdam.
In this yearly showcase, all projector manufacturers demonstrate state of the art projection technology. From projection chip to light source or resolution... There's many to see!
After reviewing last year’s trends, is there something new or different which applies for this 2018 showcase?

Have different vendors a different approach to the technology?
The idea is to give an extended view on the projection market from a vendor point of view taking into consideration what users are expecting.

INTRODUCTION
What are the criteria to evaluate in a projector and what do we specifically look for in our market?
Brightness, Contrast, Resolution, Color space are primary technical criteria.
You shall also be interested in the Total Cost of Ownership (TCO) of each projection solution which at some point makes a difference!
We should have all these information when trying to evaluate a new projector.

Know that in this paper, we’ll go a bit further than the ISE. Everything is not shown at this showcase.
Some products are showed in “whisper rooms” and some are just in roadmap which sometimes are subject to NDA (Non-Disclosure Agreement).
Please note also that in this paper we won’t review LCD projectors as we consider that they are not fitted for our market.
We’ll try anyway our best to review the market as it is today!

I. CONTRAST
Let’s start with one point we usually consider a lot in planetariums: Contrast.
I won’t go in the direction on how contrast is important and how we should measure it. Many papers at past IPSs have covered this topic. But I’d like to bring your attention to a new habit in brochures where the shown contrast value is a dynamic contrast.
By dimming the light depending on the content, it is easy to reach a very high “On/off” contrast value.
If it might be a plus in some uses, it is not the case for our domes. The main point is that, at this time, there is no way to synchronize this dimming system over different projectors.
Also, considering a night sky, if the light source is dimmed to have a better black, your starry sky will also suffer from a lack of light.
Just be aware of what numbers you’re reading, and as for a lot of technical specifications you sometimes need to dig a bit.

II. NO MORE LAMPS!
Definitely, projection market is becoming lamp free.
If we look for the projectors which are interesting us in the planetarium market, only few lamp projectors remain and they'll be EOL soon. As an example, it is announced by Sony that the well-known SRX-T615 (18000 lumens with 6 lamps) will not be produced anymore.
The advantages of a lamp free projector are easy to find: low TCO and almost maintenance free.
Of course the drawback is that, in most of the cases, the light source cannot be replaced.
In the "no lamp" projectors market, different approaches exist in what we call “Solid-State Illumination”
II.1 LED based projectors

They offer advantages like a very compact size and a system without moving parts which dramatically reduces the failure rate. Also, in matter of colors, they’re doing good, going beyond the Rec. 709 color space. On the other hand, the brightness is limited to values around 4000 lumens and the choice is limited to DLP projectors. This kind of projectors wasn’t represented that much at ISE.

At this time, we know that Norxe (not showing at ISE) is trusting in this light source for their range. Barco was offering the FL35 but we’ll see below that we feel their strategy for compact projectors is going to Laser Phosphor illumination.

![Figure 1 – Rec. 709 vs Rec. 2020 in color gamut](image)

II.2 Laser Phosphor

With this kind of projector the brightness range is wider, from 2000 lumens up to 35000 lumens. They are quite compact, flexible (no position constraint) and give reasonable colors meeting Rec. 709 color space. This technology is now well controlled and well spread in the market.

We could see a lot of new projectors in this range this year:

- **JVC** will offer the DLA-VS4010 as a replacement to the lamp based SH-7. With a native 4K resolution, it will be 6000 lumens and keeps all the advantages of the JVC D-ILA chip (10000:1 contrast ratio)
- **JVC** also widening the DLA-RS series. Even if they are more targeting the home cinema market, they might be used in multi-channel setup where their incredible contrast (up to 100 000:1 native) remain an advantage. Native resolution is 4K as well.
- **Sony** is introducing the VPL-GTZ240, it’s a kind of compact version of the VPL-GTZ280. Offering a 2000lm brightness with Sony's SXRD chip. It keeps a native contrast ratio of 16000:1 and a native resolution of 4K as well. Somehow the great contrast of these projectors counterbalance the color space limited to Rec. 709.

Barco also puts an accent on this technology with the new F series (F70 80 & 90). With brightness from 6000 lumens until 12000 lumens. They are offering a native resolution of 2560x1600 and are single chip DLP based. Keeping then a color wheel and a limited native contrast.

![Figure 2 & 3 – Laser Phosphor Light Path for 1x DLP (left) & 3x DLP (right)](image)
Many Laser Phosphor projectors can also be found in the catalog of other vendors like Optoma, BenQ & Panasonic. It is not possible to make an exhaustive list of them. They can be single or tri-chip DLP.

A variant of laser phosphor can be found at Nec with the 4K PH3501QL. It uses an additional Red laser to widen the color space of the projectors which are then better than the “regular” laser phosphor. With his 35000 lumens it will target large theaters.

Christie also brings the new Crimson to the market with similar technology. It keeps the well know Boxer chassis and offers 25000lm of illumination. Unfortunately, it is not available in 4K.

Figure 4 – RB Laser Light Path, 3x DLP

Know that for all these projectors, the light output will decrease with time. Given brightness is obtained with a new projector. In a general way, brightness drops to 50% at the end of life of the light source (usually 20000 h).

Some vendors, like Sony and Panasonic, can offer a “Constant Brightness” mode. Projector initial brightness is decreased but on the other hand you avoid the disappointment of a dark system after some running time. It also allows to extend the projectors life.

This point must be considered when calculating the amount of light needed for your setup.

Figure 5 – Brightness evolution with or without Constant Brightness mode (courtesy of Sony)

II.3 Laser 3P (3-Primary)

I did not see any at ISE (6P was shown instead, see next chapter) but this kind of lighting technology is really interesting for the advantages it brings.

Allowing really bright projectors (up to 60000 lumens) they reach Rec. 2020 color space and bring the best color. It also have a better behavior over time, letting us expect 80% of initial brightness after 30000h.
II.4 Laser 6P (6-Primary)

Basically same as 3P but a second set of 3 lasers is used with slightly different wavelengths. It allows with the appropriated glasses to offer state of the art 3D Cinema with best colors in 3D. Each glass let pass the light from one of the laser set, allowing the separation of left and right eye signal.

![Figure 6 – RGB Laser Light Path, 3x DLP](image)

Barco and Christie are both leaders on this range of products.

Primary target for these products at this time is cinema.

The Barco XDL-4K60 took a good place on their booth at ISE, delivering a 60000lm image on a 5m dome.

![Figure 7 – Separation of light of a 6P source in 3D application (courtesy of Christie Digital Systems Inc.)](image)

![Figure 8 – Barco XDL-4K60 in action at ISE 2018](image)
Still, these products are extremely big and they need a dedicated cooling unit. This cooling unit is as big as the projector. Know also that such a projector at full power draws a power of 10kW (projector + cooling unit).

Christie’s range was not shown at ISE and specifications was only preliminary, but we can expect similar specs.

**III. MORE BRIGHTNESS!**

The previous chapter let us see that we can reach very high values of brightness. We could not imagine such brightness few years ago! Also, as large projectors reach these level of brightness, the ratio "brightness / projector volume" increases. We can easily have brightness of 10000 lumens where a projector of same size reached only 2000 lumens few years ago. The F series from Barco is the perfect example of this evolution.

In a same comparison, large projectors can now reach 30000 lumens with the size of what was a 10000 lm 5 years ago. The large 60000lm are still not for all domes, but we can imagine that they'll be more compact in the future

With all this amount of light in our domes, we can offer much brighter solutions than in the past. This amount of light is very useful when you're coming to 3D. (keep in mind that after 3D glasses, only ~20% of light remains for the eye). We can now provide pretty bright 3D solutions in large domes with only 2 projectors. It brings nice 3D pictures to the dome with a total cost of ownership that remained reasonable.

The Digital Projection Insight Dual Laser is a perfect candidate for such applications. It is not a new projector, but it has been recently introduced with 120Hz processing capability, expanding his range of uses.

It is clear that the increase in brightness is closely linked with the development of new light sources like the Laser 3P & 6P. Their market share was very low in 2017, but we need to look forward for these products in the next years.

SXRD & D-ILA chip remain (at this time) out of this race. We need to watch carefully if things are moving on this side.

**IV. MORE PIXELS... WITH SAME MATRICES...**

We spoke only a bit about resolution, but if you look closer into the manufacturer catalogs, you'll find a lot of "4K UHD+" projector. So... These projectors are 4K? Not exactly. They are not really using a native 4K chip and they try to increase the resolution with a process called wobulation (or e-shift for JVC). This process was explored more than 10 years ago by Hewlett-Packard R&D teams.

By applying this technique to the Texas Instrument's chip, the visual resolution can be increased.

At this time, Texas Instruments is offering to projector manufacturers the following chips:
- WQXGA (2560*1600) for single-chip DLP & 4K (4096*2160) for tri-chip DLP

So, there is no way for manufacturers of single-chip projectors to deliver native 4K projector.

As there is a huge demand for 4K on the market, this is a not so bad solution to offer 4K resolution at a reasonable price.

![Figure 9 – Use of A frames & B frames in Wobulation](image)
Basic implementation of this technique is to use the DLP chip with a higher refresh rate and to add an optical actuator to shift the image after the chip. Doing this, sub pixels are created. Above is an explanation by Barco of their implementation of this technique (fig 9).

So, is it bad or is it good... It's hard to see everything bright or everything dark!

We could see at ISE that most of the DLP single-chip manufacturers are going in this way to answer the market requirements for 4K. So, if you wonder about a "real" 4K resolution, make sure to always check the native resolution when comparing projectors. It is sometimes needed to dig to find this information!

By the way, note that there are two ways to achieve this. You can feed the projector with the native chip resolution and let the projector upscale your source image OR you can feed it with a UHD resolution. For sure the first option is nothing good. If you try this, the image may look blurry, and it is not what we expect with a resolution increase! Second option is better, we can now really feel that the pixel pitch decreases by enabling this feature. Just make sure that the projector allows it! For signal processing reasons, some projectors allow only the first option! Still, in my opinion it is not as good as a native 4K, if you look carefully the principle describe above, you will understand that it is not possible to illuminate a single pixel. By the way, manufacturers call them 4K and consider them as 4K.

Using the same principle on a tri-chip DLP, Digital Projection introduced the Insight 8k projector. It is based on wobulation with a trip-chip DLP at 4k resolution. It looks great and it's likely that this example will be followed. Of course, it uses a “proper wobulation” with an 8K source signal. There just a little downside with this resolution. For now, the required bandwidth for an 8K image cannot be generated or transfered on a single link. It will then requires to "slice" this image in four 4K quadrants. We was using such techniques in the first times of 4K, so it is not a major issue. Just so funny that history repeats itself!

![Image](https://via.placeholder.com/150)

**Figure 10 – Insight Laser 8K at ISE (courtesy of Digital Projection)**

V. CONCLUSION

As a conclusion, we will not point the “best solution”. It does not exist and sometimes, some compromises have to be done. We believe that it is important to be educated on which technology exist on the market to make the right choice for your project!

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