
“ VP is disrupting traditional TV and film production, so we are facing some familiar resistance to adapt to these new workflows ”

Our industry experts immerse themselves in technology where reality meets imagination in the most seamless way possible

INTERVIEW. Robert Shepherd



THE INTERVIEWEES



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What's the biggest change happening in the industry driving the next generation of virtual production technology?

TIM KANG: Two things: On-set image-based lighting (OS-IBL) build-outs will become the focus as LED tile backdrops have now permeated production facilities worldwide. Volume walls cannot do this well. I saw this problem two years ago and foresaw that volume stages will build out accurate image-based lighting volumes using a mix of different fixtures arrayed out on stage walls and ceilings beyond the LED wall itself.

We are just at the cusp of this, especially since it won't cost as much, as LED walls, OS-IBL products like Quasar Science's RR and R2 units keep coming out, and the techniques to control and drive them democratise.

Secondly, AI-based technology will reduce the need for overly large 'brain bar' or volume tech teams. As an example, Neural Radiance Fields (NeRF) might allow for video plates to have the same interactive parallax that currently only 3D engine environments can supply.

DAVID LEVY: Education! Many more in the industry have now been exposed to, or have taken the initiative to educate themselves about, virtual production and the variations of the technology across pre-, on-set and post-production.

Once the opportunities that virtual production offers across each of these stages are understood, productions can identify if and where it can add value or efficiency, and whether virtual production is the most effective solution needed to deliver the project.

This informed adoption and utilisation will drive the next generations and iterations of virtual production.

CONOR MCGILL: Increasingly reliable and robust video over IP protocols such as SMPTE 2110 will greatly enhance flexibility, scalability and performance of virtual production workflows. This is because the vast amounts of visual data necessary for photorealistic real-time environments and HDR video content can be handled much more economically and creatively over a unified fibre-optic or copper network compared to traditional dedicated audio-visual signal transmission infrastructure.

CESAR CACERES: The video industry is continually evolving, and advancements in technology are creating new

possibilities for user experiences, ranging from rendering quality to workflows.

The implementation of calibrated RGBW in LED processing is expected to be a game changer for dynamic lighting quality. The extra emitter offers improved colour rendering, and having this last emitter correctly calibrated will ensure accuracy continues to meet expectations.

Additionally, as panel components continue to improve, the pixel pitch will get finer, and the refresh rate will also increase. Integration with other technologies will improve the overall quality of virtual production processes and make them more efficient.

J.T. ROONEY: Client interest and adoption has significantly increased since our team began pioneering extended reality (XR) technology. Likewise, democratisation and education have had broad changes within the virtual production landscape, in the last year I would say.

It's interesting to look back to when our team was first exploring this in 2018-2019. The ecosystem was quite different, heavily focused in the cinematic space with films like *Avatar* and *The Jungle Book*, and advanced previsualisation set-ups. In the last few years, the industry overall has expanded and we now see VP present across the entire spectrum of productions – from short-form content creation, commercial projects and independent films, all the way up to major film and TV studio work or live broadcast. Because of this incredible expansion and ever-growing demand, we are excited to have been able to uniquely position ourselves as VP specialists in multicamera broadcast, virtual set extension and mixed reality work. We receive emails and phone calls daily from various brands, organisations and productions looking to adopt this new workflow and we honestly couldn't be happier to be their partner on this new pathway.

OLAF SPERWER: Changing processes are driven by the question of what parts of the production life cycle can be made virtual. What makes sense? How do we merge traditional and virtual workflows? A good example is set construction. We are looking for a new, overarching approach to optimally merging physical and virtual sets.

What will drive the next generation of virtual production technology will kick off when the organisation and workflows are truly implemented and



understood by most of the team members and management involved. Until today, virtual production has no 'home' in the overall structure. Pioneers in the industry, companies like ILM, have placed virtual production organisationally with post-production and VFX, being the current budget owners.

In the meantime, virtual production has reached every department in film and broadcast, and we need to rethink virtual production being anchored everywhere, organisationally and financially, as in an agile matrix-based production structure. In the future, it would make sense for production designer and DOP to work together on the planning and involve other departments as needed. In any case, a clear ownership for virtual production must be defined. A new generation of producers will emerge who will incorporate immersive storytelling and revisualisation into new narrative forms and formats as a matter of course.

How is that affecting traditional and existing VP processes?

TK: OS-IBL will increase the realism and quality for more people, and bring the fun into this process. Volume or rear projection work has always been difficult to achieve true viewer immersion, but the OS-IBL advent will make it much easier with more believable fall-off, light shape variety and realistic colour rendition.

AI techniques like NeRF will reduce production cost and time, helping VP teams provide more cost-effective backdrop solutions for more clients.

DL: Education is helping to increase adoption and utilisation of the tech by demystifying the processes and practice of what are actually relatively simple concepts. In turn, this improves confidence, and acceptance by those who might otherwise be unwilling to take the perceived risk.

CM: Companies that specialise in virtual production or make products for the market must integrate forward-thinking network engineering into their business. Companies with the best-designed and implemented network infrastructure and workflows almost always perform best. In the demanding and ever-changing world of video content production, speed is key. Almost all the levers a creative would want to pull to produce a more vivid or interesting picture will inherently create more data. This data needs to be stored,

transmitted and processed, and any link in the chain that isn't adequately fast will inhibit the speed of the entire system.

CC: The finer pixel pitch will lead to more pixels required, and as a result, content rendering will be directly impacted. The incorporation of RGBW and other advancements in LED processing will enable virtual production processes to achieve more realistic lighting.

JTR: Existing VP processes are changing and evolving. Now producers, production companies, DOPs, gaffers and other team members are having prior experiences at other stages or using other workflows. This is a blessing and a curse because the industry changes so quickly. Workflows and processes are often not the same from stage to stage, VAD to VAD, rate card to card – and so forth. Because of this, the depth of our conversations with production teams increases and our focus is turning towards standardisation. At XR Studios, we are aiming to be the leaders in a standardised process, so that our client's experience is never disrupted. We offer a seamless process from load in to load out; so as the industry rapidly grows and constantly changes, we aim to find a happy balance.

OS: The industry may be reaching the limits of efficiency using traditional production methodology. VP can support better planning (previs) and creative

Education is helping to increase the tech adoption by demystifying the process



outcome, and potentially significant cost savings. One of the biggest inhibitors is the lack of experience and patience of the teams. Virtual production is currently disrupting the traditional film and TV production, therefore we are facing familiar resistance to adapt to these new workflows. Industry-leading companies in this field can actively help overcome this resistance by focusing on training, education and information.

Who is your product aimed at specifically, and what does it do that others cannot?

TK: We designed Quasar Science product lines to be the most versatile, dependable building block for OS-IBL arrays and build-outs. One can line stage walls and ceilings with ladder arrays, use Ossium frames as windows letting in virtual-world lighting or create 3D backdrops because of the fixture’s modularity.

We have the most advanced colour calibration system for this and have inspired others to follow our lead. Our fixtures can change the spectrum on the fly and support direct output of broadcast video-standard colour without complicated colour management. They can white-balance footage to make sure the last colour is what the camera needs.

They have the most robust signal and data system that allows for all Ethernet-based lighting protocols via wire for the lowest latency and highest dependability.

The Nato rail mounting system with industry-standard screw holes and Ossium sliders with mounting pins or rotator blocks allow for any elaborate visual rigging concept with minimal fuss.

DL: Arri products are, and always have been, designed for creative teams looking to achieve the highest possible image quality. When it comes to virtual production, teams are also looking for proven integration of camera, grip, and lighting systems into workflows.

From the camera side, Arri has achieved solid and simplified synchronisation through genlock and timecode. Reliable colour pipelines for volumes can be achieved via our colour management solution. Metadata



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“The larger an LED volume stage, the more reliably it is going to simulate the lighting of a scene – and the more creative possibilities it affords”

integration is key for elevated virtual production, so we are able to offer real-time transmission of FIZ data into the game engine via our Arri Live Link Metadata Plug-in.

In terms of lighting, we’ve developed real-time control and monitoring of Arri lighting fixtures via multiple control options; whether that’s a conventional lighting board or one of various available playback systems. Arri’s early understanding of the importance of IP interfaces and control protocols such as sACN and Art-Net was critical in enabling time-synchronised lighting control.

In addition, Arri Solutions developed Arri Lightnet, a centralised monitoring software, which offers real-time reporting and device management across an entire lighting network.

Finally, Arri Academy is developing a number of courses to support the growing demand and need for validated training in our latest virtual production workflows and technology.

CM: The Pixera media server is the centralised hub for all video, lighting and control data in an LED volume stage. Our broad scope of production-specific features combined with an interface that is easy to learn, use and remember is unlocking LED-based in-camera VFX workflows for more interested companies.

The larger an LED volume stage, the more reliably it is going to simulate

the lighting of a scene – and the more creative possibilities it affords. However, this scale comes with added complexity, and requires specialised hardware and software to manage video and real-time content on the wall. Pixera is the solution to this complexity. By offering an advanced 3D project visualiser, an elegant and simple content timeline and a flexible, powerful node-based show control programming system, Pixera puts these advanced workflows in reach of anyone!

CC: Our Brompton processors are designed for anyone in the industry and offer the most reliable devices in the market. Our processors enhance the quality of any LED panel and provide features that ensure excellent results for in-camera set-ups, including synchronising the LED with the shutter and several other functions to eliminate any artefacts.

JTR: Our product is a service-based production model that ensures the highest quality and smoothest workflow for production companies entering the virtual production and extended reality space. More specifically, XR Studios’ goal is to bridge the gap between traditional production workflow processes and XR’s ever-evolving technological approach. We see our services as being beneficial to multiple markets within production. XR Studios recognises that many of our





clients and their clients are new to the space; and many are in need of guidance on how to navigate the landscape. We take pride in walking hand-in-hand with creative and production partners, so their vision can become a reality in this highly technical space. Our years of experience and direct focus on creating this new workflow has allowed us to be highly specialised in understanding the intricacies of the VP space, while still continuously trailblazing in an industry that is constantly, rapidly changing.

OS: Due to the success of our products in the stage business, Roe has been increasingly able to inspire the film industry since 2017. Film studios have a similar production environment, and therefore many rental companies have helped build the first virtual production studio volumes and sets. Some of these companies have expanded their business towards integrators.

The moiré effect is a problem for LED VP – how do you navigate it?

TK: First of all, perspective. The further the subject is from the wall, the better. Regardless of lens angle of view, having the subject further forward is always critical both for moiré and selling the perspective of the wall content. This is the power of large volumes, since they allow people to back away further from the wall without seeing seams.

Secondly, props and scenery. Obfuscation and distraction via the physical world in front of the wall lead the eye away from seeing moiré issues.

Thirdly, optics. This is the dodgier ask because it changes the look, and one

may not want that. Shooting with larger format sensors will reduce the depth-of-field for a light amount, which would help immensely. Shooting at a wider stop achieves this.

One can also detune the optical path of the lenses to defocus those finer details while still keeping focal clarity. But not everyone has access to this niche service.

DL: During pre-production, it's possible to mitigate moiré issues. By working with the VP supervisor, DOP and production designer, you can schedule moiré planning into your techvis stage. Key information for the production team includes the pixel pitch of the LED, where the plane of focus (relative to the camera's distance to the video wall) will be in each of the planned shots, and where physical sets and props are placed.

With this information, it is fairly easy to understand if there is a risk of encountering artefacts. Additionally, during on-set production, it is advised to have large monitors with the camera's output displayed to help spot visible artefacts during takes. These monitors don't need to be particularly critical in terms of colour or brightness. However, they should be 55in or larger, as this makes it far easier for the DOP or VP supervisor to identify moiré.

CC: Moiré is a physical effect that can't be resolved from the processing side. But we leverage our vast experience with systems worldwide to give the best information to users so they can improve results.

JTR: Our stage designs and LED product choices are influenced by the threat

of moiré, and it is definitely discussed often. Our relationships with camera and lens manufacturers are extremely important. We continually stay in touch with them, often to share experiences, brainstorm how to find better ways to escape things such as moiré, and discuss recent developments. Over the last few years, one of our biggest focuses has been to emphasise the need for pre-light and camera blocking days and times. Part of this is to ensure shots are successful for things such as moiré, outside of the normal guidelines and workflows we share with camera teams in the space.

OS: Unfortunately, the moiré effect is a physics problem that results from any overlay of patterns or grids, even if those patterns are randomly distributed. In the days of 720p broadcast cameras, there's a reason that shirts with small stripes or patterns were avoided. The only real 'solutions' to moiré are to increase the resolution of the LED wall relative to the resolution of the camera, which comes with other major costs in terms of display brightness, cost and required rendering power for virtual production.

But moiré can be managed to a large extent by shot selection and keeping the LED wall out of the depth-of-field of the camera lens. Even in a future where far higher LED resolution becomes viable, moiré will still exist, and VP users will still need to employ management techniques in their shot planning, so it's worth learning these lessons now.

How do you reduce input lag?

TK: Remove as many devices and barriers in the signal chain. Increase processing power on the render. Render fine detail only in the frustum.

DL: Moving towards a standardised, high-speed infrastructure will be key to reducing latency. IP-based infrastructures (Ethernet, fibre) and standards (SMPTE 2110) will replace baseband, SDI, DMX and other legacy transport systems, in order to reduce latency to near real time. Additionally, the continual increase in computing performance, together with system architecture and software optimisations, will also improve latency. Finally, the overall and continuous growth, development and standardisation of global infrastructure, both physical and cloud-based, will continue to improve the speed of which users of virtual production can operate.

©ARRI



SET THE STAGE As an ever-expanding industry, but one that remains young, virtual production expertise must be disseminated

CM: Specifying low-latency signal transmission equipment throughout the signal chain is the first step to reducing input lag. From there, the total amount of latency for the slowest component must be measured and each faster input device should be adjusted to match the slowest component in the chain.

CC: Our Brompton processors offer ultra-low latency modes (ULL), which significantly reduce processing delays and – as a result – input lag.

JTR: The XR Studios space has been entirely designed with a focus on a cohesive engineering and broadcast ecosystem. This comes from a deep understanding from Scott Millar, our chief technology officer, of every step and every process in our signal chain. From the ground up, each frame – and sometimes milliseconds – is being considered from hardware selection, as well as software processes. Our ecosystem and technology stack features Disguise servers, Stype camera tracking, Ross broadcast infrastructure and some other infrastructure pieces that allow for a speedy system.

OS: Thankfully, LED walls and LED processing are already one of the lowest lag components in a virtual production

“Thankfully, LED walls and LED processing are already one of the lowest-lag components in virtual production”



system. Major LED processing platforms such as Brompton and Megapixel VR can be configured to around one frame of latency depending on how the LED wall is cabled together. Between seven and 12 frames of total system latency in a virtual production studio is common, and I believe that the major sources of this latency come from the camera tracking, real-time rendering system, frustum compositing and other video switchers sometimes installed in a VP studio.

The easiest thing that people can do today is cable their LED walls in a way that’s compatible with low-latency modes on the LED processor, and simplify any other video signal processing in their studio systems.

What qualifications and responsibilities are expected from someone operating the back end?

TK: Video signal transmission expertise. 3D rendering expertise, especially in Unreal. Media server expertise, like Disguise D3, Pixera, Mbox, Resolume, etc. Colour management skill. Lighting comms protocol familiarity. Infinite wells of patience and humour with a keen desire to learn and improvise (comedy improv ‘yes, and...’ training helps!) are an unquestionable **must**.

CM: Strength in building, maintaining and optimising digital networks. A comprehensive understanding of 3D computer graphics. An understanding of colour science and its core principles. Basic computer programming language scripting ability. An ability to stay calm under pressure. Finally, collaborative problem solving.

CC: While knowledge of video is always desirable, our intuitive UI is designed to be user-friendly and easy to operate. We also offer free training to anyone who wants to learn about virtual production technology, including beginners looking to take their first steps in the industry.

JTR: The back end of virtual production and extended reality workflows has been interesting because of the fact that the entire workflow and ecosystem is all the back end, but exposed to the whole production. It’s rare in production workflows that the full team is so aware of technology. Oftentimes, there have been complex systems running in the background that people don’t know about; but in this new industry, every



department is working together and discussing in much more detail, far earlier on in the process. So, everyone collectively is becoming more aware of what’s involved.

On the pure execution side of virtual production, there are a few departments and verticals that are quite specialised – volume control, camera tracking and the virtual art department – that have emerged in the last few years. ‘Volume control’ has started to become a more common term as more companies are starting to lean into it, and it refers to the team and infrastructure needed to control the LED volume inside the studio. This includes media playback and programming, genlock and infrastructure engineering, lighting integration, plus other departmental connection points.

Camera tracking has also turned into an interesting ecosystem with various camera-tracking hardware solutions. It also includes a deep understanding of camera rigging, placement, mounting and collaborating with DOPs and ACs, so as not to interrupt the normal flow of camera production.

A virtual art department seems somewhat straightforward, putting what is normally designed into the physical space. But turning it into a virtual and – more importantly – real-time rendered space has introduced a whole world of complexity into the designer’s realm. Making sure their scenes run at the appropriate speed and optimised quality, in addition to blending the virtual and real worlds together with props and physical objects, the virtual art department’s universe has exploded into an all-encompassing space. ●