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I want to start off by paying tribute to all the journalists, camera operators and production teams who have been bringing TV audiences updates from Ukraine over the past few months. They have told stories of terrible suffering but also great hope, all while dealing with unimaginable circumstances. While I’m sure many would say they are just doing their job, I don’t think anyone really signs up to put themselves in danger.

It’s at times like these when television becomes so essential for showing viewers the truth. Watching a news bulletin broadcast from inside a bunker while air raid sirens go off in the background brings the reality of the situation home to millions of viewers around the world. I don’t think any other form of media is able to tell the complete story in the way that TV can. I always find at times of real crises that it’s the television that I turn to.

I also want to mention how the media tech community has rallied around to support not just those who are reporting from the frontline, but also helping refugees, halting sales/shipments to Russia, making technology easily accessible for people in Ukraine to tell their stories, and raising money to help all those affected by the conflict. It’s been an incredible effort so far.

I’ll be honest, detailing some of the highlights you’ll find in this issue of TVBEurope seems almost inconsequential in terms of the above, but our industry continues to evolve and develop whatever the circumstances. In this issue, we’re focusing on both remote production and virtual production; two technologies that have really come to the fore in recent years.

We hear from ILM StageCraft, a company that has been at the forefront of the integration of virtual production workflows into both film and TV production; plus there’s a special roundtable discussion with a number of companies who have been developing technology for use in the medium.

Kevin Hilton looks at the development of remote production, and how it has become both the saviour as well as the future of live sport on TV.

Philip Stevens has an exclusive interview with Erron Gordon, executive creative director and head of studio output at TalkTV, ahead of the broadcaster’s official launch in mid-April; and Dan Meier meets Jan Harlan, who worked with legendary filmmaker Stanley Kubrick for over 30 years. Plus, we head into Earth’s orbit with the visionary hoping to launch a film and TV studio in space by the end of the decade. New NAB visionary hoping to launch a film and TV studio in space by the end of the decade. New NAB

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TVBEurope hears from a number of major virtual production companies about what customers are looking for, and how the technology could be used outside of the media and entertainment industry.
Remote production is a very attractive proposition, with many practical benefits. Even if we were to put aside necessary health implications and social distancing, there are big environmental benefits in reducing the number of people travelling to events.

The challenge is to provide sufficient connectivity to allow all the production and post production teams access to the content in a timely manner, within what may be constrained bandwidth. This means working with tools to maximise productivity while minimising the amount of data that needs to be moved.

The first step is to organise the raw footage. Whether the main server is at the remote sports event, at the broadcast headquarters or in the cloud, it makes sense to make the initial shot selections on the server, rather than transferring everything to the edit workstation, particularly if the editor is also working remotely.

To achieve the absolute minimum of data transfer, particularly if you are working in ultra HD resolution or higher, your software should allow you to create a shot list or even a rough cut on the server. Only the required content plus handles needs to be transferred to the editor. This will have two benefits: the editor gets the material faster so can start working sooner, and there is less material to work through which boosts productivity.

The second step is to minimise the size of each clip. Editing tools like Adobe Premiere Pro are designed to bring in full resolution clips, but generally work with proxies which are generated internally. In remote editing, it makes sense to create the proxies on the server then transfer the smaller files to the editor. This is a big saving on bandwidth.

The EditShare solution offers two sorts of proxy: the 'streaming proxy' which is an MPEG-4 file tailored to be lightweight for internet delivery; and the 'editing proxy' which is in H.264 or ProRes, and supports multiple audio tracks for maximum flexibility in post.

These solutions work with all popular edit workstations. Many popular software packages allow you to readily switch between proxy and full resolution versions of the content if they’re available.

Proxy resolution versions of work-in-progress can also be sent to producers for checking. They can tag comments to timecodes and return the messages to the editor.

There are two routes to finishing the project, which will depend on the nature of the job. For a prestige project, the editor will want to see the final version in all its full resolution glory. That means re-linking to the original footage. Smart software will only download the parts of the project you need for the final conform.

Where speed is of the essence, which is common in sports and other live events, then you want to avoid the time taken to transfer full resolution clips out to the editor, then transfer a very large finished file back again.

The solution is to upload the EDL to a remote renderer, or Adobe Media Encoder, hosted on the server. The EDL is, of course, a relatively tiny file so is transferred virtually instantaneously. Conversely, the server has heavyweight processing power so conforms the finished version very quickly, and the finished file is where it is needed.

To achieve the maximum boost in productivity, there needs to be good integration between the editing and server management software tools. All editing platforms now offer a degree of open integration.

Probably the most open is Adobe Premiere Pro. This allows us to implement an EditShare window within the edit platform, so the editor can carry out all of these tasks – from pre-selection and proxy generation to producer collaboration and re-linking and conformation – without leaving the familiar environment.

The real benefits of remote production are realised when everyone is working where they are most efficient. Media can now be readily moved over IP networks and the open internet, but such file transfers place demands on bandwidth, and that can slow workflows. Smart solutions minimise this bandwidth and time overhead, allowing the production team to deliver the best results, as quickly as possible.
What to do when disaster strikes

By Brent Whelan, director of services, and Steven Schmitt, international service manager, GatesAir

To borrow a well-worn phrase, the reports of terrestrial television’s demise have long been greatly exaggerated. Free over-the-air television has remained much of the world’s primary source of news and entertainment outside the US and Western Europe. However, with OTT services in full bloom and digital TV standards providing viewers with more local and national options, cord-cutters are proliferating worldwide and embracing broadcast television.

Terrestrial TV is also a very high-quality and reliable service. Over-the-air broadcasters often have plenty of spectrum to optimise signal quality, with little to no compression compared to cable, satellite, and streamed services. Reliability of service is almost always assured. But, almost assured is not always assured, as terrestrial TV services face weather-related perils and other disaster scenarios. Often, it’s as simple as an aging transmitter that finally reached end of life. When requested, we have worked with customers faced with ice-related tower collapses, or that have lost entire transmission systems from floods, hurricanes, and natural disasters. In the most extreme examples, we have replaced systems in times of genuine tragedy, such as when the fall of the World Trade Center on 9/11 took many New York City broadcasters off the air immediately.

In Europe and the UK, we typically work with network operators that install and maintain transmission systems for terrestrial broadcasters. That means we are on-site helping broadcasters get back to air less frequently than we are in the United States, for example. However, we always work closely with our partners to bring broadcasters and transmission systems back to air when disaster strikes. There is much to be lost when the terrestrial broadcaster goes dark, from reporting important local information that viewers need to know, to losing valuable advertising revenue that broadcasters often rely on to support operations.

One of the more recent UK/European disaster recovery scenarios that comes to mind is the Bilsdale tower in the north east of England. The 314-metre TV and radio mast was devastated by a fire that also took out the transmitters. A temporary system now serves much of the local community, although approximately 23,000 homes will have no access to free terrestrial services until the new permanent tower is raised in 2023 (though many have been provided access to free satellite and/or internet/mobile TV services until that day comes). This is still a vast improvement over the immediate aftermath when TV and radio signals went dark for more than one million viewers.

It’s a broad spectrum

The amount of work required for a disaster recovery mission will vary greatly depending on the situation. The immediate goal is to identify the source of the problem, which itself will require a thorough evaluation of the RF system and site.

Disaster recovery doesn’t always mean the station is fully off the air. The transmitter being on the air means that there is power; a trivial yet important checkmark on the list. But that transmitter may operate with reduced power. This will be problematic for at least a sizeable percentage of viewers who rely on the service and requires thorough inspection and a fast response.

It also means that operating at reduced power is likely on borrowed time. The transmitter that begins to naturally run at significantly reduced power is protecting itself. Perhaps it is a simple module failure, but solid-state transmitters can operate at near full power in these situations, and modules are easy to replace while the transmitter is on the air.

A more urgent problem is when reflected power affects transmitter health. Reflected power is the result of power being directed back into the transmitter from the antenna through the transmission line. This can be caused by many things, but often it is a weather-related issue. In warmer months, reflected power often surfaces after a lightning strike to the antenna or tower; in colder months, there may be substantial icing on the antenna.

Extreme scenarios like the Bilsdale fire, while rare, take on an entirely different definition when it comes to disaster recovery. Service level agreements with network operators are helpful in these situations, as those who build, commission, operate and maintain the system have very specific details on the RF design. It means getting in touch with your suppliers immediately and getting to the site quickly to remove damaged equipment while performing clean-up duties.

Often, a temporary transmitter – sometimes even an exciter – is quick-shipped to bring the service back to air at reduced power while the replacement system is specified. The road will be long, but on return the Bilsdale site will serve 100 per cent of the regional population with 70 free TV channels at far better quality, and with stronger TV signals for more than 100,000 households. The new tower structure will also be more robust and resistant to inclement weather than the now-demolished mast, which was built in 1969. This itself proves that an intelligent and thoughtful approach to disaster recovery will bring a happy ending.
Remote production and NDI

By Gerald Wong, SVP, global operations, Caton Technology

The NDI video over IP codec and transport protocol is rapidly gaining popularity. It is designed to be a universal way for users on any platform to work together, over existing IP networks. It supports multiple media streams in very high quality, it is very flexible, and it allows networks to be established easily. Co-existing with other IP standards, NDI aims to provide a low-cost, high-performance connectivity platform.

Part of its attraction is that it promotes very high video and audio standards, whatever the device involved. The converse of that is that, for broadcast streams, it is relatively demanding in bandwidth. Typically, NDI streams for production and post production are at least 100Mb/s for HD, 400Mb/s or more for 4K ultra HD. This is far below native data rates, of course, but definitely in the realms of contribution networks rather than consumer delivery.

On an internal LAN, supporting gigabit or even 10 gigabit ethernet, working with these large files is not an issue. But recent times have accelerated the move to very decentralised production and post, so we have to consider moving content over much greater distances, potentially around the world, and probably over the public internet. Connecting anyone working anywhere with anyone else is one of the potential benefits of NDI.

The idea of remote production and post for broadcast has long been an ambition. By reducing the number of staff and equipment that needs to be moved around, it not only lowers operating costs but the environmental burden. With the advent of Covid, remote working also minimised the risk to staff working in close proximity.

Indeed, for many broadcasters the start of the pandemic saw not just remote post, but live events covered with even the producer, director and commentators all working from their homes. To do that successfully, you need to be able to deliver the relevant content to each of them, with very low and consistent latency while maintaining excellent quality. Which is why it is important to fully realise the NDI goal of free flowing video. That means extending NDI connectivity beyond the LAN. To truly meet the goal, the solution has to deliver NDI video over circuits with limited bandwidth as well as it does to locations with dedicated fibre.

The NDI codec is designed to provide visually lossless video, which is why the fundamental bandwidth is relatively high. Applying harsh compression to make it fit over the internet is not an option. So, delivery needs a different approach.

At Caton Technology we have been working on an NDI Gateway for wide area connectivity. This builds on our Caton Transport Protocols (CTP), which is powered by unique algorithms and AI-enhanced forward error correction. The content is secured with AES encryption.

One area of recent work by the NDI development team aims to bring the technology to any device. NDI can now be implemented on ARM processors, for example, which are at the heart not just of all mobile phones, but are also widely used to power other devices, including video generation and display.

NDI Gateway can be implemented fully in software, and can be coded for ARM chips, and we are already working with a number of vendors. That brings to reality the idea that anyone anywhere can be connected into a production network.

With just one application, journalists will be able to connect from wherever their story takes them, straight into the live newsroom environment, confident that the signal will be protected and quality maintained. In the studio, the phone signal will appear as just another NDI source to be switched, processed and managed like any other, with no additional effort.

Video conferencing applications like Skype and Teams are already used as sources in news and magazine programmes. NDI means a production can handle them just like any other video source, provided there is a way of bringing them into the network while preserving quality and security.

In short, it is now entirely practical to extend collaborative, connected workflows using the excellent qualities of NDI beyond the LAN, while retaining high quality and extremely low latency.
Today's broadcasters and content creators face growing demand for high-quality video across more platforms than ever before. Not surprisingly, technical managers are increasingly on the lookout for connectivity solutions that can help optimise output while still meeting their reliability requirements. To solve that challenge, many of them are turning to Dejero EnGo 265, a mobile transmitter that combines live transmission and internet gateway capabilities.

News organisations have always faced the most unforgiving of deadlines. With the 24/7 news cycle, this has become even more challenging as stories develop rapidly, often requiring additional field reports and outside broadcasts.

The Dejero EnGo 265 is an ideal solution for the time-sensitive demands of news production. With built-in Resilient Wireless Technology, users can get the most out of every bit of bandwidth; delivering high-quality live video streams, no matter the obstacles.

“News teams only need to carry an EnGo 265; in a backpack or mounted in a Vehicle Antenna Dock,” explains Yvonne Monterrosso, Dejero’s director of product management. “With the EnGo 265, you can go live, quickly send or receive large files, and securely access private newsroom systems and cloud services from any location.”

Being unable to access reliable mobile or land-based internet to send content, or communicate with staff back at the broadcast centre, slows down reporters and production teams. In the past, they needed to bank on finding a dependable hotspot, or be restricted to locations where a reliable connection exists.

With competition between news services at an all-time high, the EnGo 265 removes any internet connectivity obstacles that could hinder productivity and collaboration. The ‘GateWay mode’ feature optimises connectivity and communication, regardless of location. This means ultra-reliable, high-bandwidth internet access is always possible thanks to Dejero’s Smart Blending Technology, which combines multiple network connections to increase bandwidth and maximise reliability.

GateWay mode seamlessly complements existing network structures and file transfer workflows. Offering speeds up to 300 Mbps, GateWay mode works with VPNs and other common applications used in the broadcast and media production markets, such as File Catalyst, IBM Aspera, Signiant, Latakoo, Box, FileZilla, Citrix and TeamViewer.

Dejero’s latest solution also meets another essential requirement of mobile reporting: low latency. Users benefit from glass-to-glass latency that is as low as 0.5 seconds over bonded cellular connections. It delivers smoother, more consistent talkback with the studio during live reports. Dejero has undertaken significant algorithm changes with the EnGo 265, ensuring improvements to network reliability in all the other latency settings as well.

With multiple types of cyber-attacks increasing in strength and frequency worldwide, organisations in all sectors are investing more in securing and protecting their assets. Given the inherent value of their content, it’s not surprising that broadcast and media companies have some of the most exacting security needs of any industry. EnGo 265 delivers multi-faceted security and data protection with AES 256 encryption, a security-hardened Linux OS, and a crypto-processor to authenticate the hardware. That means broadcasters can feel confident that their content will be kept secure.

Providing next-level reliability for newsgathering and live broadcasts has always been a priority for Dejero. Founded in 2008, the Waterloo-based company is helping organisations around the world solve their live video transport and real-time data transfer challenges.

Dejero will attend NAB in April. Visit booth W2722 to see the EnGo 265 in action!

Learn more at Dejero’s website.
TVBEurope’s website is a hive of exclusive news, features and information about our industry. Here are some featured articles from this month...

**ICYMI**

**GRASS VALLEY’S NEW CEO: “I VASTLY UNDERESTIMATED WHERE WE ARE IN TERMS OF TECHNOLOGY”**

TVBEurope talks to new Grass Valley CEO Andrew Cross about his first few days leading the company, and which piece of technology has blown him away.

https://bit.ly/3i0H6mc

**VIZRT GROUP CREATES INAUGURAL NDI ADVISORY BOARD**

Vizrt Group is bringing together a group of experts to support and steer NDI as its adoption grows beyond the media and entertainment industry.


**HOW PINEWOOD STUDIOS MOVED ‘IN THE BOX’ WITH ITS POST PRODUCTION SOUND**

Jens Christensen, post production director at Pinewood Group, discusses the company’s move to Avid’s large format S6 control surface as part of its post production sound refresh.

https://bit.ly/3iSYiiP

**MAKING IT PERSONAL FOR NEXT-GENERATION AUDIO**

MPEG-H Audio is the less well known of the two object-based audio systems in the DVB-T2 specification. But, its developer hopes the personalisation elements of the format as much as its immersive capabilities will win it more attention.

https://bit.ly/3iZ7ok3

**THE HIDDEN POWER BEHIND TIMELINE’S NEW BROADCAST CENTRE**

Timeline Television, system integrator Digby Installation Services, and Argosy discuss the cabling, connectors, power management and racking solutions employed for multiple new studios, production control rooms and edit suites.


**DISCOVERY TO PRODUCE OVER 600 INDIVIDUAL BROADCASTS DURING 2022 CYCLING SEASON**

The broadcaster will employ remote production for much of its coverage, says SVP of content and production Scott Young.

https://bit.ly/3qRaXY8
New Blackmagic Studio Camera!

The ultimate live production camera in a revolutionary all-in-one design!

Introducing the world’s most advanced self-contained studio camera. Blackmagic Studio Cameras have the same features as large studio cameras, miniaturized into a single compact and portable design. Advanced features include talkback, tally, camera control, built-in color corrector, Blackmagic RAW recording to USB disks and much more! You can even add a focus and zoom demand for lens control.

Revolutionary Studio Camera Design
The distinctive Blackmagic Studio Camera has the benefits of a large studio camera because it’s a combination of camera and viewfinder all in a single compact design. The camera is designed for live production so it’s easy to track and frame shots with its large 7" viewfinder. The touchscreen has menus for camera settings, and knobs for brightness, contrast and focus peaking.

Get Cinematic Images in Live Production!
The amazing 4K sensor combined with Blackmagic generation 5 color science gives you the same imaging technology used in digital film cameras. Plus, when combined with the built-in color corrector you get much better images than simple broadcast cameras. The color corrector can even be controlled from the switcher. The resolution of 4096 x 2160 allows both HD and Ultra HD work.

Powerful Broadcast Connections
Blackmagic Studio Cameras have lots of connections for connecting to both consumer and broadcast equipment. All models feature HDMI with tally, camera control and record trigger, so are perfect for ATEM Mini switchers! The advanced Blackmagic Studio Camera 4K Pro model is designed for broadcast workflows so has T2G-SDI, 10GBase-T Ethernet, talkback and balanced XLR audio inputs.

USB Expansion Port for Accessories
The Blackmagic Studio Camera features a high speed USB-C expansion port that allows you to record to external disks or connect accessories. Plus in an external USB flash disk and the camera can record high quality 12-bit Blackmagic RAW files for later editing and color correction. Plus the files are small and fast, so editing responsiveness is incredible!

Blackmagic Studio Camera 4K Plus......1145€
Blackmagic Studio Camera 4K Pro.......1595€

Learn more at www.blackmagicdesign.com/nl
ILM’s StageCraft volume system can create anything from rainy, dark streets in Gotham City to the sandy landscape of Tatooine. The company’s executive producer Chris Bannister talks to TVBEurope about how virtual production has developed since ILM first used it over 20 years ago, and where it’s going next.

**HOW LONG HAS ILM BEEN WORKING WITH VIRTUAL PRODUCTION, AND WHAT PROMPTED THAT FIRST ATTEMPT?**

Industrial Light & Magic has been innovating in the virtual production space since 2001 when we developed the first real-time, in-camera, on-set previs system for Steven Spielberg’s *A.I. Artificial Intelligence*. Since then, we have been developing a robust set of tools in this space which in 2018 were incorporated into a platform we call ILM StageCraft. StageCraft encompasses all of ILM’s virtual production and performance capture tools including our advanced LED stage technology.

**HOW HAS THAT WORK DEVELOPED OVER THE YEARS?**

Filmmakers come to ILM for the creative collaboration, world class artistic talent, and technological innovation. Our innovation is spurred by the needs of the filmmakers we collaborate with and we are always taking their feedback and suggestions and incorporating them into our solutions so we can meet the creative challenge while allowing the filmmakers to work in the way that makes them most comfortable.

**WHAT DOES ILM STAGECRAFT ACTUALLY DO?**

ILM StageCraft is a platform that encompasses a suite of virtual production tools and our class-leading performance capture solutions. Perhaps the most well known component is StageCraft LED, sometimes referred to as ‘The Volume’. In 2018, working with *The Mandalorian* creator and executive producer, Jon Favreau, along with our technology partners Epic Games, Lux Machina, Fuse, and Profile Studios, we created a system that combined a large-scale installation of LED screens, real-time rendering technology, camera tracking, ILM colour science, and the skill of ILM’s artists to create a new production paradigm. At its core, the technology provides a means to take any environment, be it real, imagined, or any combination of the two, and display it on LED screens for in-camera capture during principle photography. It has proven to be a game-changer in terms of production efficiency but also has a positive impact on sustainability and of course creative workflows.

In terms of performance capture, ILM’s tools such as Flux, and Anyma and Medusa which were initially developed by Disney Research Studios and now advanced by ILM allow us to offer our clients flexible solutions to high-resolution facial and body performance capture depending on the needs of their particular project or performer. We’ve developed solutions for use both on-set during principle photography as seen in films and series such as *Terminator Dark Fate*, *The Irishman* and *The Witcher*, and off-set performance capture as used on such projects as *Aladdin*, and *Aquaman*.

**HOW HAS VIRTUAL PRODUCTION CHANGED SINCE YOU FIRST BEGAN TO USE IT?**

We continue to evolve our virtual production technology and workflows on every project we undertake. The most substantial change is the power of the hardware that is available now versus what the state-of-the-art looked like in 2001. Processors are immensely more powerful now and we are able to run dozens of systems in parallel to create a single environment. GPUs have also come a long way and with the latest and greatest NVIDIA RTX technology we are able to create environments and effects that were unthinkable in those early years. Virtual production is now routinely used on a wide variety of project types, not just large visual
effects-driven projects. We work on projects ranging from music videos, brand films, commercials, broadcast promos, episodic series, to feature films and they all leverage virtual production in different ways.

ARE THERE ANY MAJOR DIFFERENCES BETWEEN WORKING WITH VIRTUAL PRODUCTION FOR A FILM PROJECT COMPARED TO A TV PRODUCTION?

In the current landscape, the experiences for film and TV are closer together. The key component of the service that we offer with ILM StageCraft is the people with the experience to help find the right virtual production approach for any project. In addition to our work on some of the Lucasfilm television projects, we have a close partnership with Disney Television Studios. We have provided virtual production solutions for features, television, commercials, music videos, and more.

YOU HAVE A VIRTUAL PRODUCTION STAGE BASED AT PINewood IN THE UK. HOW LONG HAS BEEN IN OPERATION AND WHAT PROJECTS HAS IT WORKED ON SO FAR?

ILM’s StageCraft stage at Pinewood Studios became operational in February 2021 and most recently was used on Marvel Studios’ Ant-Man and the Wasp: Quantumania.

WHAT TECHNOLOGY DOES THE STAGE AT PINewood USE?

Our volume at Pinewood operates on the same ILM StageCraft platform as our four other permanent stages (three located in the greater Los Angeles area and a fourth in Vancouver) and bespoke stages that we construct for specific projects. As we advance our technology adding new capabilities, we roll out updates to all of our stages so productions around the world can take advantage of them. We can render to the LED volume using ILM’s own Cinema Render Engine called Helios, or Unreal Engine.

CAN YOU TALK US THROUGH ALL THE PRODUCTIONS WHERE YOU’VE USED VIRTUAL PRODUCTION, AND HOW YOU’VE USED IT?

We’ve used virtual production technology on a variety of projects including The Mandalorian and The Book of Boba Fett, where over half of the series were shot on our StageCraft volumes, The Midnight Sky for which we built a bespoke StageCraft volume to accommodate the interior set for the Barbeau Laboratory, and recently The Batman.

HOW INVOLVED HAS ILM STAGECRAFT BEEN IN DEVELOPING THE TECHNOLOGY SIDE OF VIRTUAL PRODUCTION AS YOU’VE EMPLOYED IT MORE AND MORE?

The ILM R&D team along with Lucasfilm’s Advanced Development Group (ADG) partners with our StageCraft teams to keep the feedback loop going and a constant flow of innovations coming in response to production demands. We are always looking to streamline the system and incorporate the specific tools that a given filmmaker might request on their project.

HOW DO THE CREATIVES THAT YOU WORK WITH REACT TO VIRTUAL PRODUCTION? ARE THEY ALL ONBOARD IMMEDIATELY?

As you might expect, each project and each creative team is different. Some creatives are more firmly rooted in traditional production and
thus more hesitant to jump fully into virtual production. That said, once we demonstrate the capabilities and benefits of virtual production and answer all of their questions they’ve all gotten onboard and had a great experience. For us the key has been to set realistic expectations and educate our clients on how they can make the technology work for their production. Virtual production is not a silver bullet that solves all production woes, to work effectively you need an experienced team who knows the strengths of the approach and where it may falter so you can plan your production accordingly.

HOW INVOLVED DO THEY GET IN LEARNING ABOUT THE TECHNOLOGY?
At ILM we don’t create technology for technology’s sake, we create tools to help filmmakers bring their vision to life. Some filmmakers are technologically savvy and want to understand every facet of how the systems work; others may not be as interested in the inner workings but rather what the technology allows them to achieve. We seek to put tools into the hands of artists and filmmakers that allow them to focus on the art of storytelling and the craft of filmmaking and we let the technology fade into the background. The technology is production-hardened and our teams’ job is to make sure we bring great ideas to the table, collaborate with our clients and keep the technology working so the filmmakers can focus on achieving their creative goals.

HOW DOES VIRTUAL PRODUCTION IMPACT THE POST PRODUCTION PROCESS?
Virtual production as a whole has a tremendous impact on any production. Often, a fair amount of work that would have traditionally been done during the post production phase of a project is pulled up to the pre-production phase. One example would be CG environments that need to be created ahead of shooting on a virtual production stage. Those environments are built, scouted, and lit all before principal photography begins on the scenes involving them. Having the environments available on the day allows for much better creative since the director can see exactly what they have to work with, the DoP can frame and light shots in context, and actors don’t have to imagine what a setting will look like as they did with traditional green or blue screen set-ups but rather they can focus their energy on the performance itself.

WHAT’S BEEN THE TOUGHEST CHALLENGE YOU’VE FACED WORKING WITH VIRTUAL PRODUCTION?
Frankly, other than partnering with filmmakers to share how best leverage the technology, the hardest challenge is making key creative decisions on a much larger world scale than you would with a traditional set that fits in a sound stage. The virtual environment could be infinite in scale and detail.

ARE THERE ANY DOWNSIDES TO WORKING WITH THE TECHNOLOGY?
While some aspects of virtual production can be applied to any type of project, shooting on an LED volume is not ideal for every scenario. For example, if a scene is meant to be an exterior setting at high noon a filmmaker would likely be better off filming outdoors, on location, or a backlot to capture that type of intense lighting environment as it can be very difficult to achieve on a stage. Also, as a filmmaker you want all of your department heads to buy into the process. There are numerous decisions that have to be made up front and you want the key individuals and their departments to be aware of the process so there aren’t any surprises on the day.

CAN YOU SEE A TIME WHEN VIRTUAL PRODUCTION IS ADOPTED BY TRADITIONAL BROADCASTERS FOR THEIR DRAMAS OR ENTERTAINMENT SHOWS, RATHER THAN JUST FOR BIG-BUDGET PROJECTS?
At ILM we have worked on projects ranging from music videos, broadcast promos, and commercials to all manner of episodic series and feature films. Since we have a number of permanent volumes around the world we can offer them to a wide variety of filmmakers who wouldn't necessarily have the budget or time in the production schedule to build something bespoke for there

WHAT’S NEXT FOR VIRTUAL PRODUCTION?
We are just scratching the surface of how virtual production can be a significant contributor to filmmaking and with each production creatives get more bold in the use of the technology and how our artists can support their vision. Things are about to get very exciting!
I’ve been reading and writing a lot about remote workflows over the past few years. But the social distancing requirements of the times have made remote production much more than simply fodder for a steady stream of technical prose. Thanks in part to emerging technologies like the transformational JPEG XS compression codec, remote production is now a key component of today’s workflows, and an operational model that is here to stay.

The pandemic-driven need to support remote working and distributed workflows forced us to adopt some ideas that had been floating around for years, but that few previously had the guts to take on. Ideas like remote productions, remote operations; even the futuristic notion that you could do production on the ground and origination in the cloud.

Over the last two challenging years, we witnessed the combination of sudden changes in system needs and cutting-edge tools ready for new challenges. Technologies that used to be regarded as leading edge or proof-of-concept were suddenly being deployed in mainstream workflows with great success.

KEEPING THE BALL MOVING

The concept of production staff supporting live events from home was not part of the original plan when many systems were designed. But as the situation demanded it, production teams had to trust their IT and IP technologies to get the job done; and modern infrastructure had no problem supporting the new paradigm.

While the staff at sporting venues were tasked with remote accessing the user interfaces of their routers and other equipment at their own facility, some workflows stretch further, across the globe and the clouds. For US sports network Tennis Channel, owned by Sinclair Broadcast Group, remote production workflows were inspired by a short-term need for system expansion, along with the availability of cloud technologies to host master control.

Despite the challenges of the past two years, Tennis Channel was able to successfully cover large live events like the 2021 French Open at Roland Garros using cloud-based master control nodes. The process of bringing the cloud air-chain online took just two weeks from inception of the project. Today, Sinclair’s entire Bally Regional Sports Networks family is being optimised for SMPTE ST 2110 and ground-to-cloud workflows.

THE LONG PASS

The emergence of the JPEG XS compression codec will make it even easier for media companies like Sinclair to deliver professional video with cloud workflows.

JPEG XS offers visually lossless production and contribution quality at very low latency (less than a frame), and typical compression ratios between 5:1 and 20:1. The result is an ideal means of communicating between facilities or between remote production sites and a broadcast centre. It can also be used as an on-ramp and off-ramp to cloud-based production, with significant savings in bandwidth cost. Cloud services providers are improving the latency in and out by the millisecond, enabling highly reactive, cloud-based production-to-playout workflows.

When visually lossless live media streams must travel great distances, there may not be enough bandwidth for uncompressed HD or UHD to make the entire trip. JPEG XS, which can be implemented within SMPTE ST 2110-22, allows live UHD and HDR media to move across realms and resources to be leveraged wherever they are; allowing for more coverage at more events. In a world with 400 gigabit IP networks and visually lossless JPEG XS compression, we can move a ton of video over fibre.

With the adoption of SMPTE ST 2110-22 and the transformational JPEG XS codec, nearly any media system can interface with cloud resources for expansion beyond its walls. The same device used for processing local signals can also generate the stream you hand off to a cloud gateway for visually lossless media in the cloud. The HTML5 and similar browser-accessible user interfaces of modern broadcast solutions provide ease of use regardless of where the physical equipment lives.

FPGA resources may be available in a cloud environment, in addition to servers, allowing faster processing options for some workflows. Many new devices for permanent installation at a facility can be treated as dynamic, variable-function resources on a connected network. The overall tapestry of a media production system can contain devices or nodes in disparate locations, but still feel like one smooth workflow.

REMOVING THE BOUNDARIES OF YOUR PLAYING FIELD

While the need for remote operation was greatly accelerated by the pandemic, it has proven to be an operational model with significant benefits; having staff work from home provides better flexibility, requires less time spent travelling, and consumes fewer resources. That’s good for business and good for the environment.
As 2022 marches on, live events look to be back on the table. Festivals, concerts and live sports are on the horizon across Europe, opening up possibilities for TV networks and production companies capturing their triumphant return. Meanwhile, broadcasting options are becoming more complex and viewers more demanding, their content choices expanding during lockdown.

To that end, Poland’s most popular channel Polsat required a new outside broadcast (OB) truck capable of meeting all those production demands. Sony was chosen as the partner to provide the management systems for live production, including Live Element Orchestrator (LEO) and Live System Manager (LSM). Together with local integrators 4Vision and Autokontener, they built the first OB vehicle of its kind in Europe.
The 14-metre vehicle is based on a full IP infrastructure able to handle production in any format, including HDR and 4K. It can house 28 personnel and is expected to become Polsat’s flagship truck, thanks to the agility of its IP capabilities in meeting the most specific demands of live production.

JOINING FORCES
The Warsaw-based company has enjoyed a long working relationship with Sony Professional Solutions, who delivered one of Europe’s first HD OB vehicles to the broadcaster in 2007. When it came time to build a 4K, HDR and IP capable vehicle that could meet the rising demand for content and future delivery requirements, Polsat once again relied on Sony’s expertise.

“Sony is our trusted partner in this because of their strong industry knowledge and capacity for innovation,” comments Andrzej Szymański, CTO, Polsat. “Their proposed vision of building this OB truck matched our technological and our business needs. Sony is a leading manufacturer of devices which are already compatible with IP live standards that guarantee full compatibility of all devices on board.

“This project is also the fruit of collaboration with multiple implementation partners such as 4Vision and Autokontener and other technology vendors,” he adds. “It’s the first step in a longer-term transformation of our infrastructures and workflows that will make our content production and supply chain more efficient, flexible as well as scalable and responsive.”

SWITCHING WITH EASE
A major requirement of the project was the ability to not only operate in any format (HD/UHD/SDR/HDR) but to easily switch between them. This is especially true in sport where requirements vary from one event to the next, combined with the need to produce coverage in a wide range of outputs.

“The most important thing above all is the image format,” states Szymański. “We are moving from HD to UHD. That means four times more information for the viewer in terms of the number of pixels in
the image.” The other major trend in sports broadcasting is the move towards HDR, which more closely recreates the real-world colours in as much detail as possible. “It gives much better natural colour reproduction, the colours that surround us, what the viewer sees on the screen,” explains Szymański.

“Many live sports producers require very specific formats for the entire broadcast production,” confirms Paweł Fila, project manager, 4Vision. “Implementing IP technology in this truck allows us to freely pick any of the possible formats, with the capability to quickly switch from one format to another.”

Just how fast is “quickly” exactly? Sony’s LEO system enables the entire truck to switch from HD to 4K in a matter of minutes, half an hour at a maximum; a process that previously would have taken up to four or five hours.

**PRODUCING THE FUTURE**

Another priority was interoperability, making the OB vehicle agnostic to the technology installed on board. Using Sony’s LSM software, Polsat can efficiently monitor the complete system, including devices from third-party vendors. “The ease of system expansion was useful here,” notes Karol Sulej, live production solutions consulting architect, Sony Professional. “We have achieved ease of integration of both Sony products as well as third-party products.”

Future-proofing was also key, building an OB truck that fulfils Polsat’s future ambitions as well as its current requirements. “State-of-the-art technology requires knowledge from people who design it, but also from future users,” remarks Sulej. With that in mind, the IP core is compliant with the SMPTE ST2110 and AMWA NMOS suite of open standards. As a result, the truck is interoperable with current and future systems in line with Polsat’s creative outlook.
That future includes remote production, using IP to send live coverage to a centralised facility for the programme to be produced and distributed. “In the near future most broadcasters – and definitely organisations like ours – will introduce remote production,” says Szymański. “We’re thinking in the near future to build a hub or production centre. This will enable just one crew to handle several different projects, for example sporting events.”

**GOING LIVE**

Other Sony technology on board the OB truck includes IP-native HDC-3500 cameras, XVS-9000 multiformat video switcher, PWS-4500 video server and PVM/BVM Series professional monitors. Sony’s SR Live for HDR workflow enables simultaneous delivery in HDR and SDR without the need for duplicate hardware and production personnel, supporting Polsat’s ambition for single crews handling multiple projects. Meanwhile the NXLK-IP50Y IP HDR inherits the HDR capabilities of the HDRC-4000, further augmenting the truck’s core processing capabilities.

Third-party hardware and systems include an SSL audio mixer, Riedel talkback system, Fujinon lenses, Imagine Selenio Networked Processor for multiviewers, VISLINK wireless links, Leader SPG and WFM-s, BroaMan fibre links and networking by Cisco. Thanks to innovative orchestration based on Sony’s LEO system, all devices are holistically controlled over IP. “As far as I know this truck will be one of the best trucks in Europe,” concludes Henryk Wróbel, head of product development, Autokontener. “It might even be the best in the world.”

There is then a bright future for live events; one that TV channels are able to capture, and to broadcast immediately.
This year marks the 35-year anniversary of Full Metal Jacket, still one of the most powerful war pictures ever made and one of many landmarks in Stanley Kubrick’s shining filmography. It also saw Jan Harlan, Kubrick’s producer of 30 years, inadvertently dip into the role of casting director after hiring R Lee Ermey, initially just to train up the young actors cast as marines.

“He was a security guy in a power station,” recalls Harlan. “We looked for somebody who was a drill instructor himself and served in Vietnam. And he fitted the bill... Sensible guy, a bit weird.” The first thing Ermey did was fetch himself a sergeant’s uniform from wardrobe, and then proceeded to train the extras through shouting, coming up with much of the film’s opening dialogue in the process. “He was a barrel of profanities, just endless,” says Harlan. “Some great lines in there, I mean you couldn’t make them up.”

Kubrick had no choice but to cast the instructor as Gunnery Sergeant Hartman, a role that had already been filled but now clearly belonged to Ermey. “He knew how to shout,” adds Harlan. “He always shouted.”

Born in Germany, Harlan met his brother-in-law Stanley Kubrick in New York in 1963. The director had married Christiane Harlan, Jan’s sister, five years earlier. In 1969, Harlan was working on streamlining processes for banks and businesses when Kubrick invited him to Romania to work on a film about Napoleon, which came to an abrupt halt after MGM pulled out. “They were worried, they were afraid of it,” comments Harlan. “The other problem was Kubrick had just done 2001: A Space Odyssey, so they had just had the experience of him going over budget a considerable amount.” Instead, Harlan negotiated the rights for Arthur Schnitzler’s Traumnovelle, a project that would eventually materialise as Eyes Wide Shut some 30 years later.
Through those three decades he produced Kubrick’s best-loved movies, brokering deals, acquiring permissions and hiring staff. “I made sure the right things were there at the right time,” explains Harlan. “I’ve nothing to do with what you see on the screen… The only thing I did was music. Music was not my role, I just happen to know a lot of music.”

In fact before officially working with Kubrick, Harlan was responsible for suggesting Richard Strauss’ Also sprach Zarathustra for the start of 2001: A Space Odyssey, an iconic contribution about which he is incredibly modest: “I don’t take any credit for it, I know a lot of music so I suggested other things. He went on this one because it is so short. It comes to an end.”

Kubrick was adamant that a piece of music should be played in its entirety if it is to be used at all. “You play the piece whole, you don’t cut it,” Harlan states. “And you edit to the music, the music dictates… because if it’s good music, it has to be respected. Eyes Wide Shut starts off with the Shostakovich waltz. And he said it’s too long. He shot it so that you see Tom Cruise switching off the radio, so that there’s a reason to cut it dramatically.”

2001 was filmed at Elstree Studios, where Kubrick enjoyed an unusual level of freedom from Hollywood interference. “He loved England,” confirms Harlan. “He didn’t like the heat, he also liked the fact that he was left alone.” They returned to England to shoot A Clockwork Orange, only for Kubrick to pull the film from release after receiving death threats. “It was terrible,” says Harlan. “The police addressed it, said you’d better watch it, there are lunatics about… So he told Warner Bros, forget it, take the film off.” The movie was withdrawn in England, but more death threats were just around the corner with his next feature Barry Lyndon. “That was the IRA,” explains Harlan. “We shot in Ireland and there were threats against the British crew, not against Kubrick. We had to move to Salisbury to finish the thing.”

“Barry Lyndon was so difficult because everything was real,” he adds. Kubrick’s decision to light scenes entirely by candlelight posed enormous difficulties for shooting and editing purposes. “There were hundreds of candles and you had to cut it so they didn’t jump up and down, because they burn so fast… It was a nightmare!” Candlelight also proved almost impossible to shoot with standard camera lenses, as Harlan describes: “The smaller the lens opening, the greater the depth of field. It’s an optical law. There’s nothing you can do about it, not even when you’re Stanley Kubrick!” The director discovered that German company ZEISS had manufactured an f/0.7 lens for NASA to use in satellite photography, so he had such a lens mounted on his BNC camera, essentially wrecking it for any application beyond the optical specificities of Barry Lyndon. The biggest expense however was time, according to Harlan. “It always takes a long time,” he notes. “Stanley was not fast!”

Unfortunately for Warner Bros., the film’s release coincided with Jaws which devoured Barry Lyndon at the box office. The only city where Barry Lyndon won out was Lisbon. “Why? I don’t know,” says Harlan, “maybe they don’t like sharks!”

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Steven Spielberg came back into the frame 25 years later when he took over A.I. Artificial Intelligence, which Kubrick had prepared to shoot before giving up on the project. "I was so grateful to Steven that after Stanley's death he came and said, 'I'd like to do this,' recalls Harlan. "I said, absolutely I'll give you everything I have. And I worked on A.I. at the beginning and it was a lovely experience, such a different experience! Stanley was slow and used very few people, Spielberg had hundreds of people and it's done in 20 weeks. Stanley would take a year just to prepare it!" 

A.I. would have been a rare return to a genre already touched on by Kubrick, who leapt from one to the next with each of his films. "He would have loved to do a musical," notes Harlan. But the producer does not consider 2001 and A.I. particularly comparable. "2001 is a bow to the unknowable," he observes. "The Monolith is a fantastic expression of 'I don't know.'" A.I. on the other hand is "down to earth," a story of humanity and artificial intelligence. Surely HAL 9000 is an AI? "Sure, but it's a computer," argues Harlan. "It has nothing to do with a god." Kubrick's foray into the horror genre came in the terrifying form of The Shining, where Stephen King gave him licence to do what he wanted with the story, an offer he quickly regretted, making his own version in the 1990s. "Stanley said, if you make a film that doesn't make any sense at all, then you play on that and make it totally ambiguous," says Harlan. "The film was not successful when it came out. It's now an icon." As to whether he experienced any of the infamous on-set difficulty reported by Shelley Duvall, Harlan asks: "What does it mean, difficult? Sure, it was difficult, I had difficult times with him too. It doesn't mean anything!"

Never one to enlist Hollywood stars for the sake of it, Kubrick found himself directing A-list couple Tom Cruise and Nicole Kidman in Eyes Wide Shut, whose famously long 15-month shoot set a world record even without the 30 years it took to start making in the first place. "Tom Cruise had a fixed deal for 24 weeks, and it took a year," explains Harlan, "and not one word of complaint!" The consummate professional apparently relished the break from his usual macho roles: "It's the first time I'm a loser!" But once again trouble was not far away and the notorious orgy scene had to be altered in order to procure an R rating, by digitally imposing figures over some of the graphic images. "Stanley got carried away," remarks Harlan. "He is over the top, it's theatre, it's film theatre."

Generally though digital effects were unavailable to Kubrick, who died just before the film's release. "It's much easier now to make a film," says Harlan, "much easier to light it." That said, he does not necessarily think this availability has improved the quality of films overall. "There are so many films made, and I find many of them boring, really boring," he admits. "I walk out of them all the time. I'm not fooled."

Satisfying as it is to think Eyes Wide Shut was the first project Harlan worked on and the last to arrive, there are actually bookends to the bookends. Harlan is now working with No Time To Die director Cary Fukunaga to finally deliver the Napoleon project that Kubrick never got to realise. "With Cary I would do a six-hour series, there's already a script so it's exciting," says Harlan. "You have to do his whole life, if you only take one section it's not interesting enough."

It is fortunate then that Kubrick and Napoleon are incomparable, if just for the sake of time.

“Stanley was slow and used very few people, Spielberg had hundreds of people and it’s done in 20 weeks. Stanley would take a year just to prepare it!”
COLLABORATION IN THE CLOUD

By Nicholas Pearce, co-founder and CRO, Object Matrix

Just prior to the onset of the pandemic in 2020, Forbes discussed a move from the “information age” to the “collaboration age”, highlighting the impact that both task automation and frictionless virtual collaboration would have on the workplace.

No-one could have foreseen the pace that this cultural shift would occur, or the widespread adoption of cloud-based workflows due to remote working. So, have we fulfilled the prediction of seamless collaboration and are media organisations solely experiencing the benefits of the cloud?

THE COMPLICATIONS OF A MEDIA MODEL

In recent months, the virtues of a cloud-based approach have been preached from every angle. And while more flexibility within the culture of work and rethinking the need for physical office space are both crucial for commercial evolution, not all sectors have the same demands. It is often the case that in conversations around virtual collaboration, broadcasting’s more complex workflow requirements are overlooked by mainstream thought leaders.

Most broadcast and media organisations with a large archive of video content currently fall into two categories: those yet to adopt cloud-based infrastructure; and those that have begun a cloud transition but are not fully optimising their archive or content workflows. These organisations have not been living under a rock, they understand both the operational benefits of cloud migration and the opportunities to diversify their talent base with staff in different locations. However, there is a big question mark hanging over the cost of moving to an opex, cloud-based model, that should give media companies a reason to press pause.

BEING MORE SELECTIVE

The broadcast industry requires collaboration throughout the media supply chain, whether that’s remote editing, review and approval, or teams accessing archive content. However, there is a lack of understanding around the complexity and resources associated with implementing a fully cloud-based approach. It’s crucial that media organisations and broadcasters understand this before they dive-in, and perhaps be more selective regarding which workflows they want to transition.

In a recent webinar with our partner Vidispine, we discussed the merits and pitfalls of cloud-based services within media production. The lessons from that conversation were that straightforward media supply chain workflows, such as preparation, transcoding, or content packaging were no-brainers when it came to leveraging the cloud. As were collaborative workflows, such as review and approval, or general content access. But it becomes more challenging when the content needs to be moved. High egress fees can be applied to cloud-based archive footage, which content owners are looking to repeatedly access and ultimately monetise. News, sport, and advertising workflows all require frequent access to archival content, and that level of interaction with your media soon adds up.

COULD CUSTOMISABLE CLOUD BE THE ANSWER?

Having one point of access for everyone is an important requirement for media organisations, but that doesn’t mean all the content needs to sit with a single cloud provider. That’s where multi-cloud and hybrid cloud environments come into play. Organisations are now exploring the potential of flexible cloud and hybrid approaches, not only because of the redundancy issues associated with public cloud providers going offline, but also to suit specific workflows.

Media companies that have the requirement for frequent interaction with their archives will need a platform that provides instant access to everything, with no egress fees. Splitting content into regular archive access and deep archive categories means companies can adopt a more flexible cloud strategy, keeping the lower demand content in cold storage. This enables companies to manage the balance between archives that they need to protect and search with associated metadata, and archives that just need to be kept for posterity.

Some organisations with very large archives may also choose to build a silo of proxy content that can be viewed anywhere. Then, depending on requirements, if they need to access a higher resolution file, users can go to the deep archive to pull it back. The potential for proxy workflows is huge. With new developments in technology, there is now the option to playback complex timelines including effects. This allows media professionals to create wipes, dissolves and manage voiceovers in a virtual environment. That ability to deliver an editing experience in the browser, will have a significant impact on remote collaboration moving forward.

NEXT STEPS

In the media industry, working collectively and efficiently means more than checking in on video calls and group chats. Media assets and broadcast workflows have inherently unique attributes, making task automation and remote access more challenging and costly. Important factors to consider are the complexity of supply chain processes as well as the asset size and overall scale of media archives. With the potential for more post production and editing workflows to transition than ever before, broadcast companies can weigh their options before committing.

Adapting storage and workflow infrastructure to suit the specific requirements of a media organisation is now possible. The cloud shouldn’t be a one-size-fits all solution. It’s time to demand a tailored approach to content collaboration.
Ahead of this year’s NAB Show, TVBEurope speaks to new NAB CEO and president Curtis LeGeyt about his expectations for the event.

**HOW HAVE YOU FOUND TAKING OVER AS CEO AND PRESIDENT OF NAB SO FAR?**
After working at NAB for ten years, I was well aware of the respect lawmakers and regulators carry for our organisation and for what our industry does for local communities. But this new role has afforded me greater opportunity to engage day in and day out with our members and gain a greater understanding of the tremendous impact our trade association plays in their ability to serve their communities. That has been extremely gratifying.

**IS IT WHAT YOU EXPECTED?**
NAB’s success is always going to be measured by the strength of our Washington, DC advocacy. But my biggest surprise stepping into this new role is the tremendous impact our organisation has in helping our member companies navigate business challenges beyond laws and regulations. Whether it is technology initiatives, training the next generation of broadcasters and executives, or providing small business resources, our team at NAB is helping to drive the industry forward in so many ways. I have been overwhelmed by the many industry leaders who have reached out to express their support and appreciation for so much of what NAB does.

**HOW DO YOU THINK THE GLOBAL BROADCAST INDUSTRY HAS WEATHERED THE STORM OF THE PANDEMIC?**
It has been tough, but I think broadcasting has been resilient and risen to the occasion. The pandemic certainly accelerated trends that were inching their way forward before 2020. Remote or decentralised production, the growth of streaming and the focus on personalised and unique forms of content are now at the
forefront of the media industry. NAB Show attendees will see deep explorations of these topics at the show.

**HOW EXCITED ARE YOU TO WELCOME BACK ATTENDEES TO LAS VEGAS?**

We’re very excited to welcome attendees and exhibitors back to NAB Show. There is a lot of anticipation for the show and we’ve seen momentum really start to build, especially in recent weeks. NAB and our exhibitors are hearing from attendees and customers that they are excited to get back to doing business face-to-face.

On a personal level, I am looking forward to a live, in-person event where I can walk the show floor and talk with broadcasters, hear different perspectives within our industry and see the incredible innovations that are going to change the future of content.

**WHAT MAJOR DIFFERENCES WILL THERE BE TO THE SHOW THIS YEAR?**

We took feedback from our exhibitors and attendees to heart and reimagined the NAB show floor this year. We have reorganised the show around three main themes of Create, Connect and Capitalise that make up the content lifecycle, and an Intelligent Content showcase that overarches these themes.

We have also created specially tailored experiences that give attendees hands-on exposure to the latest products, focused educational programming to encompass these main themes, and organised networking opportunities so industry professionals can meet like-minded professionals, regardless of the medium in which they work. We believe this year’s NAB Show will provide a curated journey for attendees that will better fit their needs and interests.

**HOW ARE YOU PERSUADING INTERNATIONAL VISITORS THAT NAB SHOW IS READY TO WELCOME THEM BACK?**

We are living in a world where content knows no borders. The tools needed to produce a high-quality radio show or distribute the next hit television show or monetise captivating content have universal appeal. NAB Show provides ideas and inspiration that can come from anywhere. By not attending, media professionals are short-changing themselves.

We’ve been pleasantly surprised by the level of interest from international registrants and that interest keeps growing. It’s a clear demonstration that people are ready to get back to doing business face-to-face and there’s no replicating NAB Show when it comes to achieving that.

**WHAT PIECE OF TECHNOLOGY INNOVATION HAS REALLY STOOD OUT FOR YOU SINCE THE LAST NAB SHOW IN 2019?**

There has been rapid acceleration in personalised content experiences for consumers that are customisable, on-demand and data-driven. We are focused on helping attendees understand and take advantage of these trends at NAB Show.

We will explore the metaverse, which is creating new immersive digital worlds that place the consumer at the centre of the universe. Our Intelligent Content showcase will explore utilising data technology and AI to unlock a unique experience for each user, customise programming to users’ tastes and interests, and cater advertising that fits audiences’ differing needs. Blockchain technology and its unlocking of a more decentralised system of content creation and ownership will also be a main focus of NAB Show as we help attendees navigate this emerging field.

**WHAT DO YOU HOPE ATTENDEES AND EXHIBITORS WILL TAKE AWAY FROM NAB SHOW 2022?**

I hope our community comes away feeling like there’s no place like NAB Show to do business. There is nothing like getting a hands-on demo with cutting-edge equipment that is going to change the industry or how a chance meeting with a colleague on the show floor can turn into a lifelong collaboration, or hearing from a thought leader in one field can spark an idea that changes another field. After three years apart, our industry is eager to experience that again.

**LOOKING AT THE EUROPEAN MEDIA TECHNOLOGY LANDSCAPE FROM THE UNITED STATES, IS THERE ANYTHING YOU FEEL EUROPE IS AHEAD ON IN TERMS OF DEVELOPMENT AND ADOPTION?**

Europe made some early strides with combining over-the-air broadcasting with broadband with the adoption of HbbTV. I think television broadcasters in the US watched this and have applied those early lessons learned in our deployment of ATSC 3.0 and Next Gen TV. US broadcasters are now building some very compelling interactive applications and I expect these will be quickly adopted as NextGen TV continues to roll out across the country.

**SUM UP THIS YEAR’S NAB SHOW IN THREE WORDS.**

Back to business.
With the countdown on to Eurovision 2022, the team at dock10 tell TVBEurope about their role as the UK’s new permanent production base and broadcast location.

When millions of viewers across Europe tune into the Eurovision Song Contest Grand Final on 14 May, they’ll see the UK’s jury broadcasting from a brand new location. This year the BBC’s production base for the show is moving to a new home at dock10 in Salford, Manchester. The facility will beam the results of the UK jury to Turin, which will send the feed back to Salford, via London.

dock10 has played host to a number of major live events in recent months. In March, it facilitated the live broadcast of Comic Relief, and has also been the home of the BBC’s coverage of both the Tokyo Summer Olympics and this year’s Beijing Winter Olympics.

For Andy Waters, head of studios at dock10, the show’s production move will be a chance to catch up with an old friend. “I used to work on the show when I worked for the BBC at Television Centre, so it’s quite nice for it to be coming up to Manchester,” he says. “It’s probably the first time it’s come out of London.

“We will be looking after all the production feeds and the distribution to the network and adding in any additional commentary, any additional requirements or graphics required for the show. That will all be based around one of our studio galleries, including things like EVS replays, etc. We’ve been doing a lot of these major events over the last couple of years with the Olympics and the Euros and this is a sort of showbiz version of the same thing,” he laughs.

Viewers will get to see Manchester as part of the broadcast, thanks to drone footage organised by dock10’s head of marketing, Darren Deans. “That’s been great fun, actually,” Deans says. “MediaCity changes so quickly, so we’ve been doing some new drone test fights, flying them around and getting some nice shots.”

dock10 works with over 30 different connectivity providers, so connecting to Turin shouldn’t be a problem. “In addition to that, the BBC’s own network of connectivity, which extends across the country, is also connected to us,” explains Waters. “So there’s going to be
a combination of routes coming in and going out, but a lot of it will be over the BBC’s own connectivity landing in the MCR in London, and then distributed across the country up to us. We regularly do live TX for ITV or Channel Four, and having all that connectivity available, as it was for the Euros last year when we had UHD feeds coming in from all over Europe, is really invaluable.”

With all those feeds pinging around between Italy, Manchester and the rest of the UK, is Waters worried about latency issues? “I think there’s always going to be latency no matter what network you use,” he says. “Even if the show was being transmitted from Turin directly to your television there is always going to be a slight latency issue, because the speed of light will only travel so fast. But it’s pretty damn quick!”

“The thing which impacts latency more than the fibre network is routing equipment and digital technology. Even a vision mixer will have a couple of frames delay in it. But it’s nothing significant and nothing different to what we’re already very much used to.”

“Eurovision would be all the poorer if there weren’t those little satellite delays between the countries, wouldn’t it?” adds Deans.

In terms of revealing the votes of the UK jury, that will involve the BBC’s host stood in front of a camera pointed at a green screen, something the team at dock10 are well used to facilitating.

“We do a lot of green screen, which has now elevated to a lot of virtual studio solutions,” says Waters. “We could do a whole lot more if the production team wanted us to, and have the UK presenter appearing to be live from the moon,” laughs Waters.

“This is going to be a relatively simple green screen, so quite traditional with interesting shots of MediaCity just to bring home the message that it’s not coming from London, it’s coming from another part of the UK.”
We are in a period of transformation across the broadcast industry. Beginning as a necessity amid lockdowns, many mainstream broadcasters are now integrating and adopting cloud-based live production tools. Historically, there's been a resistance to disrupt the status quo and shift from the traditional hardware and standard workflow.

But due to the rapid technological transformation within broadcast, the cloud is here to stay. Many questions remain though, about the best way to make the shift, and the true benefits achieved. Sure, flexibility and scalability in a technology stack is important and is undeniably a key pillar of cloud computing, but the cloud offers so much more when it comes to producing live broadcasts.

**WOW AUDIENCES WITH BETTER QUALITY CONTENT, WITHOUT AN EXTORTIONATE COST**

All the cloud benefits in the world won’t matter much if your audiences are losing interest in your content. One of the key driving factors for choosing software-based live production tools is that they help broadcasters produce better quality content that wows audiences wherever they are, on whatever device they want to watch.

Putting live production tools in the cloud makes remote collaboration far easier too, ensuring broadcasters can use the best team for the job, not just the most local team. This can help attract and retain the best permanent and freelance staff, regardless of location in the country – or the world – empowering users to create the best productions possible.

Furthermore, by adopting the opex cost model that cloud- and software-based solutions provide, broadcasters enjoy more cost-effective access to enterprise-grade software such as 4K switching, studio automation, sports analysis, and cutting-edge graphics; often these are seen as out of reach for smaller broadcasters when faced with large upfront capital investments.

**SUSTAINABILITY AND REDUCED CLIMATE IMPACT**

Sustainability is also a critical component for broadcasters as we move further into 2022 and beyond. Climate-conscious producers are looking to reduce carbon footprints where possible, and many are turning to cloud-based productions to easily achieve this.

With the goal of becoming net zero carbon by 2030, and as a sponsor of the COP26 climate change event, Sky News wanted to lead by example and create the most sustainable production yet. They opted to produce the 12-day coverage of the COP26 event using cloud-based live production tools. This meant that not only could they remotely produce from the main HQ in London, despite the action happening in Glasgow, but they could also reduce the CO2 footprint by over 90 per cent.

Speaking at the AWS Media & Entertainment Symposium at the end of 2021, David Travis, group director of content, broadcast and platforms, explained how Sky News’ cloud-based broadcasts produce just 10kgs of CO2 per nine hours of programming, versus 119kgs for traditional broadcasts; and this comparison doesn’t even account for the additional CO2 produced by the need to leave traditional on-premises hardware running 24/7.

**MORE MANAGEABLE TECHNOLOGY COSTS, AND IMPROVED IT RESILIENCE, TCO, AND STAFF PRODUCTIVITY**

Technology is a high and unavoidable expense for broadcasters and media companies. Ask IT pros whether ‘the cloud’ is a more affordable option over traditional hardware and you’ll have a potentially intense debate on your hands.

Working out TCO of on-prem versus cloud hardware set-ups is undeniably difficult as they aren’t like-for-like comparisons. But while each business will have differences in how they calculate TCO of IT systems, it’s hard to ignore the 61 per cent TCO savings made by Discovery, Inc when it moved its playout infrastructure to AWS. Additionally, two independent and in-depth studies of 1,500 AWS customers found an average 42 per cent reduction in IT cost-per-user.
Only cloud-based live production set-ups allow organisations to spin up new production abilities whenever they are needed and turn it off again when it's not. As a result, cost efficiencies improve, and you avoid having to leave hardware running 24/7. Therefore, you save running costs and reduce carbon footprint simultaneously! These capabilities just aren't possible with a traditional hardware set-up.

The benefits don't stop there, though. By reducing or eliminating tasks that are no longer needed, IT teams have additional capacity to focus on higher business value projects. Not only does this represent tangible ‘man-hour’ savings, but more importantly provides an exponentially valuable reduction in total IT cycle time, with some enterprises revealing a 50 per cent reduction in tactical IT tasks leading to ten-times the number of projects supported.

With clear monetary and productivity savings by switching to the cloud, broadcasters can repurpose that time and money into innovation projects, helping to maintain a competitive edge.

**DECREASE TIME-TO-MARKET**

Cloud-based live production environments can be spun up in minutes. Compare this to the weeks or months it can take for a traditional set-up and the appeal is obvious. Creating new channels for core or peripheral on-demand programming becomes so much simpler, allowing you to focus on keeping audiences informed and engaged instead of the IT side of things. Want a real-world example of the difference the cloud can make to channel deployment times for a national broadcaster? Kevin McCue, director of group production platforms at Sky recently explained how they reduced their time-to-market from six months for traditional channel deployment to just three to four weeks for the COP26 cloud-based programming.

**THE FLEXIBILITY TO EXPERIMENT WITHOUT CONSEQUENCE**

In traditional broadcast technology stacks, you only get one shot to get it right, and any form of failure can come with some monumental consequences. However, with software-based production tools and the flexibility and scalability of cloud computing, you can test new things. If all fails, it fails quickly and cheaply. It isn't the be-all-and-end-all, simply change it up, and test it again.

Cloud as a platform enables broadcasters to easily see what works and what doesn't until it meets their exact needs. The ATP Tour project is an example of trial and error until success. Orchestrated by ATP Media, the broadcast, and media arm of the ATP Tour, along with Gravity Media and AWS, the project covered seven tennis matches a day over the first four days of the Rolex Paris Masters (an ATP Masters 1000 event).

Bringing an NDI-native Vizrt Live Production Solution to the table, Vizrt collaborated with other software vendors in an AWS cloud environment to give ATP Media a unique opportunity to test various cloud-based live production tools.

The Vizrt technology also gave ATP Media the ability to understand how multiple vendors could work together to provide the best solution. The success of this project, which began as a trial, was entirely reliant on the cloud and the benefits it provides.

“To have the time to be able to experiment with combinations of vendors interoperating with each other and to understand the benefits and limitations of the single vendor solutions is so invaluable as we look to create our roadmap to this exciting future and all the benefits it can bring,” said ATP Media CTO, Shane Warden.

**THE FUTURE OF CLOUD-BASED BROADCASTING**

Better quality content, vastly improved sustainability, notable cost savings, decreased time-to-market, improved productivity and efficiency, higher operational resilience, increased agility, and the ability to test, fail quickly, and test again; it's no wonder broadcasters have their heads in the cloud.

However, based on the myriad benefits and advantages discussed in this article, it's clear that cloud-based production isn't just the future; it's now. Are you ready?
SHINING A LIGHT ON VIRTUAL PRODUCTION

Jenny Priestley finds out how light fields could be a way into virtual production for traditional broadcasters who aren’t ready to invest in major LED stages

Over the last few years, virtual production has been one of the most talked about new technologies in the media and entertainment industry. From The Batman to The Mandalorian, virtual production is finding its way into a number of high-end production workflows. But could the technology ever be used on dramas or soap operas produced by traditional broadcasters?

The team at BBC Research and Development (R&D) have been looking into just that, developing a system to capture, edit and render single-camera light field backgrounds that could be used in virtual TV production.

They created a 360-degree rig that was deployed on the set of EastEnders to capture a 30-second complete revolution, recording exposure-locked video at 60 frames per second, which resulted in a dataset containing 1,800 frames, or five frames per degree.

While the idea of virtual production is still in its infancy for many content creators, BBC R&D first began exploring it in the late 1990s, winning an RTS Innovation Award for its work looking at camera tracking systems used in virtual studios. “That really led the way for the use of virtual production in TV production and was used by Peter Snow on the election night programmes back in 1997,” explains Graham Thomas, head of applied research production at BBC R&D.

“We’ve been working on virtual production on and off for some time. Some of the work we did moved out of studio-based virtual production, and we started doing work on virtual analysis and virtual graphics for sport. That led to the Piero sports graphics system (the little circles under players when the analysts are discussing a game), which is now used by the BBC on Match of the Day. That’s been sold to broadcasters around the world, so we have quite a lot of experience in mixing virtual reality graphics and broadcast TV.”

The hope back in 1997 was that the vast majority of TV production could happen in front of a green screen, says Thomas, making the days of sets wobbling when someone slammed a door a thing of the past. The idea was that creatives could walk into a studio with their set on a floppy disc (this was the late ‘90s). The BBC R&D team would use a Silicon Graphics Onyx Supercomputer, which was “the size of a very large freezer and probably had the same rendering power as you’d have on a mobile phone. It turned out to be an awful lot cheaper in terms of both the skill sets of the people available and understanding, just to carry on making sets out of cardboard and paper and wood,” he continues. “Coupled with little things like it being very difficult to sit on a virtual chair without falling through it or to slam a virtual door.

“Virtual production tended to be used, at least on the broadcast side, for programmes where there were elements that you couldn’t easily realise physically; so for very large video walls, views out across Tokyo for the Olympics, things like that. It certainly found its niche, and there’s been a history of virtual production in constant use since the late ‘90s.”

LIGHT FIELDS VS 3D MODELS

Producing 3D content often requires high-spec models of the scene you’re trying to recreate, involving highly trained modellers and animators who will spend time taking photos or creating manual models. “That can be quite expensive just in terms of the hours that are spent, but also will only ever give you the equivalent of a painting of an area,” says Thomas. “If you’re working on an immersive experience, where you might want the...
The kind of experience we were thinking of was really aimed at people wearing a headset, but sitting in a seat so that you can move your body by something like plus or minus half a metre maybe. We weren't necessarily thinking of something that you could walk all the way around. We weren't trying to compete with creating huge game worlds, but something that was visually realistic and would work for somebody with a headset. That was really the starting point.

Previous projects of this kind had involved multiple cameras, but this time the BBC R&D team decided to use just one. "I have some wonderful examples of arrays of cameras on long sticks that we took around to different locations to try to capture things," smiles Thomas. "Multiple cameras are bulky, and expensive, and they throw up lots of problems, like having to match the brightness and contrast and colour rendition between the cameras. You also create a huge amount of data if you've got five cameras running rather than one. So the challenge we really set ourselves was 'how simple can we make this? What's the smallest number of cameras you could capture content with? One. Okay, what can we do with that?' And particularly if you're thinking of capturing a static environment that you think you're then going to animate later on and add foreground objects or interactive features, you can probably get away with one camera that you move rather than multiple cameras that stay fixed. That was really our starting point," he adds.

To begin with, the team used a GoPro camera mounted on an upturned waste paper bin, with a small motor, a length of tube from the nearest builder's merchant and lots of gaffer tape. The camera rotated slowly and captured a field of view well enough to warrant further investigation. "We wanted to find out what would happen if you had a much larger field of view and an obvious extension of a camera with a large field of view would be a 360-degree camera," explains Thomas. "You don't have to use all the images that it captures. In fact, what we ended up doing was using just the top forward, down, and side views, we didn't use the rear view."

The kit was also upgraded from the upturned wastepaper basket to a motorised boom arm that would rotate the camera at a consistent speed. "The arm did actually have a bit of wobble on it and we spent some time trying to take the wobble out or correct it afterwards," Thomas continues. "Another nice feature of using this approach for capturing environments is that you're capturing just one stream of video. That's something that broadcast production teams are well used to handling, so anything like colour correction, or painting an object out or anything that you would do to a normal video stream you could do to this, you don't need any special editing tools. The beauty of our approach was that what you got was one video file, and you could then do any kind of post production on it that you wanted to do. It was, if you like, bridging the gap between trying to do 3D light field capture, but in a form that matches the post production pipeline that people might be more familiar with."
**FEATURE**

Key to the light field project has been Alia Sheikh, senior development producer at BBC R&D, who brings a content creator perspective to the project having also trained as a film and TV director. “I realised there were a lot of things that we worked on at R&D that could be used to make TV and film but probably shouldn’t be on version 0.01 of the prototype,” she says. “So I ended up doing a lot of the department’s experimental filming. I’ve been working for Graham for about five years or so on immersive and interactive content, including 360 video, virtual reality, and this project on light fields. Where that gets interesting for me is not just the technical aspect of, ‘Can we use this technology to make the story?’, because generally you can, but it’s what kind of story can you tell?”

The team wanted to use a set with real depth and it helped that the BBC has one on hand: EastEnders. “It was absolutely surreal to have grown up watching EastEnders, and then getting to walk around it,” says Sheikh. “The set has so much depth to it, and that’s why we wanted to film a light field there, because it’s such an iconic BBC property and it’s a perfect set for light field; it’s all around and up and down. Everywhere you look it’s a really immersive set.

“We got in touch with them and it was a revelation to me actually, because EastEnders is so busy, they produce so much TV of such quality on this completely gruelling schedule. Their response was that the project sounded quite interesting. At the time they were celebrating their 30th anniversary and they were interested in doing slightly experimental things.”

The two sides then discussed when the Elstree set would be clear for the R&D team to film without catching the cast and crew in the shot. “When we’re doing a rotation pass we don’t want anything in the background,” explains Sheikh. “We actually shot both inside and outside because we wanted the challenge with the outside shot where things will change, like the clouds moving, or the trees swaying. We wanted to capture what I call a ‘breathing loop’. You essentially loop any repetitive motion that appears in the capture. Not only does that deal with the window causing things to move, but it makes the scene even more 3D and gives it life.

“In all my years of doing non-360 filming the question of where do you hide the crew has never come up,” she laughs. “Luckily we could just hide inside the Queen Vic. It’s very tense because you set the whole thing running and then you leg-it inside the Queen Vic while it does a pass, and you’re very anxious to watch it back later and see whether or not it worked.”

**WATCH OUR FOR REFLECTIONS**

While ensuring everyone was out of shot for the outside filming, when things moved inside it wasn’t quite so straightforward. When the team decided to shoot inside EastEnders’ corner shop they placed the camera in front of the check-out desk with the door left slightly open so the camera could see out into the famous Bridge Street Market. “It’s so interesting because it takes all of the things that a camera normally sees and puts it into 360 space,” says Sheikh, “but then it also takes all of the problems that you have to work around and puts them into a 360 space.

“On a normal day, the EastEnders crew will be caring about making sure you never see a camera operator in shot. But with a 360 circle you have to check whether the camera is visible in a fridge door that might normally not even be in shot. You’ve got to hide the camera from everything in all directions. Even camera shadows will be picked up. There are all these considerations.”

Other challenges faced by the team included handling such a large quantity of video material on a standard graphics card. “We wanted to give the viewer the real feeling of being able to move their head freely and to have a high resolution view of the scene,” explains Thomas. “We started with the premise that graphics cards and memory are getting so cheap that it’ll be really easy to store masses of data on a GPU and it won’t be a challenge. But we actually found that even with the very latest graphics cards, we still had to reduce the amount of data that we had. So maybe we’re still slightly too far ahead of the time when using masses of images to represent an area is practical. But I expect the rest of the world will catch up with us at some point.”

So, is there a day soon when this technology could actually be used by the EastEnders crew? “Well, for EastEnders itself I couldn’t possibly comment. I have no knowledge of what their plans are,” says Thomas. “We have thought about using backgrounds captured like this for virtual production, because obviously if you’ve captured the view of a scene from a range of positions you could drive that off a camera tracking system in a virtual set.

“One thought was that everywhere a BBC production team goes, they just take one of these cameras and they capture it and you build a massive library of places that are available to use. You can reposition the camera slightly or move it around because you’ve not just got a still, you’ve got a complete 360 image from a range of positions. I think in terms of the technology and particularly the amount of data these things use, I wouldn’t be at all surprised if people weren’t already trying to use light field captured material in the context of a virtual set. The two are obvious things that you could put together. It’s certainly something that we thought about and may well be thinking about more in the future.”

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Alia Sheikh and Florian Schweiger set up a 360 camera for a capture rotation on a custom motorised rig

Checking exposure: Paul Golds and Florian Schweiger set up the 360 camera
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REACH FOR THE STARS

Jenny Priestley meets the entrepreneurs who want to make TV and films in space

Is space the next frontier for TV and film production? Well, that’s the belief of film producer Andrea Iervolino and MMA legend and producer John Lewis, who are joining forces to pioneer outer space entertainment.

Their company, Space 11 Corp, plans to construct and launch a specialised free-flying space station to service film and TV projects in the same way a soundstage works on Earth.

The idea is to launch Space 11 Studio: a film and television studio focused on high-concept science fiction films and television formats shot in space, involving zero-gravity; and Space 11 City: a film production facility designed in detail to accommodate high-end film and television productions.

The company has also created MMA-ZERO G; a mixed martial arts league where fights will take place in parabolic flight and zero-gravity outer space. It is already working on reality TV series Galactic Combat, which will be the first TV series to shoot in Space 11. The show follows MMA fighters through a 12-episode competition for the opportunity to be the first to fight beyond Earth’s borders.

“We wanted to innovate an entertainment format and so we thought, ‘what about MMA in Zero G?’” explains Iervolino. “I met John, who is a pioneer in MMA, and we thought, ‘why not take advantage of Zero G to change existing sport and entertainment formats?’”

Lewis adds he was intrigued when Iervolino first approached him with the idea. “I’ve been approached by a multitude of different kinds of MMA organisations, but I hadn’t seen a reason to get involved in anything,” he explains. “When Andrea told me about his idea, I was like, ‘Oh my God, this is the one, it’s the next step above’. It was easy for me to say yes. This is like the UFC on steroids and it was just a match made in heaven.”

The idea is that the initial fights will take place during Zero Gravity parabolic flights. Iervolino admits the concept sounds complicated, but he believes technologically it will still be easier to build in space than creating a bespoke studio on Earth from scratch. “We imagine the studio in space will be where we’ll hold the live MMA fights one day,” he explains. “We also want to use the space to shoot other formats, maybe part of a movie will be shot there, or even a full movie. There are many other formats that we think can utilise the space.”

Asked how easy it will be to beam back pictures and sound from space for a live event, Iervolino argues it’s already been done. “When Jeff Bezos went into space that was all broadcast live, the same with Richard Branson. The point is that the technology is already there, it’s not something that is impossible. Now, I have to say of course there were technical problems with the live broadcast and it wasn’t quite the standard we would expect to see, but in the next few years that will get better and better.”

“New services like Starlink and things of that nature will change a lot of those issues,” agrees Lewis.

The pair hope to have their studio in operation by 2028, but admit working in space means things can change very quickly. “We are working towards that goal every day,” states Iervolino, “because this is the main mission of our company. We are not a technology, real estate, or hardware components company, we don’t do that. We are just the entertainment part of the project. So this means we are really dependent on our partners’ technology.”

“We have an agreement with Nanoracks, an in-space services company, and Voyager Space,” adds Lewis. “They were one of the three companies that were awarded money from NASA to build space stations. We’re working in partnership with them to develop our project together for the space station, which is called the S11S.”
Space 11 Corp is now looking for partners as it looks to develop the technology to actually broadcast the fights back to Earth. “We are in discussion with a few companies, but we don’t have any official agreements in place,” explains Iervolino. “A big component of our investment will go into research and development to help us understand how to make things happen, because we are trying to do something that nobody has done before and we want to work with the best people in the industry.”

So, how is this being funded? Currently the money is coming from Iervolino and his partners, but he doesn’t rule out opening equity to investors in the future. “I haven’t met anyone yet who’s said ‘this guy is crazy!’” he laughs. “We believe that the technology is there. We just need to bring our own innovation to adapt the coming technology for our needs.

“When I first started in the industry at the age of 17 I believed that digital was the future and at that time, at least in Europe, not many people were using it. People were telling me ‘I’m never going to shoot a move digitally,’ and now nearly all movies are shot digitally.

“So, I believe what we’re suggesting now will become the norm, eventually everyone will be doing it. But we’re the first two crazy guys who are going to try it,” states Iervolino.

“This industry is pioneered by people with big dreams,” adds Lewis. “They are the people who push the boundaries forward. What we’re finding is that the people we talk to look at us like ‘all right, it’s a new idea’ and they embrace it.

“There’s two sides to it, having dreams, and then having the ability to pull it off, whether it’s financially or whether it’s your business acumen,” he continues. “A lot of guys have a great dream, but they don’t have the ability financially to pull it off. We have the complete package. We have the dream that makes sense and we can explain how it makes sense. And, we have the ability to pull it off.”

“I believe what we’re suggesting now will become the norm. We’re the first two crazy guys who are going to try it.”

ANDREA IERVOLINO
Remote production is truly flourishing as a method to produce premium live content. Before Covid-19, remote set-ups were already gaining momentum, but the pandemic accelerated this trend. Major events like the 2022 Winter Olympic Games opted to employ remote production, with 1,000 crew members and nearly all on-air talent located in NBC’s Stamford site to capture and package this year’s event. This approach contrasts with that of the 2008 Winter Games when just 250 personnel worked remotely.

When we talk about remote production, what does that mean? What are some of the specific configurations of a remote environment? The answers can depend on where the crew is. It is well known that traditional remote productions have a central hub that includes switchers, replay, highlights, and the final content packaging handled away from the venue while the cameras and operators are located on-site.

In the last year, the more widespread use of cloud-based tools has meant that some remote productions can have team members spread across several locations – even across the globe – with each controlling part of the content workflow. There could be crew handling remote replays and highlights in France, vision mixers in New York, and shaders in the UK. These spread-out configurations are now commonly referred to as ‘distributed productions’.

In distributed productions, teams, or even individuals, manage specific tasks to get the final premium live content onto viewers’ screens. A critical but technically and operationally challenging component of these productions is remote commentary.

**SPORTS COMMENTATORS BRING THE DRAMA**
Detailed and insightful commentary is the backbone of all sports productions, from tier 1 to lower tier and niche sports. Sports commentators have a vital role in describing what is happening while also increasing viewers’ excitement and drama. Like other aspects of live production, commentary can increasingly be handled remotely.

The inherently flexible nature of remote commentary has led to more engaging and tailored live content. Today, commentators can join live broadcasts from anywhere in the world using just a laptop and a microphone. As a result, media companies are tapping into the best local commentary talent to provide more relevant regional insights and a better appreciation of local nuances.

The result is production staff are more empowered to create localised and native language content for regional audiences. Regionalisation of content is critical for media companies today, as it allows them to push the most relevant branding, related regional assets, distinct advertisements, and bespoke commentary to each local audience.

Remote commentary also empowers media companies to invest resources and effort into localised media experiences by reducing the need for production staff and their equipment to be on location; thus driving down overall costs through reduced travel, accommodation and transport expenses.

**REMOTE COMMENTARY IN ACTION**
Like any element of remote production, localised commentary does present some significant challenges, not least of which is latency. Reliance on broadband can lead to intermittent delays to commentary feeds, especially if the media company is delivering multiple audio streams to different audiences over one live video stream. This a challenge that Grass Valley has found a unique solution to.

The unofficial industry standard for latency that avoids disrupted live coverage is a 250ms delay between the video capture, playback, and the commentator receiving it. Where live productions have failed to meet this standard, Grass Valley’s cloud-based AMPP (Agile Media Processing Platform) has enabled production teams to overcome this hurdle.

AMPP is unique in its ability to afford users the full spectrum of a production workflow, from pulling in the live feeds for asset management through to playout. Crucially for remote commentary, AMPP timestamps everything automatically, which makes syncing up the different video, audio and commentary feeds a seamless process.

AMPP is used daily to provide cloud-native production capabilities for customers around the world. It sits at the heart of workflows that might need to handle as many as 60 content versions, and therefore 60 remote commentaries, for sporting events such as ice skating, football, car racing and more.

**A LIVE AND IN-SYNC FUTURE**
There was a critical need for remote commentary over the last two years, offering production innovators the opportunity to prove its viability and value. Moving forward, the broader benefits are clear. Media companies are better able to target content, provide richer local media experiences, and maximise yield per asset.
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ENGAGE YOUR AUDIENCE ANYWHERE
In an exclusive interview, Philip Stevens finds out more about the latest channel to join the news and debate genre.

Launching on the evening of Monday 25th April, TalkTV will offer a mix of programming, including hourly and half-hourly news bulletins, sports and entertainment bulletins, as well as current affairs, debate and opinion shows hosted by some of the biggest names in media, including Piers Morgan and Sharon Osbourne.

Being part of the News UK organisation – the multimedia business behind The Sun, The Times and Sunday Times and national radio brands including talkSPORT, Virgin Radio and Times Radio – TalkTV will be broadcast both from state-of-the-art studios at The News Building at London Bridge and other facilities at the Timeline Television production centre at Ealing, West London. It will be available live or on-demand, on linear and connected TV and on any personal device.

“In reality, everyone in the UK will have access to this innovative new channel,” explains Erron Gordon, executive creative director and head of studio output.

Gordon comes to the position following 13 years at ITV where he launched and was series director for Good Morning Britain and where he launched the highly regarded live politics show, Peston. He joins other recent
recruits including Kate McCann moving from Sky News to become the station’s new political editor, and leading TV production talent including Vivek Sharma (latterly running Steph’s Packed Lunch on Channel 4) as executive producer of TV broadcasting and Oliver Gardner as deputy head of studio output. Ben Briscoe moved from Good Morning Britain to join as series editor for Piers Morgan’s new global show, and he reports into executive editor of Piers Morgan Uncensored, Winnie Dunbar Nelson, a senior TV executive who has spent more than a decade working with Morgan in the UK and US.

Earlier in the year Scott Taunton, who ran News UK’s radio and audio arm from November 2016 following its acquisition by News UK, had his remit expanded beyond radio and audio to include video and TV as EVP, president of broadcast at News UK. He is leading the TalkTV launch.

BEING CREATIVE
Gordon continues, “I was reassured very early on by senior executives at News UK that they wanted to create top quality programme output. The nice thing is that as well as doing the creative and managerial side of the operation, I’m also going to be in the hot seat and directing Piers Morgan Uncensored which will also air on FOX Nation in the US and Sky News Australia. Live directing is really something I love, despite the stress of the situation. I believe it has to be in your DNA so that you can carry on doing it.”

He adds, “I was thinking to myself the other day of the stressful time it can be as you’re launching something new with a new team and working long hours, but in the end, it is hugely rewarding. I have launched a few shows, but bringing a new channel to air is different; takes it to another level.”

As well as the Piers Morgan show, TalkTV’s primetime schedule will include Tom Newton Dunn’s major weeknight news and current affairs programme. The hour-long show will give viewers the news that matters to them in a straight and balanced way. News UK’s specialist journalists from print and broadcast will join Newton Dunn every night to share the very latest in their fields.

The legendary Sharon Osbourne has also signed up to front a major new current affairs primetime panel show: The Talk. Airing weeknights on TalkTV, the programme will bring together five opinionated famous faces – all
from different backgrounds and with differing views – to debate the most interesting stories of the day.

**PRODUCTION CENTRES**

So, just what is the set-up at TalkTV? Gordon has the resources of four studios at his disposal. Three are located at the London Bridge headquarters of News UK, the fourth at Timeline Television.

“During the day, the majority of the output will be visualised radio which will originate from the existing talkRADIO studio which uses a MultiCAM automation system. However, production of the regular news bulletins and sports news will be handled by a director who will self-vision mix.”

He adds, “During the daytime we’ll be broadcasting something that has its origins in radio: talkRADIO, which has been growing its audience across YouTube and connected TV for some time. While that output is simulcast on radio, it is something that is very polished for TV and the talkRADIO team under programme director Dennie Morris has been doing an incredible job. We will continue to do that, but with a few more bells and whistles on TalkTV.

“However, when we come to the primetime schedule, we are very clear that we’re going to be making new and original programmes that are designed from scratch to be peerless TV shows. After all, we will be in competition for eyeballs across the primetime schedule.”

The other two studios at News UK’s London Bridge HQ are set up for virtual production and are equipped with Sony HD cameras mounted on Quattro S heads. All are manually operated. Vision mixing is under the control of Grass Valley Kahuna units which have recently been upgraded to meet the new demands of the channel. The London Bridge operation uses Avid iNews as its newsroom system. There are no plans to link this with any vision switching automation.

**MAJOR PRODUCTIONS**

The studio at Ealing which will be used for Piers Morgan Uncensored is also equipped with Sony cameras. Four are pedestal mounted, one is positioned on a jib and there is a radio Steadicam. Gordon says that a seventh source can be added, if required. Autoscript prompters are attached to the cameras.

“In the gallery there is a Grass Valley Kahuna vision switcher. Unlike the London Bridge studio, this gallery will be fully staffed, so the director can call upon the services of a vision mixer. There is a place for automation in the broadcast chain, but we didn’t feel it appropriate for these top flight programmes. We have employed three vision mixers. Timeline made some modifications to the switcher to suit our specific needs.”

Audio mixing is handled by a Calrec Artemis console. “This is very familiar to most sound engineers and is an obvious choice for our needs,” states Gordon. Communications both at Ealing and London Bridge are controlled by Riedel equipment.

When it comes to graphics, a Chyron system is in place for the key programmes. “The London Bridge studios had been using Brainstorm for lower thirds, but our needs at Ealing are different. Chyron will be used for both on-screen graphics and for the walls.

“In terms of set design, we enlisted one of the world’s leading set designers, Jim Fenhagen,” explains Gordon. “He is a multi-award-winning designer who has incorporated a great many LED products into the sets. Obviously, we looked at the very latest virtual and augmented reality systems and opted for Brainstorm as the supplier of that equipment. I have seen the system in use at other locations and am very confident that it will more than meet our requirements. Mo-Sys is used for camera tracking technology.” Lighting rigs at all studios are provided by ATC.

**MULTIPLE RESOURCES**

Beyond the studio, TalkTV calls on the expertise of journalists and broadcasters from across News UK’s plethora of brands, which between them reach almost 40 million UK consumers every month.

“That’s one of our major selling points. We can tap into any of our sister brands, from The Times to The Sun, who already have people on the ground in places like, for example, Ukraine,” states Gordon.

He goes on, “Unlike some other broadcasters, our journalists will not, in general, self-shoot. Because we are not a news-only operation, there is no need for that kind of set-up.

“We have a crew of shooters who will take care of any location material that is needed. And like so many others, we will make use of the impressive kit from LiveU. And beyond that, of course, there are stringers across the country that can be used as and when we require their services.”

That material will then be edited using Avid. “Our senior producers know how to use desktop editing, but they will generally rough cut the material before passing it on to one of the eight craft editors we have on board. We intend to transmit only the very best content and that means producing to the highest standard.”

Gordon concludes, “At TalkTV we will be covering the big stories of the day and beyond, stories that matter to our audience. I have been given the resources and the talented staff that is needed to make TalkTV the very best. We are planning to make it the most talked about television, for all the best reasons.”
linear playout systems have been around for a long time and have developed over the years from automation control of discrete hardware devices to software-based solutions that replicate the functionality of older hardware products. We are now seeing a new generation of playout that can be hosted in public clouds with solutions available from both new entrants into this market and also from older more established broadcast technology companies. This article looks at how a playout system can leverage the advantages offered by the cloud and discusses both the benefits and the challenges.

**BENEFITS OF A CLOUD NATIVE ARCHITECTURE**

To get the maximum advantage of hosting in the cloud, the solution has to be cloud native. An older product designed as a real-time system for on-premises dedicated hardware might run in the cloud, but it won’t utilise the full power of the cloud. Furthermore it will be inefficient in resource usage and expensive to operate. A modern cloud-native product would be designed using microservices, containers, and orchestration. Rather than one large monolithic application, there is a large number of smaller services that run in containers and are deployed and orchestrated by an orchestration layer, such as Kubernetes. The advantage is that you get the resilience and elasticity that the orchestration provides. For example, Kubernetes will automatically detect and restart failed containers allowing services to recover from failures very quickly. Cloud platforms can also detect failures at the hardware and OS level, automatically replacing failed hosts while Kubernetes reschedules the services to healthy hosts, minimising service disruption. Advanced monitoring tools are used to notify engineers when these failures happen so they can investigate and take appropriate action. There are other benefits too; software upgrades are much easier and less risky. Ask any experienced playout support engineer when they are most concerned about the reliability of their playout system and they will probably tell you it’s when an upgrade is in progress or shortly after. Using microservices has changed the way software releases are managed. Rather than one or two large releases per year, it is possible to release software incrementally, which greatly reduces the risk of carrying out upgrades, while customers receive the software sooner. It is now possible to upgrade only the services that are affected by any software changes made and most upgrades can be done whilst the software is running. It’s also possible to roll back easily if any issues are encountered with the new version.

The cloud also offers a number of services that make deployments easier. For example, AWS provides a relational database service (RDS) that runs on a resilient cluster to protect your data, so you don’t have to implement database replication like in the old days of on-premise solutions. You also get a seamless changeover if a host fails. Azure and Google have similar services too. There are many other services, for autoscaling, load balancing, hosting Kubernetes, and so on.

Remote accessibility is also worth mentioning. Using secure connections, it is possible to access systems from anywhere in the world.

**COMMERCIAL BENEFITS OF THE CLOUD**

Running playout in the cloud offers many potential cost savings. For a start you don’t need to invest in expensive on-premise hardware or budget for the maintenance that goes with it. You also don’t need the equipment rooms, the air-conditioning, lighting and the personnel to manage all the infrastructure. Instead, the software is spun up in the cloud and configured to meet the needs of the channel. This includes setting up the bit rates, frame rates, formats, graphics, subtitling, I/O and so on.

It is very easy to launch new channels. Some systems can actually deploy new channels in minutes. Compare that to several weeks, if not months of planning, rack layouts, wiring, commissioning and so on as it used to be done with older on-premise systems. It’s also just as easy to decommission channels when they are no longer required. This means you only have to pay for infrastructure that you use and not what you don’t use. This greatly reduces the risk when launching new channels.

Some vendors offer both pay-as-you-go (PAYG) pricing and perpetual licensing to provide the optimum cost saving. Customers can choose the best licensing model for each channel; PAYG for channels which may have a short life or perpetual licensing for those channels that are expected to be more permanent.

However, established broadcasters may have long building leases and are already committed to space and on-premise equipment for several years. So when a cost comparison is done, it doesn’t always stack up if you fail to factor in all the space savings and associated costs. That is one of the reasons why coralbay.tv has designed its products to operate both on premises and in the cloud. In fact, hybrid solutions are also possible, where some channels can be hosted in the cloud and others on premises, all with the same user interface and workflows. Edge solutions are also possible and can offer savings in distribution costs.

**RESILIENCE**

Although the cloud offers many benefits, you still need a well-architected product to provide the feature range and the high reliability expected.
by today’s broadcasters. A good product will be architected to provide additional resilience over and above what the orchestration provides. All mission critical components, such as the database, message bus, core automation services and video pipelines need to be replicated for redundancy. The outputs from the video pipelines can be fed to a downstream product, which monitors the output of the main and back-up pipeline and can switch automatically if one was to fail. For added resilience it is also possible to deploy the system across multiple availability zones, so if one cloud zone was to fail, playout would continue from the other zone. And for those that want even greater resilience, it is also possible to go one step further and deploy systems across multiple regions.

One interesting feature that coralbay.tv developed for a particular customer was the ability to play channels in advance from spare video pipelines by a pre-configured period of time and for these outputs to be fed to the input of delay servers located on premises, which are configured to delay by exactly the same period. The output of the delay servers are therefore in sync with the main outputs and provide protection against failure of the main system hosted in the cloud, or a complete cloud failure. In the event of a main system failure, the delay server running on premises can then be controlled independently until the fault in the cloud is resolved. This mode of operation can provide some broadcasters extra reassurance; however, this feature can only be used for pre-recorded channels and not for channels with live programming.

OVERCOMING CLOUD CHALLENGES

One important factor when working in the cloud is coping with resources being taken away for a period of time. When running on premises on dedicated hardware you can be sure that the resources are permanently available and if you want to do an upgrade to the infrastructure you can decide when and how to do it. In the cloud, however, things aren’t as simple. For example, you have to be very mindful that cloud service providers expect to run the latest orchestration versions so you need to keep up to date, otherwise an upgrade will be done automatically and this could have drastic consequences for a playout system. In addition, cloud service providers, such as AWS and Azure, will perform upgrades to services and the system has to cope with that. Databases and networks may disappear or be degraded for a few seconds or even minutes whilst the upgrades are in progress. So how does a playout system cope with that? coralPlay has been designed to continue running during the loss of resources, through the use of local caches and built in autonomy within all critical components. For example, the video pipeline replicates in software all the functionality of traditional hardware products, and provides video server, master control switcher, DVE, graphics, subtitling, scaling, SCTE triggering and many other functions. Using a local cache, pipelines can continue to run independently if communications to other critical components are temporarily lost. Multiple pipelines can also be run in parallel.

Ensuring reliable signal delivery is also a challenge in the cloud. On-premise solutions use protocols such as UDP but these cannot be relied on when working in the cloud. To ensure a transport stream gets from one place to another reliably, you need to use an automatic request repeat (ARQ) protocol, such as Zixi, SRT or RIST.

FLEXIBILITY IN HOSTING

Even in today’s modern age, not everybody wants to run their playout in a public cloud. Some products can be hosted anywhere; in a public cloud, on virtual machines or on bare metal servers. The flexibility in hosting gives customer choice, portability and ‘future proofness’. For example, customers could choose one cloud service provider today and move to another in future if a better price or service is offered.

LIVE EVENTS

In traditional SDI on-premise playout systems, handling live inputs is quite straightforward. An automation system only needs to control a router or master control switcher and switch to a live source when a live event is scheduled. These events typically have undefined durations as it is impossible to predict exactly when a live event will end. Commercials or
other events can be played during the live event and when it ends the operator presses the ‘next’ button and the playlist moves on to play the next video event in the schedule. There are no delays to be concerned about and the operator can view the output in real time and make decisions on when to move on in the schedule easily. In the cloud, things are different. The inputs and outputs are normally compressed transport streams and there are encoding delays. Switching isn’t that easy either; you can’t just switch instantly to a new IP address and make a frame accurate transition between transport streams. So, how then can live events be handled reliably in the cloud?

Any serious playout system needs to be able to switch between multiple sources as there is often a need to switch from one live feed to another. To handle multiple inputs in the cloud, it is possible to decode multiple sources at the same time and the video sources for these to be fed to the input of the video pipeline’s internal software router. If a switch from one live source to another is required, the video source(s) is already decoded and a frame accurate switch can then be made.

To make life easier for the operator, the live input feeds (as well as the channel output) can be monitored. Rather than make the decision on when to switch out of a live event by monitoring the delayed output, it is possible to view the input and make the decision based on that. Then, the output encoding delay is not a significant factor.

To reduce delays and make things even easier, low latency monitoring can be used, such as webRTC. And for those wanting high-quality video with minimal delays, formats such as JPEX-XS, NDI or 2110 can be used, although 2110 could be prohibitively expensive in the cloud. AWS’s CDI is a more realistic alternative. But there is more to managing live events. It is also a requirement to be able to manually control proceedings during a live event. This could be to trigger commercial breaks or it may be to control a logo or other graphic manually. coralPlay enables users to set up and control these functions using manual control panels in the UI. So, during a live event, such as a cricket match, it is easy to bring up a graphic manually or to play a commercial.

**MEDIA AND WORKFLOW MANAGEMENT**

Every playout system needs a certain amount of media management, whether it is hosted in the cloud or on premises. There is a need to store metadata about the assets and to provide users with a UI to enable them to search for media easily, for example to replace an item in a schedule or to insert a new event. Some products also generate thumbnails to enable users to easily identify the media they are searching for.

Workflow engines handle non real time tasks ahead of playout time, such as media discovery, quality checks, media imports, moves to deep storage, automated retrieval of media ahead of playout time and copying to the pipeline hosts, deletion of assets no longer needed, schedule import and upload, automatic [Adobe] After Effects pre-rendering and a variety of other tasks. There are useful reports too, such as missing media reports, which can be filtered by channel and sorted by earliest on air time. ‘Deletable’ media reports can also be produced, which provide lists of items that are not scheduled in any playlist and are not ‘delete protected’.

**GRAPHICS**

Most playout products are able to play pngs, TGAs and TIFFs, which are often used for station logos. For more advanced graphics requirements coralbay.tv offers HTML5, where third-party graphics creation tools such as Adobe Animate, Google Web Designer or Singular.Live can be used. HTML5 enables complex graphics scenes that include DVEs, animations, dynamic text fields and so on to be played out easily. Rather than have a number of different elements in the playlist to define the various components, which is tedious and prone to error, it is possible to prepare complex scenes in a single HTML5 page. Picture in picture DVE effects, with animations, audio ducking and dynamic text updates from the playlist and from external sources are supported.

After effects pre-rendering is also possible. In this case the automation looks ahead in the playlist for graphics that need to be pre-rendered and sends the necessary elements to Adobe After Effects for pre-rendering. When the pre-render is complete a file is sent to the pipeline and used during playout later. One advantage of using pre-rendering is that since graphics are rendered in advance and not at run time, less CPU or GPU is needed on the pipeline host. Also, integration with Adobe After Effects makes it possible to pre-render complex 3D graphics.

Some vendors are also open to interfacing to third-party graphics products if that is what the customer wants, but unfortunately not all third-party products are cloud-ready.

**CLOUD INSTALLATIONS**

There are now several playout systems running in the cloud, many of which are hosted in AWS, Microsoft Azure or Google Cloud. Some installations are very large and the channels are varied, ranging from simple thematic channels which are mostly static, to more dynamic channels with live input feeds and local insertion of commercials and other programmes.

It has been proven that it is possible to play TV channels reliably from public clouds, such as AWS, Azure and Google, and that there are a number of benefits from hosting in the cloud if the system is cloud native. At this moment in time, there are many broadcasters that still prefer to run their playout on premises; however, in the future it is expected that more will transition to the cloud.

The challenge for playout vendors will be to keep up with the demand for new features to ensure that they meet the needs of all channel types. Older on-premise playout systems had the option of interfacing to third-party solutions if the feature could not easily be provided internally. When working in the cloud, there are few options available so most features have to be developed in house. ■
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Where Content Comes to Life
Launched in January, the Virtual Production Glossary aims to be a dynamic, industry-propelled effort that establishes common vocabulary across professionals working with the technology.

It has been created by the Visual Effects Society (VES), the American Society of Cinematographers (ASC), and a number of industry experts, with support from Epic Games and Netflix.

According to Noah Kadner, one of the contributors/co-curators of the Glossary, the original founders wanted to develop a central reference to help filmmakers understand the new processes and take full advantage of the opportunities. “We also hope to alleviate concerns and help producers realise the benefits of pivoting to virtual production via education and shared experiences,” he says. “In short, we aim to support the uptake of virtual production and address any misconceptions regarding its potential.”

This is a view shared by Caryn Ruby, an independent script supervisor who has been active on the Glossary’s website since launch. “Working on different sets with different crews all the time, it gets confusing when people use different terms for the same thing; especially for those of us that don’t have a technological background,” she states. “The more we all speak the same language, the more effectively we can work together.”

She adds, “In my job as the script supervisor, I interact with all the department heads and often need to answer questions related to various aspects of continuity. If it comes up that there is a question or a problem with a digital asset or something else tech-related, I need to be able to understand what the issue is and how it is being resolved in order to communicate with the other departments.

“If I can’t effectively communicate a concern to the director, DP or VFX supervisor, it can waste valuable time on set – and worst-case scenario, hamper my ability to catch continuity errors before we roll – which costs everyone time and the production money.”

The Glossary will be constantly updated as virtual production continues to evolve. The curators are looking for terms that are professionally used in virtual production or have historical significance for milestone projects. “To help prioritise new terms, we ask for citation examples of professional use wherever possible,” explains Kadner. “If we reject a term, it’s typically out of scope related to virtual production, or it may be a term where we feel the relevant guild or professional association would be more appropriate to define it. We also aim to keep our terms as concise as possible to avoid information overload and get people to a common point of comprehension as efficiently as possible.

“Filmmaking is a collaborative medium, and we want to reflect that in our openness to new ideas and concepts,” he adds. “We offer a variety of methods for interested individuals to submit new terms or suggest updates to existing ones. You can click on the submission link on any page on the website, or you can visit our Discord server and engage fellow interested parties to discuss possible new terms. Also, virtual production is evolving at an incredible rate. So new experiences are very relevant.”

The Glossary’s creators say they believe virtual production has unlimited potential, and all of the technological and workflow breakthroughs that have already been achieved will continue to accelerate more and more rapidly. “What might be impossible today will be standard practice tomorrow; that’s how quickly things evolve,” states Kadner. “Interest in the Virtual Production Glossary ranges from a vast cross-section of veterans who recognise its transformative potential to newcomers enthralled by the potential they envision. We want to support all of these perspectives with this initiative.

“Virtual production has already been in use for drama productions since almost the dawn of computer-generated imagery,” he continues. “It was used on projects like The Matrix, The Polar Express, Avatar, Gravity, Rogue One, The Mandalorian, and many more. We find it’s not so much a question of whether virtual production is in general use; it’s how many people are aware of it. The results are so well-integrated and magically invisible that people don’t realise the technique’s prevalence.”

The Virtual Production Glossary can be found at vpGLOSSARY.com

AN INSIGHT INTO VIRTUAL PRODUCTION

As virtual production becomes more prevalent in the media and entertainment industry, a group of experts have launched a database of common vocabulary.
Sports broadcasting has always been able to cover the action on location through specialised outside broadcast (OB) vehicles housing the necessary audio, vision and graphics equipment. Today, with the advent of remote production, that concept has been turned around the other way. Picture and audio mixing, plus graphic and caption insertion, is carried out at the main broadcast centre with signals sent from the location over communication links.

Two of the UK’s leading sports broadcasters, Sky Sports and BT Sport, began considering a move to this methodology long before it became a necessity during the Covid crisis. Sky Sports started trialling remote production technologies in 2015, primarily, explains director of operations James Clement, as a means of creating content across all the broadcaster’s rights and making the best use of its resources. “It wasn’t just a technology project,” he says.

The 2015 trial led to full remote production techniques for the 2017 British and Irish Lions rugby union tour of New Zealand. The standard approach would have been to ship out ENG crews and equipment for producing Sky-style presentation to enhance the host feed. In this instance, Sky commentators, presenters and reporters travelled to New Zealand, while crews in the UK worked remotely. “It was the furthest distance away to prove latency would not be a hindrance,” Clement adds.

As a result, Sky Sports drew up a five-year plan for moving production of its major sporting rights, including Formula One motor racing, Premier League football, cricket and tennis, to remote models. Similarly, BT Sport had a four-year plan, which began with National League...
PRODUCTION AND POST

This is the lowest division in English professional football and although media coverage of it had been increasing since the late 2000s, as Jamie Hindhaugh, chief operating officer of BT Sport, explains, connectivity at stadiums was an issue. “We did a lot to try out technologies because none of the National League grounds were connected,” he says. “We started out with 4K coverage using satellite uplinks but also cameras over 4G.”

According to Hindhaugh, the “key challenge in sports production” had been people travelling sometimes long distances to get to venues. “Because of that we are very aware as a company of the impact on the environment,” he comments. “What we wanted to do was create more inclusive broadcast operations [so] all production spaces are accessible. We have so much gear at our Stratford studios that is able to enhance content and we wanted to reduce travel times and give access to our galleries through a centralised workflow.”

It was the potential of such set-ups, observes Charlie Cope, head of operations for BBC Sport, that convinced people remote production was viable. “The technology got to the point where there was no reason not to do more remote productions,” he adds. “Latency issues had been overcome and on the cost side international connectivity [meant we] could afford to bring back multiple feeds.”

The carbon footprint caused by large numbers of staff travelling to cover sports overseas was another consideration for BBC Sport as it assessed remote production during 2018-19. Despite that, Cope says pre-Covid there was some opposition to throwing out the old operational practices. “There was more editorial resistance to changing the working models of having a dedicated team on-site,” he comments, “but the pandemic pushed us to the point where it wasn’t a choice any more.”
The global health emergency also forced the hands of some independent sports production companies. “Before the pandemic we were looking at remote production but had no real need or saw any advantage in going that route at the time,” says David O’Carroll, operations director of Aurora Media Worldwide. “A lot of the productions we work on are new or up and coming properties where there’s a great deal of on-the-ground development that goes on between the broadcast, events and digital teams on-site.”

Because of this, the usual operating model of Aurora Media – which works on Extreme E electric off-road racing, Formula E electric motor racing and the Six Day Cycling Series – had been based around the traditional OB truck. “What we found, though, was that the technology to be remote all existed and the barrier to it was [based] around collaboration on-site and the production team’s familiarity with the truck and being at the venue,” explains O’Carroll.

Once Covid made on-location working out of the question, O’Carroll says production staff soon realised working remotely was not the impediment they had feared: “The technology was such that they didn’t feel remote and were working in a familiar operating environment. The pandemic helped us get across the line from it being talked about to it actually happening.”

By contrast, prior to 2020, Timeline Television had been working on remote productions of Women’s Super League (WSL) football, the SailGP sailing championship and the National League for BT. “They all have slightly different models but we were working on those shows remotely pre-pandemic,” comments David Harnett, Timeline’s head of operations. “When the pandemic hit it changed the entire industry.”

He explains that Timeline has three models for remote production, which can be used individually or in combination. The most basic, which was used for the WSL before Covid, relies on cellular bonded backpacks connected to 4G data networks. “The only crew that go out are the camera operators and the sound assistant,” comments Harnett, “but you can have a really comprehensive production.”

Model two is based on satellite technologies, with four cameras embedded on an 18MHz carrier through the use of modern compression techniques. “We radiate two satellite carriers and bring in up to eight camera feeds to our broadcast centre or to BT Sport at its Stratford hub,” Harnett explains. “You can produce a high profile match but with the benefits of reduced crew, using a satellite van rather than a large OB truck.”

The third model, used on SailGP, Formula E and Dubai horse racing, relies on “big data pipes” for fast network links with high bandwidths. In this way, 40 to 50 feeds of video can be transported with, Harnett says, almost no latency. “There’s obviously a trade-off between connectivity versus travel and expenses but model three is really good and is what most companies are talking about in terms of remote production,” he adds.

That is certainly the case for Sky Sports, which built up the number of events it produced remotely using Gigabit (scaling to 10 Gb) fibre connections, including for the English Football League (EFL), in the years up to 2019. “Our plan was to start remote cricket coverage in 2020, have the Premier League (PL) running at the end of 2022 and then be pretty much moved over to full remote by the end of 2023,” says Clement.

Covid brought all that forward dramatically. After the initial period of no sport at all, Sky – and other sports broadcasters – found itself in the
position of catching up with numerous postponed matches and events, including 100 PL games in 40 days. "As lockdown ended we worked with our suppliers to build temporary facilities at Sky Studios, using the blueprint of our EFL coverage," he adds. "We accommodated more games and I don't think we would have been able to achieve the number required if we had stayed on traditional workflows."

BBC Sport's Cope observes that the Covid-enforced change brought by remote production has transformed how people work covering FA Cup games, which previously involved a lot of time on the road. "They would be travelling the length and breadth of the country but now it can be done remotely from Salford," he says. "That means the crew does not have to travel and can be back home with their families the same day."

As for connectivity, Cope says links should suit the location and technology the production is looking for. "On high-profile productions we're using resilient fibre solutions with satellite back-up," he continues. "On the other side, Whisper is producing the EFL for us using mobile-based systems brought back over LiveU portable streaming packages. We accept that there is some latency involved but satellite is still useful there as a back-up, rather than as the main system."

BT Sport has ten models, depending on the sport, what cameras are being used and other requirements. These range from fibre connectivity to accommodate UHD, HDR and Dolby Atmos on PL coverage (as is the case with Sky) to 4G for Super League rugby league matches. Jamie Hindhaugh sees the next step as 5G carriers, something BT Sport demonstrated in 2018. This, he says, has the advantage of network slicing, which is able to create virtualised and independent segments within a network. In addition to this, network slicing also offers the guaranteed latency, bandwidth and quality needed for live broadcasting.

As well as these technologies, there is the potential of the public internet. Sky Sports has been testing this for netball coverage, using error correction to give more latency. "It can be challenging but we wanted to provide more content," says Clement. However, he notes that viewers will not be seeing the Premier League produced over the internet any time soon.

However, 'sooner rather than later' has been the case for remote production in recent times. Sky Sports has delivered its five-year plan three years early. BT Sport's four-year project came in two years ahead of schedule. All of which is making TV sports nearly 100 per cent remote while, at the same time, totally connected.
In recent years, virtual environments have progressed in leaps and bounds. In 2021, the global augmented reality (AR), virtual reality (VR), and mixed reality (MR) market was valued at around $30.7 billion alone.

WHAT ARE THESE TECHNOLOGIES AND WHY DO THEY HOLD SO MUCH VALUE?

• Virtual reality (VR) creates a simulated virtual environment viewable through a headset
• Augmented reality (AR) adds 3D content into the real world and ‘augments’ it
• Mixed reality (MR) allows real-time rendered content around and under actors and objects

Extended reality (xR) is an umbrella term under which AR, MR and VR exist. In essence, xR relates to all technology that blurs the lines between the physical and virtual world.

xR has already revolutionised potential for broadcasters allowing for remote production to take place, the extension of studio sets, more natural performances from talent, and the opportunity for broadcasters to create shows that engage audiences from every demographic at a lower cost.

disguise’s industry-leading xR solution empowers seamless delivery of extended reality by combining in-camera LED screens, real-time generative content from engines like Unreal Engine, camera tracking technology, augmented reality and the disguise production workflow to seamlessly extend the physical space into a virtual world.

So far, the disguise xR solution has powered over 400 productions, including some of the world’s biggest broadcasts like TV Azteca’s coverage of the 2020 Tokyo Olympic Games, which took advantage of the new disguise xR cluster rendering feature to a total of 170 hours of live xR transmission. disguise has also powered the 2020 MTV VMAs, ITV Sport’s coverage of the 2020 UEFA European Football Championships and the 5G Courtside Concert Series at AT&Ts NBA Conference Finals, to name just a few.

disguise also teamed up with White Light to realise ‘teleportation’ capabilities where the technology behind disguise xR was able to take live footage of remote athlete interviewees and beam it into a virtual studio in 3D augmented reality, creating the illusion that both the studio presenters and athletes being interviewed were located in the same space. Presenters could conduct face-to-face interviews with athletes located miles away, without having to fake eye lines or ‘fix it’ in post production.

In order to maintain its position on the bleeding edge of this technology, disguise recently acquired broadcast data and content visualisation solutions platform, Polygon Labs.

Through its suite of software solutions, Polygon Labs provides a cloud-native platform and turnkey services that are used by global broadcasters such as CNN, Unvision, The Weather Channel and TV Globo.

By adding Polygon Labs to its solutions, disguise will build integrations where studios using their xR workflow will have access to a wider range of broadcast workflows. These will deliver improved remote production and cloud-based collaboration. In the future, users of both disguise and Polygon Labs will experience easy-to-manage, data-driven graphics workflows running fully native Unreal Engine, as well as extended design and production capability for graphics.

HOW CAN BROADCASTERS BENEFIT FROM USING DISGUISE XR TODAY?

They can:

• Bring together remote production teams through virtual studios and cloud-based collaboration
• Enable real-time edits on set and in the moment
• Extend the studio space far beyond the LED walls in the physical space
• Enable pixel-perfect graphics for any broadcast platform
• Create immersive production environments that grabs attention from any demographic

If you want to use extended reality workflows to power the graphics for your next production, book a demo at www.disguise.one
Over the past couple of years, accelerated by the terrible pandemic, we've all seen countless articles about the 'paradigm shift' in live broadcasting and streaming. Most have hailed the move to remote production and the even wider untethering of production workflows more generally. There has been a tone of great achievement and, in some cases, that's genuinely true. Here at Limitless we still remain to be convinced how many have truly unleashed their thinking and ways of working.

As WilkieTV, and now Limitless Broadcast, this was the mantra from inception back in 2011.
My first interaction with the broadcast or television industry took place well into my time at university. I studied English Literature with Creative Writing and thought I’d set up a theatre company or become a script writer for radio. Incidentally, it was the student television station that captivated me. I soon got behind a camera, cut a show with a vision mixer, and explored the technology behind the scenes, going on to play a key part in the move from pre-recorded content to live streaming. This truly got me hooked and it became clear the live TV environment was where I felt most alive.

My first live OB job was as a runner for BBC Events on the production of the Queen’s Diamond Jubilee, followed quickly by the London 2012 Olympics. I learnt all I could, fascinated by what the crew were doing. After a couple of years, I moved into BBC Entertainment working across live formats such as Strictly Come Dancing.

Before long, my father and grandfather’s entrepreneurial streak broke through; WilkieTV was set up in parallel to starting my TV career at the age of 23. We began working for the university I’d attended as an outsourced technical and filming resource. I had £20 in my pocket and a vision in my head and knew we simply had to get the job done with the resources available.

Our first regular client was a large, local sports facility in Surrey, UK. I pitched the opportunity to reach new audiences and grow their fanbase by saying, “Look, you fill your arenas every week but you’re only ever reaching those people in the room; you have platforms like YouTube and other social media channels, let’s utilise them.” This saw us shoot sports highlights and weekly interviews with grassroots teams. The facility went on to host athletes for the 2012 Olympics.

Fast forward to the summer of 2017 and although we’d cracked live streaming, we were regularly hearing of great projects unable to come to fruition that really should have seen the light of day. The ability to produce live content was purely based on the attractiveness to sponsors, and this led to a chicken-and-egg scenario with new or minority sports.

A conventional large outside broadcast set-up for smaller or minority sports just wasn’t feasible but the hunger for live content was growing. The ability to watch sports on the move, using mobile devices, and the rollout of 4G rapidly created a growing divide between what fans expected and what content was available. Not only did they want to watch in real time, but in higher quality than previous live stream attempts; often in venues or locations with no broadcast infrastructure. It was clear that something needed to change.

We discovered a way forward: innovation. By using a relatively unheard term (at the time) ‘remote production’ it was possible from our base to produce live events that were taking place elsewhere. Suddenly, you didn’t need the production team to be physically located at the venue, and although we had been successful using our OB vehicle to cover sport, remote production became our chosen workflow because of its flexibility, storytelling potential, and the creative freedom it provides to niche and extreme sports. As a workflow, remote production is cost effective, streamlined and simpler for the end client. This new technique required extensive trial and testing, but by early 2018 we were able to demonstrate this successfully to our clients.
The summer of 2018 led to our first full-on period of live remote production; coupling technology with mass-participation sports such as cycling or marathons was a winning formula. The benefits for a long-distance race that couldn't realistically be cabled (or linked via helicopter RF) were only unlocked with the power of untethering using 4G bonded remote production. We designed and delivered our own technology to produce pilots for major television channels, create reality TV shows and affordable consistent live streaming for lower tier/grass roots sports. This was the magic moment.

The following year brought a game-changing summer of remotely produced live sport, covering events across the country with full 4G remote production. Getting clients and national federations to buy into the method and potential was key; but once we proved the effectiveness there was no going back.

Nearing the end of 2019 the UCI hosted the Road World Championships in Yorkshire; a week of elite men's and women's races across the county. All races led to Harrogate, the centrepiece finish for the 11 major events. At the start of the week the Para-Cycling International was held in the same location; a series of six races on the first day. However, broadcasters weren't covering these races, so the UCI and our partners Cyclevox delivered a groundbreaking solution ourselves.

We provided a world-first: unprecedented, highly cost-effective and high production value coverage. Content was shown on six giant LED screens in four towns, fan zones, the VIP media centre and live streamed to viewers at home. The nine-camera coverage included every start, finish and six races across the 100km of Yorkshire countryside, deploying motorbikes to track the cyclists. The entire broadcast was remotely produced from Limitless Broadcast's production gallery in Surrey. The mould was broken, bringing new audiences and visibility to a brilliant sport.

Truth be told, it was a challenge to encourage decision makers that 4G/5G remote production would be successful, lower the cost of broadcast and create dynamic content in an environmentally friendly and flexible way. To open up the possibility of live coverage to those who otherwise couldn't afford the price tag – a real barrier to entry – the comfort zone needed stepping out of and the workflow needed to change. Being the first to try something new and embrace technology that heralds huge opportunity within not just sports but across industries, takes courage. At Limitless, we encourage our clients to partner with us to pioneer and demonstrate that this technology is the way forward for everyone. This is what drives me personally; unleashing potential and ensuring that no-one is left behind. If that means changing our workflow and methodology, so be it.

Remote production has opened up a world of new opportunities to deliver high quality content using broadcast-standard equipment but at costs typically associated with live streaming. The difference between the two worlds is constantly narrowing. The acceptance of remote production has meant we can, for example, stream from a multi-camera studio at a global conference in Scotland, but produce and cut the week's show from London. Given the pressing issue of climate change, the ability to lower the number of people travelling to site is a brilliant positive change for the industry.

During the pandemic, we've significantly upgraded our Surrey production hub with a new gallery and MCR to cater for increasing demand, giving us the flexibility we need. We have multi-purpose live and virtual production studios here too.

Having built up a team of people who inspire me, who bring their own ideas to the table, and who thrive within an ideas-led culture it was clear that WilkieTV wasn't cutting it as a brand. We're driven by big adventurous ideas and the mission to bring them to life, better still, something that's never been done before. Having laid the foundations for almost a decade the company is dedicated to encouraging others to step beyond their comfort zones, building them up to feel unstoppable. What word best describes this mindset? “Limitless”.

Starting a technical company in this industry has had its challenges; how many female founders of broadcast technology companies can you think of? This has given me a fiery determination to liberate perceptions and help others own their space to be who they are. I was grateful to find Rise and the role it’s playing in gender diversity at a critical point in my career. Having a relatable mentor is undoubtedly a great boost in a male dominated industry.

As a team we’re on a mission to challenge the limits in broadcast to deliver the most imaginative ideas to drive exposure for all, by harnessing remote production and its unparalleled potential. We’re forging a limitless future, to inspire others to break the mould. Our industry really is at the tip of the remote production iceberg, with epic new ideas and opportunities yet to be embraced; and we’re going for it. ■
Amazon Prime Video Italia opted for an innovative way to promote its new fantasy series, *The Wheel of Time*, ahead of its release at the end of 2021. The company streamed a four-hour live action role playing (LARP) launch event on its Twitch and YouTube channels, in a bid to engage young OTT viewers.

Local Italian production company Nexting deployed Dejero technology for connectivity at Gargonza Castle in Tuscany, the theatrical backdrop for the launch event. Featuring famous streamers, gamers and commentators, the multimedia presentation was streamed live to more than 5,000 spectators.

Gargonza Castle is a 13th century fortified village, spread across 10,000 square metres in the Valdichiana valley. Connectivity was therefore limited, posing technical hurdles for producing a live broadcast with multiple links between interiors, alleyways and open spaces in the remote foothills of Tuscany.

**DEALING WITH PLOTLESS LIVE ACTION**
Live action role-playing (LARP) is a form of role-playing game where the participants physically portray their characters. The players pursue goals within a fictional setting represented by real-world environments while interacting with each other in character. The outcome of player actions may be mediated by game rules or determined by consensus among players. Event arrangers called ‘gamemasters’ decide the setting, establish the rules, and facilitate play. For *The Wheel of Time* launch...
event, famous Italian YouTubers @DarioMocciaChannel, @Fraffrog, @KuroLilye, and @Kafkanya joined the broadcast, with commentary from @InnTale.

The LARP session itself provided a unique challenge compared to traditional live broadcasts, because there was neither a script nor a plot. With little opportunity to plan or rehearse camera shots, the mobile cameras on site needed to be able to roam without losing connectivity in order to capture the 100 extras as they improvised freely around the dramatic surroundings.

“"The event location gave us amazing panoramic views over Valdichiana, close to the city of Arezzo," says Antonio Palmieri, co-founder and CEO, Nexting. "A stunning place, but with really terrible connectivity! The set was potentially the entire castle, so we had to think of a way to ensure camera operators could capture the action without fear of live transmission being interrupted."

ACHIEVING UNINTERRUPTED CONNECTIVITY

Nexting covered three different sets with 17 fixed cameras, eight wireless cameras and a drone to ensure none of the action was missed across multiple locations. The Naples-based company guaranteed reliable connectivity for the wireless cameras using Dejero EnGo mobile video transmitters. The gear was equipped with SIM cards from multiple network providers to create a stable, resilient internet connection to cover the remote site.

Powered by Dejero’s Smart Blending Technology, EnGo can simultaneously connect to multiple IP networks, including cellular, Wi-Fi and ethernet. The technology was developed for video transmission and general connectivity use cases because it offers enhanced network reliability, expanded coverage, and greater bandwidth by managing the individual connections in real time.

“We love the versatility of the EnGo because it works with different cameras and resolutions, which is really important for a video transmission,” adds Palmieri.
An SRT encoder was set up to live stream the captured video to a central master control room for remote production. To maintain an uninterrupted stream, a Dejero GateWay network aggregation device supplied high bandwidth public internet connectivity by combining multiple wired (broadband, fibre) and wireless (3G/4G/5G, Wi-Fi, satellite) IP connections from multiple networks to achieve the desired reliability through carrier diversity.

Each connection was continuously measured in real time. If a connection was lost or became congested, the data packets were automatically rerouted in real time, across the other connection paths. This way, GateWay was able to deliver a fast, secure, and reliable connection, facilitating the delivery of low-latency video from anywhere in the village.

In addition, Nexting utilised the Dejero Control cloud-based management system ahead of the live stream. The system enabled the company to monitor the EnGo SIM cards, traffic usage and mobile coverage all from a web browser, allowing the production crew to maintain optimum cellular network configuration in the various locations.

"With Dejero Control, all the wireless cameras and feeds were monitored with ease, enabling our technicians to adjust settings and troubleshoot remotely so the camera operators could focus on getting the shot," says Palmieri.

Nexting also used the Dejero EnGo's internal IFB system and a radio back-up for communications, which enabled real-time collaboration and feedback between the crew on set and dispersed teams across the globe.

**ROAMING FREE**

"It was absolutely crucial that our wireless camera operators could roam freely without fear of losing connectivity. EnGo gave our crew the freedom and mobility to stream from the best possible vantage points in any of the castle locations," explains Palmieri.

With Dejero connectivity solutions, Nexting were able to provide creative freedom to the Amazon Prime production teams in this ambitious live launch event. It gave them the confidence to live stream from the incredibly challenging remote location of the Gargonza castle. With Dejero's Emmy award-winning Smart Blending Technology, both creative and production teams were unrestricted even in a very challenging location.

Nexting were able to ensure a smooth creative process for the production crew and a unique viewing experience engaged the 5,000 spectators who watched the event live across Amazon Prime Video Italia’s Twitch and YouTube social channels. The YouTube video of the LARP launch event has since had more than 27,000 views.
With a background in art and experimental video installation, Barbara Ford Grant has been working with live video production and computer graphics from early in her career. This led her to working in feature animation, where she worked as post production manager on two Shrek movies. “We were doing this project for Universal Studios called Shrek 4D and this wasn’t really virtual production, but it was the start of the journey into virtual production for me,” she explains.

“I then worked for a company in the San Francisco Bay Area doing production work with IMAX sized projection and the only way to really see what we were creating was to fly to Los Angeles and do dailies at the Science Center. We would do all this animation work where we’d kind of look at it on our screen, hope for the best and then go to LA once a week and look at it 50-feet tall. I thought, ‘this is crazy, there's got to be another way to do this’.”

Ford Grant joined forces with a colleague to develop a playback and projection system for 3D projection in real time enabling artists to be in the room to discuss their projects at scale. “Being able to use digital tools in a way that allows multiple people to collaborate and see and talk about the same thing at the same time was kind of a lightbulb moment,” she says. “Fast forward several years later, I wound up at Sony Pictures Imageworks and they'd been using performance capture on projects such as The Polar Express and Beowulf. “I came in and started working with the computer vision and R&D team to develop some tracking and solving technology. That ultimately got used a bit on Watchmen and a few other shows but the one that was the most fun was Tim Burton’s Alice in Wonderland. That was a green screen, we didn’t have LED walls yet, but we did have these giant LED light clad green screens. We were tracking cameras to real world performance, but we also had a gimbal tracking and motion control tracking. So it was a combination of real principle photography combined in real time with data and then data collection. It was still using the equivalent of a tennis ball at the end of the stick but we were getting to see some of the future.”

Following a stint at Digital Domain where she first began working on what’s now deemed as virtual production, Ford Grant’s journey has now led her to joining NEP as president of the company’s Prysm Stages business unit. “My heart’s in production. If you look at my history I’ve
been doing this for almost 30 years now and I just love that synchronistic moment on set when things really happen,” she adds.

NEP Prysm Stages is part of NEP Virtual Studios, which was formed in August last year after the company acquired Lux Machina Consulting, Halon Entertainment and Prysm Collective to accelerate its virtual production solution offerings worldwide.

Ford Grant describes the current move towards virtual production workflows as an exciting time to be working in the industry. “It’s not an application you just launch, it’s a combination of all these interoperable, interconnected, integrated systems that make something happen. It’s reached a level of maturity where, when we were doing Alice in Wonderland, it was a bunch of software people on the set trying to make our way through a movie,” she explains. “Now you have people like Jon Favreau and Caleb Deschanel, who was the DP on The Lion King, and he’d only done practical photography his entire career, and they were able to intuitively understand how to use that toolset and shoot a movie that was completely virtual.”

Ford Grant has previous experience of working with NEP, specifically while overseeing live production at HBO where her team bought and rented trucks from the company. “It was always more of a partnership,” she says, “they were so heavily involved in what we did.

“When I was contacted by Cliff Plumer, who actually put the Prysm Collective together, he talked a lot about what had happened since I left HBO and in the past few years with NEP and the global reach of it, the expansion into not just virtual studios by acquiring the Prysm Collective but on the live and broadcast side. They’ve done so much work with LED walls, with virtual techniques, with media playback in 3D environments.”

She adds: “NEP is in seven continents and a gazillion countries and employs thousands of people around the world. We’ve got infrastructure in all the big media hubs. That kind of backbone allows us to focus on not just building the actual virtual production experience product, but how we interface with clients and storytellers who want to use these facilities. That’s kind of an advantage that I don’t know you can get any other way in order to create this kind of business. We’ve got global reach from an infrastructure, network bandwidth and media tools perspective. So it is a great leg up for sure.”

In November 2021, NEP announced its first Prysm Stage at Trilith Studios in Atlanta, Georgia. The Prysm Stage at Trilith Studios is one of
the world’s largest virtual production facilities, featuring a fully enclosed 80’ x 90’ x 26’ virtual production volume in an 18,000 square foot purpose-built sound stage. “Trilith Studios is awesome,” enthuses Ford Grant. “Marvel is their largest tenant by far and in their marketing video Marvel’s president Kevin Feige talks about how it’s not just about using the stages, it is an experience. That’s kind of true. I actually just came back from spending a week there and the stages are all state-of-the-art and beautiful and really well and thoughtfully done. They’re arranged in a way that takes advantage of the arc of the sun. “Plus, there’s enough space in between that you can actually park trucks. I know that sounds silly, but if you’ve ever tried to shoot at any of the stages in Los Angeles you’d know what I mean. Everything is thoughtfully designed. It’s a great place to have a flagship stage because you just don’t want for anything, it lets you just focus on the creative process. We want Prysm Stages to not be an add-on or standalone, but be part of the creative ecosystem.”

We’ve seen virtual production already employed by some of the major global streaming services of their episodic productions, as well as huge blockbuster movies, the most recent being The Batman. Does Ford Grant envision a time when it will be used on your different platforms. “You’re not going to build it again. You’re going to think about not just Prysm Stages, but the virtual studios collective we have inside NEP, we have the reach and the infrastructure, we have the capacity to do live broadcast and traditional production techniques, but we also have the artists to create a virtual art department, to create assets. We have people to work on set, to actually shoot, and we have the ability to do all sorts of genres whether it’s commercials, features or series. We can create assets that can work for almost any context and we can deliver it out to any context. We can act as a sort of hub in the distribution process.”

So does Ford Grant see virtual production replacing traditional cardboard or wooden sets? “I think for some things it’s probably going to happen,” she states. “There was a time where it was like blasphemy to say that we should maybe come up with a virtual set instead of building a physical set for something like a talk show. I remember having these conversations not that long ago. Now, it’s like why would you build a physical set for two chairs? “I think there’s going to be environments and real world locations that people will want to go to and that virtual production can be complementary to but will never take the place of. There are going to be humans that you’re going to shoot,” she continues, “and no matter how great meta-humans in Unreal Engine get, I think you’re still going to use real humans. We use AI a lot for animation, but there are still animators. So I think it’s complementary, and I think in some cases it’s going to push in a lot further than in others. “What I hope is going to happen is there’s going to be more of an awareness of what the tools are and how best they can be used, because I think that’s been a struggle,” states Ford Grant. “The barrier to entry has remained high because it’s not a box that you can just turn on and people can point to and understand. If you’re looking at a script and you’re trying to break it down, it’s very abstract right now. I think there’s an education process, a training process, that’s needed and that will lead to getting people more exposed. “Having Prysm Stages in really key locations that are also big production hubs, it’s great to take advantage of the productions that are going on there, but we also want to use them as outreach centres so that people can come in, see what it is, get some training, learn about how this all works,” she explains.

Asked if that means Prysm Stages opening new facilities in the UK or Europe, Ford Grant says that is something that is likely to happen in the future, but she can’t say anything more. Watch this space!
TIME TO ASK HARD QUESTIONS ABOUT THE CLOUD

Mike Ward, head of marketing at Singular.live, looks at how cloud-native workflows are increasing remote production and transforming sports broadcasting forever.

Emerging from the fog of the pandemic, it is time to seek some clarity about the future direction of our industry. Certainly, any doubts about cloud's suitability for live production should now have been swept away. Distributed workflows powered by cloud processing and internet connectivity kept live events – and many broadcasters and producers – in business these past couple of years.

So much so that it is increasingly difficult to justify a return to traditional methods and carry on amortising expensive hardware. The return to the new normal marks the end of the road for conventional outside broadcast workflows but this will not happen overnight.

The reality, in the short term at least, is that broadcast is likely to deploy hybrid systems, still leaning on traditional tools but incorporating new software, IP and cloud elements.

The reasons for shifting production, contribution and distribution architectures to the cloud are overwhelming. Cloud technology has proven to be flexible, scalable, and battle-hardened with its enforced global use from March 2020 shaving years off the timing of its inevitable introduction. Both the cost and limitations of legacy systems will eventually prove to be too restrictive, especially when resolving the economic impact of Covid-19.

It's not as if broadcasters were deluged with complaints about the quality of production delivered under remote and sometimes even remote-from-home conditions. Cloud offers localisation, personalisation, and interactivity which traditional systems have no means of matching. In parallel to that, sports fans are increasingly migrating to streaming services and online viewing, which offers the opportunity to deliver the advanced digital features not available in traditional productions.

The expected production values for live sport using cloud systems are often just as high as productions using conventional OB gear. Singular.live, for instance, provides Intelligent Overlays; live custom graphics integrated with rich data to enhance presentation for all Scottish Professional Football League matches in conjunction with the league’s production partners QTV and RCS. Matchday teams are using Singular.live to create and control all the broadcast graphics in the cloud.

So far, I've used the term 'cloud' broadly but if the industry is to truly evolve then it must learn to differentiate vendor technologies and the claims made for cloud.

One popular version of cloud is ‘virtualised’ or ‘remote surface’ production’ using cloud-based tools. These solutions are indeed superior to traditional OB technology since they slash shipping and transportation requirements of kit and crew. However, they are not 'cloud' in its true sense. They still require dedicated hardware; it is simply stored somewhere and controlled remotely over the internet.

Cloud native solutions, however, do not use or require dedicated hardware. This is the only way the industry can unlock the real benefits of cloud; namely scalability, flexibility, and crucially, sustainability.

Simply moving to cloud is not good enough. A recent IBC Innovation Accelerator project on sustainable live production put cloud forward as a potential way of easing the environmental impact of live production. As a leading participant in this along with BT Sport, Sky, Microsoft and the Premier League, we realised that there is still lingering confusion within the industry over what cloud is. Cloud production reduces the amount of technical infrastructure required for the gallery production, for some broadcasters up to 70 per cent and that is compared to a remote production.

For example, it is still not clear to what extent cloud services can reduce the environmental impact of live productions. This uncertainty stems from the fact that the industry has not properly defined what cloud means. As we continue to learn more about what we mean by cloud and in particular 'cloud native', we will be better informed as to how we can realise the benefits that can be gained.

Even as an entirely digital cloud native solution we can't quantify the carbon savings that the use of our platform would make compared to buying dedicated graphics hardware and shipping it around the world, let alone a system that is cloud-based. Sky, the BBC and BT Sport identify the same issue. It's because it is incredibly difficult to trace and measure the total resource usage of cloud providers, which often use a mixed power supply infrastructure that harnesses various different sources of energy. As a result of initiatives like the [IBC] accelerators, cloud providers are fully cognisant of the demands being laid down by broadcasters and are actively engaging with the industry to collaborate on this.

We applaud them for that and urge everyone to go deeper in working with initiatives like albert to ask hard questions about how environmentally friendly their cloud platform is.

Cloud native solutions are essential to achieving effective remote working, global collaboration and to driving more sustainable working practices. If the solution is not cloud native it is just a stop gap to the inevitable future.
India’s broadcasting industry is likely to see a series of significant regulatory, policy and behavioural changes in 2022, making it one of the most significant years in its history. As per the CII-BCG report, time spent on video consumption increased to 3.2 hours in 2021 for digital and video platforms. For television, the same has increased to 4.5 hours. As per a BARC India study, of the 300 million homes in the country, 210 million have access to television. Clearly, there is scope for the sector to grow. Also, with the onset of the pandemic that led to the closing of cinemas and other forms of live events, OTT platforms have emerged as one of the most constant sources of entertainment for audiences where they had easy access to a plethora of fresh and compelling content.

The sudden proliferation of OTT services in India since 2020 can be attributed to increased internet penetration coupled with high availability of – and easy accessibility to – smart devices. The OTT industry is likely to grow from $121.6 billion in 2019 to $1.039 trillion by 2027. Industry trends indicate that with access to better networks, digital connectivity, and smartphones, OTT platforms in India will become the leading entertainment pathway.

Currently, the Indian television industry is undergoing a seismic shift and operational challenges. The country’s growing middle class with higher disposable income has become the strength of the media and entertainment industry. According to an EY report, entertainment audiences grew 15 per cent in 2020 to reach 450 million, with 65 per cent recorded in rural India. Users want different experiences on each platform, different flavours of content, and they want it all on their personal schedules. Data consumption continues to grow exponentially in India, amounting to 15 GB per subscriber per month. This exponential rise in video consumption poses unprecedented pressure on the telecommunications infrastructure, compelling network operators to look at more efficient video delivery mechanisms. The broadcast offload mechanism addresses this issue and also unleashes the potential of universal direct to mobile reception throughout the country, thereby justifying the rationale for broadcast broadband convergence.

Public private partnerships will play a major role in driving innovative technologies for taking broadcasting to the smartphone, leveraging 5G as the next big innovation to overcome spectral and energy inefficiency. Broadcast does not support OTT and cloud applications. The video delivery in the broadband network is based on the ‘best effort, shared pipe’ model of IP. Thus, video quality degrades due to instantaneous congestion in the pipe. Video needs a ‘constant quality’ pipe. The point to ponder is whether a potential collaboration between broadband and broadcast networks will attract new users and retain existing users by creating an immersive experience with integration of AR/VR technologies. Technical feasibility and financial viability is the challenge.

The expansion of 5G internet will enhance better quality video on mobile devices and decrease buffering. India is the world’s fastest growing OTT market, set to become the sixth-largest by 2024. Moreover, work is underway to connect all Indian villages by optical fibre for faster broadband services by 2025. A study on broadcast broadband convergence is being led by an Indian start-up called Saankhya Labs, and the outcome will be very useful to Europe and the United States in terms of advanced technologies and user-friendly features. This is a great opportunity to integrate ATSC 3.0’s state-of-the-art broadcast capabilities into the global telecoms ecosystem, especially given the massive size, scope and influence of India’s market and technological expertise.
In early March, a world-first multi-venue music event underpinned by 5G technology took place. The 5G Festival involved over 20 artists performing together simultaneously for 90 minutes from three different venues, 70 miles apart: The O2 Blueroom at The O2, Metropolis Studios in west London, and Brighton Dome.

As part of the project, eight different organisations worked together with Digital Catapult to explore the potential of 5G in the music industry, and provide a blueprint for how the technology could play a key role in the future. The aim of the trial was to showcase how 5G could communicate the “live-ness” of an experience wherever the audience or musicians are.

Planning first began in 2020 when the UK government launched a project called 5G Create, which had £30 million to invest in projects looking at ways to utilise the country’s 5G network once it was rolled out. Digital Catapult put together a consortium of nine different companies including themselves to investigate the role of 5G in the entertainment and arts. Each week the consortium would gather on Zoom to discuss a concept they could submit. Eventually everyone decided on three possible use cases: a remote collaboration between musicians, which would see the group design and build a network that would allow the musicians to play together remotely; broadcasting a remote performance by the musicians to phones, tablets and VR headsets; and a hybrid of the first two, involving the three venues and broadcasting the performance to a live audience.

“When we came together, none of us knew if this could be done,” explains Jamie Gosney, director of Sonosphere, one of the members of the consortium. “We wanted to do it, and we were told by some, who had apparently tried, that it couldn’t be done. We submitted the bid on 1st June 2020, and 12 days later we got an email saying we’d been shortlisted. Then in August we found out we’d won the bid and we were awarded £3.2 million between the nine companies. And that’s when we went, ‘Yikes! We’ve really got to do this’.”

With funding in place, the next task was to get the right technology in place to properly test their theory. Digital Catapult had previously set up a private 5G testbed at Brighton Dome, which has since been enhanced to support the 5G Festival project. The company also set up a private 5G network at Metropolis Studios and used the public 5G network at the O2 Arena.

While the purpose of the project was to test 5G, the team actually leased fibre lines, to simulate the speed of 5G, between the three sites, employing 5G for the final hop to those watching on phones and tablets.

There’s been much talk about how 5G will help broadcasters deliver enhanced experiences to audiences, but what about other entertainment genres? A recent test involving 5G for both audio and video took place across the south of England. Jenny Priestley puts her ear to the ground to find out more.
The first proper test took place in March 2021, when three musicians performed at the same time in different parts of Brighton Dome, each connected via Cat 5 cable. This was to test how the musicians would deal with any latency issues brought about by such a large network.

“One of the tests involved the musicians playing the same song over and over and over again,” explains Gosney.

“Every time they played, we’d increase the latency a little bit on the network and we didn’t tell them what we were doing. We just asked them to give us feedback each time and tell us if anything changed. We added five milliseconds, no change, we added ten milliseconds, they didn’t notice anything. When it got to around 15 they asked if we’d added some reverb or EQ’d it. When we got up to 40 milliseconds the whole thing fell apart.

“We then took it back to 25 milliseconds, and they thought it was back to normal,” he continues. “They were using KLANG Immersive in-ear monitors, which are part of the Audiotonix Group, and when we changed them from immersive to stereo they couldn’t play at 25 milliseconds. So we realised that the KLANG monitors, which originally were just going to be a nice sparkly icing on the cake way of listening, actually became really important and part of the project.

The KLANG system adds latency to various instruments and vocals to create that sense of distance and that became a really, really important part of the project. It bought us about 10-15 milliseconds of latency.”

In real terms the network latency was actually around eight milliseconds for the round trip, the equivalent of the musicians being stood around ten feet away from each other. “We actually set the latency on the network at a 20 millisecond round trip, which was one of the KPIs that we had to achieve,” states Gosney.

Further trials followed in June of last year, this time with six musicians across two venues, a guitarist and keyboard player on stage at Brighton Dome, a drummer and vocalist at Metropolis Studios, and a second vocalist and bass player in another room in Brighton Dome.

“I’d gone to Metropolis Studios in the morning to see how it was all going and there were a bunch of boffins there working on the network. It worked for 30 seconds and then it fell apart and nobody knew why it kept failing,” says Gosney. “I just sat there thinking I have no idea what these guys are talking about, so I got in the car and drove down to Brighton, walked into the middle of Brighton Dome where we’d actually put up an immersive audio system, a d&b Soundscape system, and I heard ‘One, two, three four’ and the drummer started playing. I’d just left him up at Metropolis Studios, and there were vocalists, and I suddenly saw all these images on screens that we’d put up and a tear...
came to my eye because I realised that what we talked about and what people had said couldn't be done, we'd just done it!"

Gosney admits the project wasn’t without serious challenges, including times when the network would fall apart and no-one would know why. "Because there is currently no dedicated hardware for this, Audiotonix had to secure elements from its group brands to deliver the end result. This required a team of skilled product specialists to combine their brands’ hardware and skills to deliver the end result. Ultimately, we needed to set up PTP clocks (precision time protocol) across all the equipment in each of the locations so all the equipment on the festival was on exactly the same time to the last millisecond,” he notes.

"As we move forward the next thing is to take all those bits of technology and try to incorporate it into one box that musicians can plug into. That becomes part of the commercialisation of this project. There’s definitely an appetite for this technology. One of the really positive things that has come out of this is how the results of the project feed into the whole green agenda. Musicians are currently getting on aeroplanes to go and do recording sessions or to record or to write, and they won’t need to do that. Now they will be able to do live collaboration over a network, reducing their carbon footprint."

Everything was now in place for the full 5G Festival, with performers including Newton Faulkner and Lola Young hitting the stage in March 2022, complete with both audio and video. Screens showing the musicians performing at the different venues were set up next to each stage. This aspect employed two different systems: the first based on a common service platform from Mativision, which generated a point to point system and links between the collaborating artists via their infrastructure and protocols; and a standard video broadcast system. "In some cases when you were at either The O2 or Metropolis, the projections which were taking the feeds from this broadcast system were somehow out of sync from the audio," explains Digital Catapult’s lead technologist, Kostas Katsaros, "but that was maximum one second or less than one second sometimes."

"If you think about other major music festivals where you don’t have remote collaboration, it’s just a camera projecting images onto a big screen, that is delayed, even if you are on the same site,” he adds. "So the audience is used to that latency."

Another aspect of the project was to provide the audience with AR and VR headsets so they could watch the gig. "As we move forward, we’re looking to perhaps bring in some other partners with hologram technology so that we can actually place musicians as virtually as possible on the stage without having to use screens," says Gosney. "Our partners have identified that there is a clear R&D space to continue potentially tackling audio over 5G,” adds Katsaros. "Critically, for distributed environments, you need synchronisation. Looking at how the network could support timing and synchronisation, we had to set up three PTP clocks, one per site. But what if the network could provide that strict synchronisation? That will be coming through 3GPP and 5G standards in the future. We want to see how that can benefit us. Having more synchronisation within the network between audio and video, and potentially improving that aspect, is something that we want to investigate."
Video is expected to account for 82 per cent of all internet traffic by the end of 2022, up from 67 per cent in 2016. Unsurprisingly, during the Covid-19 pandemic, the video streaming industry has seen substantial growth rates in consumption and accelerated innovations across the entire ecosystem; from personalisation to video quality optimisation.

As the world continues to emerge from the pandemic, this too will impact the video streaming industry and present new opportunities and challenges for video developers who are constantly trying to meet the demand for improved viewing experiences without causing costs to spiral out of control.

In a bid to get a snapshot of the current state of play in the video streaming sector, Bitmovin recently surveyed 538 video developers, industry experts, customers, and prospects from 65 countries for our fifth Annual Video Developer Report. We found that this nascent industry is continuing to mature across the board.

LIVE LOW LATENCY STREAMING REMAINS A CHALLENGE

In 2020, the biggest challenge for video developers was cost. Yet, while controlling the costs of bandwidth and storage remains high on the list of challenges, low latency topped the list as the biggest headache for video developers, which isn’t entirely surprising. Despite significant technological advancements, live low latency is still a conundrum for the video streaming industry and lags significantly behind broadcast. Most respondents expect low latency video in the three to five-second range, while 25 per cent of our respondents expect sub-second delays for the second straight year in a row. However, many of the necessary measures streaming services take to scale up and improve reliability amid rising demand end up increasing their end-to-end latency.

Solving the issue of low latency requires examining and optimising several points in the delivery path from encoding, packaging and DRM to the player and CDN strategy. There are trade-offs between quality, cost and scalability when trying to reduce latency, so each service needs to find the approach that delivers the most value for their viewers and use case.

AV1 IS PRIMED FOR THE SPOTLIGHT

We have always been champions of the AV1 codec and its potential but we also acknowledge that it’s a multi-codec world. However, the results from the Video Developer Report indicate that AV1 will experience a significant uptick in usage. Currently, AVC/H.264 is the most used video codec because it has the greatest device reach. Companies will need to continue supporting H.264 to ensure interoperability with every device. However, our report found that HEVC, VP9, and AV1 saw significant increases in testing and production usage, with HEVC being deployed by over half of the respondents. The ecosystem may be ready to make the jump to AV1, considering AV1 adoption by consumer platforms like YouTube and increasing device support from the Fire TV Stick 4K Max. Qualcomm also recently announced its support of AV1. Our report found that 22 per cent of video developers plan to use AV1 over the next 12 months, suggesting it could be this year’s breakout star.

NEW PRIORITIES FOR AI AND MACHINE LEARNING

In 2020, ‘recommendations and personalisation’ topped the list as the artificial intelligence and machine learning features that would improve the video experience for viewers. This year they were surpassed by audio transcription and speech-to-text and ‘Tagging and categorising video content’. A total of 43 per cent of respondents said they were using AI and ML in their audio transcription and speech-to-text efforts.

There are two significant cases for using video transcripts. The first is providing closed captions for video content, an essential part of any video strategy. Facebook, for example, discovered that an enormous 85 per cent of video content on their platform was watched on mute. Therefore, closed captions are crucial to providing context for this growing number of users watching content with no sound. A less obvious benefit for transcripts is the increasing discoverability of video assets. Making content easy to find becomes increasingly essential as video archives continue to grow, leading us to the second use case, which is tagging and categorising video content where the benefits lie in storage, search, and sharing videos.

The video streaming industry remains one of the most exciting technology industries. It only started taking off around 20 years ago, and the pace at which it’s continued to evolve is astonishing. Over the next 12 months, we expect increased usage of newer and more efficient codecs. For media companies, having access to wider codec options is a sound way to optimise the high-quality viewing experience for viewers. Additionally, increasingly widespread adoption of AI and ML will continue to improve the viewing experience for audiences.
THE FUTURE OF VIRTUAL PRODUCTION

Virtual production is becoming more prevalent in the media and entertainment industry. TVBEurope speaks to a number of major vendors about their virtual production capabilities, what customers are looking for, and how it’s likely to evolve in the coming years.

WHAT CAPABILITIES DO YOU HAVE FOR VIRTUAL PRODUCTION?

Bryce Button (BB), director of product marketing, AJA Video Systems: The role of AJA technology in virtual production is multifaceted, from supporting audio and video I/O and recording needs to bridging between different geographically disparate technologies on-stage. Our desktop and mobile I/O technology is heavily integrated with volumetric capture solutions used in the craft. AJA KONA 5 and Io 4K plus, for instance, are often a crucial component of larger virtual production systems harnessing game engines like Unreal and GPU cards like those offered by NVIDIA. They enable more seamless output of real-time or digital cinema resolution video from Mac, Windows, or Linux computers, which is fed to live LED displays with background and foreground elements and virtual sets. A group generally referred to as the Brain Desk unifies all the graphics engine capabilities, game engine code, and broadcast and digital cinema standards for varied rasters and frame rates to tie it all together.

As these systems are complex, downtime is always a concern, and we’ve seen a number of professionals look to file-based recording solutions like AJA Ki Pro Ultra 12G to capture live virtual production run-throughs with actors and hosts amidst virtual backgrounds and foregrounds. In episodic or film production, this allows the director to play back footage of all the materials integrated for redundant capture. Signal flow is another consideration in modern virtual production requirements, as teams must connect a range of equipment spanning routers, recorders, and LED displays. To this end, there’s a real demand for high quality signal transport over long distances, which is where we see AJA KUMO compact SDI routers and AJA fibre conversion solutions employed. These solutions help ensure more accurate signal flow and provide the distance required of larger virtual production stages.

David Levy (DL), director business development global solutions at ARRI: ARRI Solutions is a dedicated organisational unit within ARRI, focused on designing and engineering broadcast and virtual production environments. We’re able to take ARRI’s expertise and understanding of the correlation between professional lighting and camera systems, image management and colour science, and through our collaboration with industry partners, we deliver cutting-edge workflows for virtual production environments.

As well as our ARRI Stage London in Uxbridge (above), which was developed and built in collaboration with Creative Technology, ARRI Solutions was also responsible for the overall technical planning and installation supervision for the DARK BAY Virtual Production Stage in Babelsberg, near Berlin, one of Europe’s largest permanent LED studios.

Richard Mead (RM), CEO, Brompton Technology: Virtual Production is an umbrella term for many things, but Brompton gets involved where LED screens are being used for in-camera visual effects (or green screen replacement, if you prefer). We provide LED video processing; that means we take in the video feed, and ensure it is reproduced accurately on the LED screen in a way that can be captured by the camera without artefacts.

Some of the challenge is about scale; a large LED volume for virtual production may be made up of hundreds or thousands of individual LED panels and many millions of pixels. But the real secret sauce is in dealing with the fact that every LED or driver chip has a slightly different behaviour, and we need to correct for all those differences to ensure a beautifully consistent, accurate overall image.

Our heritage is in supporting the world’s biggest live events, and most of those are televised, so performance on camera has always been a priority for us. This meant we were well placed to support the rapid acceleration in the use of LED for virtual production, and over the last two years we’ve added many features to ensure the LED screen fits more gracefully into an overall virtual production workflow and help the creative realise their vision.

Sam Measure (SM), technical consultant, CVP: For more than 30 years, CVP has been one of the leading production solutions providers in the United Kingdom and Europe, it supports its customers by bridging the gap between AV suppliers and cinematography suppliers. This unique market perspective allows us to have very broad virtual production capabilities and for us to provide a complete, bespoke package for our customers.

Jordan Thistlewood (JT), product management director, virtual production, Epic Games: Virtual production in most cases is a broad umbrella term that captures a lot of potential specific workflows with either a full CG, interactive or supporting traditional filmmaking result. Some of the most well known
examples are full CG cartoons, and LED wall in-camera VFX-based live action shows like *The Mandalorian*. In the pre-production world, virtual production covers the techniques of previz and techvis. More recently are examples like *The Matrix Awakens: UE5* which is both an interactive experience and linear content.

Unreal Engine is host to a wide range of virtual production workflows. We can create interactive content and drive it on large LED walls for broadcast, film and commercial productions. We can produce offline rendered footage for playback from either a real-time or path traced rendering engine. We interface with motion tracking systems focused on cameras, props or performers driving content in Unreal Engine. We have systems that support input or output of data from DMX systems. For cameras we can take streams of FIZ data from multiple vendors allowing for the accurate integration of CG content with live action. We have a broad range of systems for world scanning & creation, look development, animation, lighting, and FX. Any or all of these can be combined as a suite of tools for broadcast and filmmaking needs.

**Mike Ruddell (MR), global director of business development at Naam:** Real-time engines and camera tracking are the two key elements of VP, allowing for more flexibility and quicker turnaround times. When you can see everything in-camera, you can make better decisions and have that ultimate flexibility, which means you can get the shots you want on set, and also tweak them in post. But currently, there aren’t a lot of people that can apply these tools to a VFX workflow. Last year, we opened two new VP/ICVFX studios in Europe and Latin America, built to support the growing demand for virtual sets, LED stages, and training facilities where people can learn and test out new tech in a worry-free environment.

**Claus Pfeifer (CP), head of content acquisition, Sony Professional Europe:** From a technological perspective, Sony’s cinema Camera VENICE and VENICE 2, combined with our unique Crystal LED displays create the framework for virtual production. VENICE/VENICE 2 can reliably capture the image of the Crystal LED by wide latitude, low noise shooting by Dual Base ISO, and entire colour reproduction by S-Gamut3.

From a knowledge perspective, the Sony Pictures Division has very good expertise and knowledge when it comes to 3D VFX and production. We also benefit from a unique relationship between PlayStation and Epic Games in the gaming department. Collaboration between the different departments has created a system that reflects voices of creators inside and outside the Sony Group. Crystal LED specifically reflects the voices of creators and SPE engineers, and has a surface treatment that suppresses reflection during shooting on a panel with high brightness and high gradation expression even with a narrow pitch. In addition, it achieves a wide viewing angle, that is strong against shooting from various angles.

From an infrastructure perspective, we’ve been deploying facilities since 2019 around the world. In the United States, we have opened a development base at Sony Innovation Studio at Sony Picture Entertainment in Culver City. As of January 2022, we are constructing a new studio in the United States with the latest Crystal LED, allowing for actual shooting of commercial movies. In Japan, the company opened a solution development base by virtual production at its headquarters building in 2020; and in 2021 the virtual production base at Sony PCL headquarters was relocated in movie shooting studio called Toho Studio for a limited period (composed of 8K/440” Crystal LED).

**WHAT ARE YOU FOCUSING ON WITH VIRTUAL PRODUCTION TECHNOLOGY AT THE MOMENT?**

**BB:** Presently, extending technology partnerships with key players in the space like NVIDIA and Epic Games is a key focus for us. We’re collaborating with them to refine our technology for virtual production applications in film and TV, and beyond.

**DL:** A key focus for ARRI is to ensure smooth, dynamic integration at all stages of virtual production workflows. For example, when it comes to real time metadata transfer, ARRI has developed a lens metadata plug-in, which pulls camera data directly into Unreal Engine. Real-time lens values drive environments, changing how the visuals are presented on screen and creating an accurate and immersive experience for the scene.

Lighting integration within a virtual production environment is also incredibly important for accurate colour reproduction. Although LED video walls are very good at producing high resolution reflections and a homogenous base level of light, the displays do not have very good spectral output, which results in skin tones and fabrics not being faithfully reproduced.

We’re able to complement the lighting from the LED walls with ARRI fixtures. In our Uxbridge stage, we installed a 360-degree “Ring of Fire” using 50 units of our latest luminaire, the Orbiter, to provide detailed contrast control, and accurate colour reproduction lighting in the stage. And because we’ve designed an IP-based data network for lighting control, we can integrate into the playback engine, allowing time synchronise interaction.

These technical workflow considerations are mirrored by our specialised studio design, ensuring that each space is as effective as possible. This could include motorised LED displays, or lighting bars, which boost shoot efficiency and remove the need for working at height.

**RM:** Our focus has been looking at all the interactions between the LED screen and other elements in the virtual production workflow, and asking how we can make things easier. The most obvious relationship is with the camera itself, where we’ve added features to ensure camera set-up can be based on creative needs and not limited by any inflexibility of the LED screen. For example, when working with LED on camera, it used to be difficult to change shutter angles because the camera would ‘see’ a partial LED refresh and that would create artefacts. But ShutterSync, a unique Brompton feature, allows the refresh timing of the screen to be adjusted to suit a specific shutter angle avoiding artefacts. Elsewhere, we are also integrating with on-set colour grading tools and camera tracking systems to solve real-world problems and improve the virtual production workflow.

**SM:** There is so much opportunity in the industry at the moment with developments in LED walls, processing, use of games engines and camera tracking really revolutionising the space. Our main focus over recent times has been to really position CVP as a ‘full-service’ solutions provider for...
TECHNOLOGY

studios to be able to create their entire virtual production installation with us. We listen to our customers, understand their needs and deliver the right solutions with the ambition to be the best ‘media and entertainment’ reseller in the world.

**JT:** We are always balancing expanding the possibilities of what can be rendered in real-time as illustrated by many of our UE5 examples with improved UX for artists and enterprise applications. The two go hand in hand for the broadcast and filmmaking industries. Specifically in the broadcast space, we have many technology partners who leverage our advancements, add their own level of innovation and service on top, creating powerful broadcast solutions.

**MR:** No matter what the project, it all comes back to speed, simplicity, flexibility and compatibility. This is where we see the biggest need for improvements, and we have some big announcements planned for the coming year.

**OP:** From a technological point of view, we’re looking to harmonise the colour pipeline from camera to CLED screen. From a market perspective we’re working with partners in Europe such as TSF and PRG in France to organise demonstrations of virtual production environments using our technologies. The next XR day is scheduled in Paris for 21st April.

**WHAT ARE YOU BEING ASKED FOR BY CUSTOMERS IN TERMS OF VIRTUAL PRODUCTION?**

**BB:** When combining equipment in such a way that virtual production does, timings must be adjusted to account for discrepancies in the various technologies employed. To this end, our clients in virtual production are largely interested in reliable tools that can capture real-time virtual production feeds set to strict resolutions and timings, with latency of the utmost importance. AJA’s core philosophy has always been to guarantee the lowest latency possible, while providing high resolution and deep colour imagery for these contexts, and it is an area we remain focused on.

In recent years we’ve worked to advance buffering capabilities across our products to ensure each piece of the virtual production — whether it be graphics, live camera feeds, or additional overlays — arrives in perfect sync in the finished product.

**DL:** Our customers and partners want to understand the full potential of virtual production for their specific content requirements. The latest workflows allow for such a detailed level of control over your environment, without losing creative freedom. The types of shots in these environments that you can achieve in-camera are amazing and would certainly be otherwise impossible on location.

Each environment is unique, in terms of scope, production requirements, budgets and so it’s important to work with each client from the very start, to make sure the solution precisely matches their requirements. Starting with consultancy for the overall objective, rather than purchasing hardware and trying to retrofit a solution, sets the foundation for the most effective outcomes for clients.

**RM:** Accurate colour management and repeatability are very important to virtual production customers, and we are very strong there thanks to our dynamic calibration technology and excellent support for HDR. We support all the common colour spaces, including ACES AP1, and our ability to import a custom 3D LUT gives advanced users complete control.

Low brightness performance is another key area. In part because LED screens being used for virtual production are often operating at way below their maximum brightness, which creates its own challenges. But even when screens are running at normal brightness levels there will be dark areas in the content and that is where artefacts are most likely to appear. We are constantly iterating to try and improve performance here, and we have some exciting new technology due out in the next couple of months. All Brompton customers get free software updates so that their systems continue to benefit from new features and enhancements throughout their working life.

**SM:** One of the main asks has been for LED volumes and that has really led into a range of other services that are part of the ecosystem. For example it’s not just when you’re shooting against a volume, if you’re going to be using it with an engine, then you need to track the cameras to make sure that you’re getting the correct field of view and parallax. And that can also lead into a conversation involving processors, media servers and render engines.

**JT:** Virtual production is a relatively new field in the grand scheme of things. The requests vary by vertical but there are consistent themes of workflow improvements and growth in the education markets to increase the available talent in the market.

**MR:** When camera tracking is used across verticals – from major broadcasters to one-man YouTube channels – everyone has their own unique concerns. But the common themes are flexibility and future-proofing; customers need a tracking system they can use in myriad scenarios, indoors and outdoors, with little to no risk that their investment will become obsolete. Speed and simplicity are other concerns; it’s crucial that a tracking system presents as few limitations as possible.

**OP:** The main ask is to increase the quality of resulting images from camera to CLED in terms of colour, ghosting effects, moiré, etc.

**HOW DO YOU THINK THE TECHNOLOGY WILL EVOLVE IN THE NEAR FUTURE?**

**BB:** Artificially intelligent technology is rapidly evolving, and its continued progress will set the stage for future virtual production advancements. AJA is keeping close tabs on AI-driven image recognition advancements and other evolutions, and their potential impact on hardware and software technologies that underpin the virtual production process. We’re engaging in ongoing conversations with customers and partners about the space and working to deliver simpler video control packages and capabilities for the field as it advances.

**DL:** The evolution of virtual production solutions is incredibly fast moving, and there is a huge amount of learning with each unique project. And critically, that learning is being shared between partners who are delivering these new production environments together. The success of our most recent projects has been underpinned by a very open dialogue
between all technology partners involved in defining the workflows and product integration. This allows the industry to move much faster than before and lets us develop in a more collaborative and efficient way.

RM: Everything about LED video performance is a trade-off. A higher LED refresh rate may mean lower bit-depth, or a higher maximum brightness may affect low brightness performance. A lot of these restrictions come down to the design of the panel hardware or plain, old physics; and previously the manufacturers of a panel have tried to determine the best balance of performance characteristics for general-purpose use. But Brompton has just recently introduced Operating Modes as part of its Tessera v3.3 software features, which allows a panel to have different configurations that prioritise different aspects of performance. As this makes its way into users’ hands, I think they may be pleasantly surprised at how much performance improvement is available once you are no longer constrained to a one-size-fits-all configuration.

SM: Something that would be really interesting to see would be a further flexibility of how you can shoot with hardware. Not necessarily just driving down the pitches of walls, but having the processing on the back-end to drive it and without compromising on the quality of the content, which I’m sure will all come in time.

JT: I think as awareness of the possibilities increases we will first see more of the traditional roles adapt to virtual production. Production designers, cinematographers, directors, etc, finding a seat at the table. They will bring with them creative and workflow needs that will see virtual production accelerate its evolution on both the software and hardware side. There are so many hardware and related systems involved in virtual production that I think we will all be able to leap forward as each contributing system advances in leaps and bounds.

MR: Over the past year, we’ve seen the release of lots of tools designed to aid those wishing to adopt the various benefits of VP, including virtual camera solutions, LED wall integrations and a number of real-time compositing tools (often based around Unreal Engine). What seems to be missing thus far is an off-the-shelf ‘control centre’ where all these technologies come together in a cohesive user interface. I would like to see someone develop a tool, or set of tools, specifically designed for virtual production.

OP: Further integration between camera and LED wall. Multi-camera production. There will also be further applications for virtual production, be it in simulation or corporate markets.

WHERE DO YOU SEE IT BEING APPLIED OUTSIDE OF TV AND FILM?

BB: We’re starting to see modern virtual production technology and techniques influence many fields outside of film and TV including live sports, entertainment and events, corporate communications, and even healthcare. Although not entirely responsible for this trend, the Covid-19 pandemic has certainly accelerated virtual production technology adoption outside of film and TV. In live event and entertainment settings, the inability to host large crowds at concerts during the pandemic necessitated a pivot, with virtual production providing a unique way to broadcast or stream live concerts and events featuring digital avatars while adhering to social guidelines. In the same way, corporations are now using virtual production technologies to help geographically disparate team members and clients come together in a digital space to safely create a sense of togetherness for presentations, company announcements, launches, and more. Applications in healthcare are in the early exploration stages, but we expect emerging innovations in the space to better support surgeons and educators in the coming years.

DL: The technology and processes required to design and engineer LED volumes are still complex, however the cost of LED technology will eventually come down and processes will simplify and move towards automation. This will reduce the complexity and risk, which will certainly open up the technology to wider sectors. Education on how the technology and workflows are developing will be critical; from higher education to DP, producers, VFX supervisors and our colleagues in the gaming, live events, and broadcast worlds.

RM: Virtual production with LED is all about creating a convincing virtual reality from the perspective of a camera. But it is clear that these techniques can and will be applied to create immersive experiences, ranging from very serious applications for training environments or simulation through to the entirely fun theme park rides or virtual tourism experiences. Running alongside all of this is that buzzword of the moment ‘metaverse’, which raises many obvious questions about how humans interact with an expanded virtual world. Do we spend our lives wearing VR headphones? If not, then the techniques developed for virtual production with LED will surely have a role to play.

SM: Something that I’ve noticed in recent years is the increasing crossover between the TV, film and gaming worlds and I can definitely see virtual production allowing these mediums to merge and collide into something really interesting and immersive for consumers.

JT: We already see adoption of Unreal Engine-based virtual production in museums and art exhibits, education, theatre, live music events, and YouTube streamers presenting as VTubers. There are very few places where virtual production techniques are not being explored. Many uses right now are niche but hint strongly at what could be possible in the future as virtual production techniques continue to be democratised by Epic Games and others.

MR: Aside from camera tracking being used live on film sets and later in post production, there are other exciting use cases our customers are actively involved with today. Major sports broadcasts, spectacular live entertainment events and esports tournaments are all taking advantage of real-time camera tracking to add engaging and immersive CG content to what could otherwise be very ‘flat’ productions. We’ve also recently seen tech being used in the corporate space. Online keynotes from the CEO are far more engaging when powerpoint is replaced with well designed AR elements!

OP: In the mid term, virtual production could be applied to environments such as the creative departments of companies, like marketing or communications. ■
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Allen Broome, CEO, of MediaKind, discusses his nerve-wracking introduction to the industry, and the democratisation of video

How did you get started in the media tech industry?
I spent about ten years working in telecommunications on VoIP at start-ups and Fortune 100 companies. Then, one of my close colleagues joined Comcast, and he made a few introductions on both the voice and video side of their business. The next thing I knew, I was on a flight to Philadelphia and interviewing for roles within both of those teams.

I will never forget my final interview for the video team. It was with a very well-known senior engineer who authored many cable and MPEG specifications. I remember sitting in his office sweating as he flipped through my resume for what seemed like ten minutes. Although it was printed in black and white, my interviewer's red pen notes ensured more red ink on the pages than black. Finally, he looked across the desk and said: “Well, the way I see it, we could hire someone with video experience, or we could hire you. Tell me why we should hire you.” I had created this story around the similarities of voice over IP and video over IP, and how they were very similar, only voice was more challenging because of the latency issues with crosstalk in a conversation. Boy, was I wrong. Video turned out to be a lot harder! I received offers from both teams and decided to take the IP video role as it was something brand new, both for Comcast and for me. From there, I built a lab and a team that ran some of the first IP linear testing over DOCSIS.

How has it changed since you started your career?
VoD was still a recent product launch at the beginning of my career, and IP video was in
its infancy. There was no such thing as ‘direct-to-consumer’ (D2C) as all video was delivered through an aggregator. And Netflix was still shipping DVDs!

The cloud has since taken a much more prominent role in the media and entertainment space in terms of operation, processing, commercial and deployment. Streaming is growing exponentially in terms of how viewers and subscribers want to consume their media. It is almost unrecognisable as an industry since I took my first tentative steps into it and continues to evolve at pace. This is one of the most enjoyable parts about being part of it!

What makes you passionate about working in the industry?
There isn’t one single element. I have been fortunate to meet so many great people over the years who have not only been fantastic colleagues but have also become wonderful lifelong friends. Another key point is that you must be driven to tackle and solve new challenges.

Video is hard. It presents some of the most difficult scaling problems in technology, whether it’s Super Bowl-type live events, addressable advertising with millions of viewers hitting an SCTE-35 trigger at the same time or ultra-low latency synchronised streaming for sports betting. However, the world’s leading media brands rely on innovation to respond to the demands of their viewers. It’s this responsibility and trust that is hugely motivating.

If you could change one thing about the media tech industry, what would it be?
On International Women’s Day in March, I saw a powerful advert campaign on LinkedIn from a company in the UK. One of the ads asked the reader to imagine a CEO and another to imagine someone crying in the office. The first ad then asked, “Is it a man?” and the second “Is it a woman?” If you polled a hundred people, I doubt the response would be even close to 50/50. To make our industry more inclusive, we must first address and shatter stereotypes and unconscious gender biases that are inherently at play.

How inclusive do you think the industry is, and how can we make it more inclusive?
Not nearly enough. There have been big efforts and notable improvements over the years, but meaningful change takes time, and we have a long way to go. It all starts with awareness and education. People must understand what it means and understand the value of diversity and inclusion.

I am a huge fan of the OODA (observe, orient, decide, act) loop for problem-solving. The way diversity really clicked for me was when I understood the ‘orient’ phase. This is where you take all the information you have gathered about a problem, and you start applying mental models to that data to understand it, matching patterns based on previous experiences. One of the key things you must do is to try and remove your own bias from these mental models or how you interpret the data, and having as much diversity as possible in this phase creates the most accurate orientation of the problem. I know there are many benefits, but I believe this is one of the fundamental ones that helps everyone learn and become better every day. Wider diversity ensures that we all have a broader perception of the world and environment around us.

How do we encourage young people that media technology is the career for them?
Like everything else, it’s through awareness. There is such a broad range of careers in the media space. From cameras, video editing and production, marketing, legal, finance, and all the engineering and technical roles, ranging from building better codecs, streaming protocols, and the networks that deliver video down to the devices and applications. If you really think about it and look on YouTube, Instagram, TikTok, etc, more young people are in the media technology space than ever before. Video is truly becoming democratised.

Where do you think the industry will go next?
The very next step will likely be around high-quality, low latency streaming for gaming and sports betting. But before we get there, our industry needs to continue to inspire and push the boundaries of the streaming era. Ultimately, we need to realise a future where live can be delivered without limits, at broadcast quality and scale, to any screen or device. Unless we resolve that challenge, every other innovation will be a very long way off.

What’s the biggest topic of discussion in your area of the industry?
There are many to choose from! One that is close to mind though is the pressure TV operators find themselves under to drive additional capabilities to their media business, particularly in light of growing competition from streaming service providers. At the same time, they also need to reduce ongoing costs for their media services and operations.

There is now an increasing need for flexibility in resource and infrastructure usage. Event-based services and DVR platforms are driving short-term use of what would have traditionally been fixed capacity headend services, using platform services based on user demand and the streaming of content scaled based on delivery needs. All these factors are helping to increase the use of cloud-based infrastructure. But our customers and partners are now faced with operating media-specific services in a cloud environment. That requires specialised operational capabilities, and that’s no mean feat.

What should the industry be talking about that it isn’t at the moment?
The industry went from all video being delivered to a customer through an aggregator to shifting more and more towards D2C and applications. We tend to over-rotate in these major shifts and go too far. There needs to be some sort of correction to get back to a balanced place, as I believe we have over-rotated on too many options, too many apps and too much fragmentation.

It’s hard to find content. Even global searches on Apple TV, Android TV, Amazon Fire TV Stick, and Xfinity boxes fail to find what we want, and the consumer is often left performing a search within multiple levels of the platform. It’s frustrating, and the whole point of entertainment is that it’s supposed to be easy and quick to consume.
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