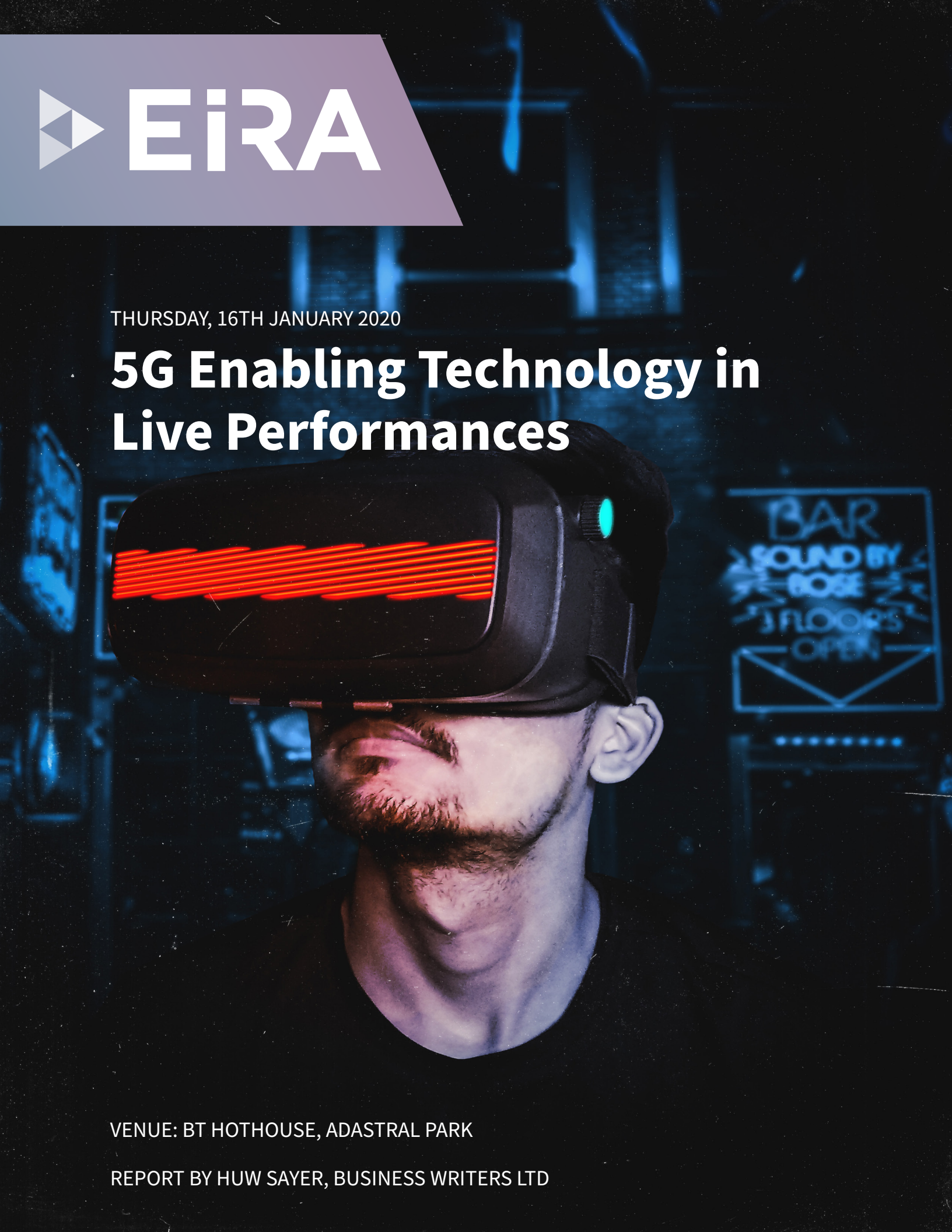
EiRA

THURSDAY, 16TH JANUARY 2020

# 5G Enabling Technology in Live Performances




VENUE: BT HOTHOUSE, ADASTRAL PARK

REPORT BY HUW SAYER, BUSINESS WRITERS LTD

# Contents

**On 16 January 2020, around 50 people from the East of England's arts and academic community met at BT's global research centre in Suffolk. They were taking part in a special one-day BT Hothouse organised by the Digital Creative EIRA team led by the University of Essex. Their aim was to explore the challenges and opportunities that 5G networks present to the arts community, particularly for live performance.**

This report aims to capture the main ideas that participants discussed during the event. If you would like to explore what 5G might mean for you or your creative practice, please contact the EIRA team. They will seek to introduce you to relevant experts and help you identify support and funding for specific projects.

*Emma Wakeling e.wakeling@essex.ac.uk*

**What is a BT Hothouse?**

BT Hothouses are normally intense multi-day events focused on helping an individual company tackle a specific business problem. They bring together industry experts with those company employees responsible for addressing the challenge. Through workshops and discussions, they aim to accelerate the process of developing a solution from months to days. BT has used the Hothouse process on more than 650 occasions since 2004 for a range of corporate clients, with proven results.

**Setting the scene**

How are you with heights – love them or hate them? Imagine standing in an elevator. The doors open and there in front of you lies a vast cityscape – and a plank. An ordinary wooden plank, stretching out like a diving board over the streets a few hundred feet below.

Now step out onto the plank. You can feel it under your feet and it's wobbly. You can see birds flying around and cars moving far below. Carry on walking out on that plank but be careful, there's nothing to hold on to. You reach the end of the plank. Do you jump? Can you jump?

At that moment the plank and the abyss feel very real, even

*Delegates playing with headsets on the day*

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though you know you are standing safely in the BT Hothouse Lab. Your fear is surprisingly intense – particularly if you are scared of heights – your legs feel wobbly and your hands clammy. You barely notice the weight of the VR headset and even the digitally painted cityscape doesn't seem to detract from the 'reality' of the experience.

*BT , Adastral Park*

**Will 5G be an enabling technology in live performances?**

Watching a concert or play or dance in virtual reality (VR) is not a new experience. Many artists have created 360° videos that allow audiences to immerse themselves in performances. Likewise, millions of people have played augmented reality (AR) games like Pokémon Go using just their smart phones.

However, these experiences demand superfast internet connections and high bandwidth to handle large amounts of data. That's fine if you have a fixed fibre connection but current 4G mobile networks often struggle to cope. Artists and consumers become frustrated by slow downloads, dropped connections, and frequent buffering – in short, their expectations far exceed the capability of current 4G enabled technology.

The EIRA 5G Hothouse began with a series of talks (*reviewed below*) from industry experts looking at the technology now and how it might develop. These were followed by round table discussions, with seven mixed groups of 6-8 people from different organisations. Inspired by the morning talks, they explored the possible challenges and opportunities (*summarised below*) of using 5G to enhance artistic performances.

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**1) BT's view on 5G now and in 5 years – review of talks by Andy Corston-Petrie and Andy Gower, BT**

Telephony has changed rapidly since the WOW! factor of making calls on the move in 1985. The introduction of 4G in 2012 turned mobile phones into multi-media devices that are now an essential part of daily life for many people. They have changed how we consume events – increasingly we see life through the lens, either watching live or recording for reliving later.

Now the industry is gearing up for the rollout of 5G (fifth generation) wireless networks, which combine radio technologies with different wavelengths to provide uniform coverage. Low frequency waves carry long range data transmissions. High frequency waves carry higher volume local transmissions. Millimetre waves (very high frequency) fill the gaps to give connectivity everywhere you need it.

There are three main benefits to 5G:

1. Data transfer speeds of 1Gb a second (peaking at 10Gb), around 100 times faster than 4G
2. Network capacity (the amount of data it can handle), around 100 times greater than 4G
3. Latency rates (detectable delays) around 50 times lower than 4G.

The aim of 5G is to bring the world of fixed and mobile internet together. By combining different frequencies, it should make the transition between indoor and outdoor internet access (WiFi to mobile) seamless. In urban areas, dense 5G coverage can offer a real alternative to fibre optic networks, with similar speeds and data capacity.

At large scale events where thousands of people might be connecting devices, the signal may still need boosting further. This can be done using 'edge computing'. Essentially this involves

**'' Insightful and inspiring''**

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setting up servers close to the venue to handle event specific data, rather than transferring it across the wider network.

BT's subsidiary EE and other providers started rolling out the service across UK cities in 2019. O2 made the service available in Norwich in January 2020. EE expects its core network to be established by 2022, with immersive mobile AR services available from 2023.

BT has teams of researchers looking at how to bring different technologies to life. The mobile networks team has an open to the public test-bed facility to help artists trial ideas for using 5G to enhance live performances and enable real-time virtual collaboration. Currently you need to build specialist private networks for such high-bandwidth activities but BT thinks it will be possible to use 5G to run many of them over the public network.

The three main areas that could benefit from 5G (and have overlapping needs) are:

1. **Enhanced mobile broadband** –for services such as high definition video, VR and AR, and the 'tactile' internet (creating virtual touch), which all demand high data rates and low latency.
2. **Safety critical machine communications** – for real time services such as remote surgery and autonomous vehicles. These need stable connections, high data capacity and low latency rates. Human reaction times range from 30 to 100 milliseconds, depending on physiology and training. BT expects 5G to deliver virtual reaction times of 30-50 milliseconds.
3. **Massive Machine type communications** – for connecting sensors for smart objects, smart buildings and smart cities to enable the Internet of Things (IoT). The vision for 5G is that it

**'' EIRA's hothouse gave me the ideas for further development of our company's projects.**
**Thank you for organising this event!''**

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will support up to one million connected devices per kilometre squared. BT, through collaboration and testing, is seeing just what the technology can do and exploring what commercial services business might offer.

BT has long worked with artists and venues to create bespoke events and special effects, including 3D holograms. It is now keen to help them use 5G to support immersive and interactive content production for live events by synchronising multiple data feeds in real time. This includes testing 8K (4 times more data) 360° -degree multi-camera experiences on TV, tablets and VR headsets.

*Find out more about how BT can support creative ideas:*

*Adam Oliver adam.2.oliver@bt.com*

2) **Evolving immersive performances – review of talk by Dr Liam Jarvis, University of Essex**

The practice of live performance is evolving as technology gives artists new ways of expressing their ideas and venues new ways of engaging their audiences. We have seen writers entering into play writing collaborations with artificial intelligence platforms (with mixed results). In London you can enjoy VR enabled 'sense hacking immersion rooms' at Otherworld.

Many people see potential in using tele-presence for long distance learning, rehearsal and collaborative performances. We have already seen the launch of LIVR, which claims to be the world's first VR content platform dedicated to theatre. It offers "a fully immersive 360° VR experience that transports you into the audience at some of the best live performances; on-demand and from the comfort of home."

*Liam Jarvis, University of Essex*

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Artists have been experimenting with motion capture technologies for some time now to create new visual experiences. One such example is the dance production as·phyx·i·a created by Maria Takeuchi and Frederico Phillips in 2015. They used 'inexpensive' Xbox One Kinect sensors to capture a performance by Shiho Tanaka and then used the data points to create 3D representations of the dancer.

Technology aside, our fascination with immersive experiences is not new. Immersion for many is all about losing oneself in the moment, cutting ourselves off from mundane reality and seeing the world (or other worlds) from a new perspective. That is why we enjoy watching plays and films in darkened theatres.

We are fascinated by how immersive experiences can shape our perceptions of reality and even deceive us (a simple low tech example of this is the 'rubber hand illusion'). Take the perceptual disorientation of Catherine Richard's artwork 'Virtual Body 1993', where you hand goes off on its own, or Henrik Ehrsson's academic study 'If I were You' (2008) into body swapping, where you shake hands with yourself.

Some charities are using the power of illusion in 'empathy apps' to help people experience having a disease or disability. BeAnotherLab is conducting experiments with 'body swapping' to tackle social conflict – to feel how your enemy feels. However, as this technology becomes more prevalent and powerful it raises ethical questions about how it might be used or abused – about our sense of ownership over our own bodies.

It's not just about what artists, venues and audiences want to do with technology. It's also about what the technology – the experience – does to us. What are we putting our audiences through?

**'' This was an intense day, with lots to learn about a quite specialist topic. However, it seemed like a highly efficient way for people from a range of organisations to share knowledge and ideas in a structured way.''**

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What does it mean to take possession of a virtual body and to some extent lose control of your own? Do people really want this – do they want to be influenced in this manner. At what point does it cross the line from entertainment and psychotherapy into brainwashing?

*Find out more about virtual experiences in Liam's new book Immersive Embodiment.*

3) **Creative Campus – review of talk by Shoel Stadlen, Head of Communications at Snape Maltings**

Snape Maltings is a globally famous music and arts venue set in the beautiful rural landscape of coastal Suffolk. It is known and loved in part for being remote – for its otherworldliness and lack of connectivity – and gets around half a million visitors a year. Many people come here to get away from city life and, in some cases, technology – and to immerse themselves in nature and real-world creative experiences.

Despite that lack of connectivity, it already runs a Digital Campus where it shares knowledge and performances with national and international audiences. A current hot topic is the link between music, health and wellbeing. It is bringing together artists, clinicians and researchers to help them prepare for 'social prescribing' and has been working with the All Parliamentary Group for Arts, Health and Wellbeing.

However, there is a big question around how the centre maximises its reach. How does it capture and share the vast range of work, learning and experiences that take place here every year? Is it possible to replicate the real world in the virtual world – particularly those unexpected, sometimes serendipitous encounters that help spark so much creativity?

**" It was a great opportunity to network with other people in the field of interactive technologies"**

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Could 5G enable more innovative ways of building links between artists elsewhere in the world and those in residence? The centre is already working with academic partners at the University of East Anglia (UEA), thanks to EIRA funding, to explore possible ways of using digital platforms to support creative culture. However, it has to weigh the attraction of investing in new technology with the need to invest in its physical infrastructure, including new facilities for visiting performers.

*Find out more about artist residencies at Snape Maltings:*

*Shoel Stadlen sstadlen@snapemaltings.co.uk*

4) **Innovating in Immersive Tech – review of talk by Matt Martin, Co-founder Immersive Studios**

If you think of VR, you probably think of clunky, heavy headsets plugged into a PC or games system. You were pretty much fixed to the spot unless you were prepared to lug a heavy PC backpack around. This is one reason why gamers were slower to adopt headsets than the industry expected.

But that is all changing – and fast. Immersive Studios was one of the pioneers of VR, AR and 360° video experiences. It has now set up a new company, XIST, that is making the dream of free roaming VR real. New, lighter headsets, combined with streaming content are giving players the freedom to explore large spaces and interact with objects in that space and other players.

It's not all for fun either. XIST is already exploring ways of using this free roam VR combined with haptic technology (virtual touch) in training and personal development. For instance, it could enable a team of engineers to work on a virtual jet engine together, taking it apart and examining the parts before reassembling and

*Matt Martin, Immersive Studios*

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testing it.

XIST is just the sort of service that should benefit from the speed, capacity and low latency of 5G. Localised servers, 5G enabled sensors for tracking people and objects, and 360° cameras will enable streaming of fully interactive virtual content to players on site. The wider and more stable the 5G network, the more scalable the service – this opens up a wealth of creative possibilities for live performances, particularly large festivals with numerous stages.

This sort of immersive experience can also open up marketing opportunities, as Cirque du Soleil recently demonstrated. They created a 360° promotional video that put the viewer at the heart of the virtual performance. This sort of innovative and memorable content is relatively cost effective to create and can be streamed through different devices and platforms, so the viewer doesn't need special kit to enjoy it.

Going beyond marketing, it is now possible to create virtual tours. This can improve accessibility by making it possible for the housebound and those in hospitals or care to still enjoy live performances. That has business benefits too – in effect you can sell one seat 1000 times or more (if you have broadcast rights) – venue capacity ceases to be a problem.

But such technology needs funding to bring it to life – and artists and venues to embrace it. The benefits are not confined to audience engagement. There is also the potential to create new experiences through remote collaboration and performance – essentially creating virtual sets, with virtual artists and audiences.

The power of 5G could also revolutionise set design. Visualisation tools, such as CAD, to create virtual models have been around for decades. However, immersive technology will make the process

**"Great opportunity to understand the resources that BT has at Martlesham, and to meet members of their team. Also, really good to meet new peers from across the creative sector."**

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feel more real and make collaborative design easier. Producers, directors and performers will be able to walk through 3D stage scenery, testing perspectives, choreography and even virtual costumes before visiting the venue.

For more information about creating immersive experiences, please contact Matt Martin.

5) **Examples of artists creating immersive experiences**

EIRA Hothouse guests also heard from three artists who have been creating immersive experiences with a mix of technologies. Rather than trying to describe these in detail, we would encourage you to follow the links below to view their work and find out more about their creative processes.

**Using Tech in Sound Art - Jane Pitt**

Jane is a sound artist who likes to work outdoors and uses sound as a sculptural material. She explores the way sound shapes a place and how that makes people feel. Her creations are standalone and use multiple digital and ambient sound sources to create a virtual sound world – she is particularly fond of megaphones. Low cost, mobile technology is essential to creating these sound installations because they have to operate away from mains electricity and standard broadband with no loss of quality.

**AΦE – creating immersive choreography – Aoi Nakamura and Esteban Fourmi**

AΦE is a touring company that creates VR dance experiences that are not restricted to a stage. They invite audiences to interact with both the dancer and each other. Usually immersive technology isolates people but AΦE aims to reconnect them with the real

*Jane Pitt, Sound Artist*

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world around them. They use light-touch technology, usually just headsets and iPads with everything pre-loaded, which makes their creations accessible and affordable. As such they can perform in any venue with no extra tech support – just the space for participants to move around.

Their first major production – WHIST – premiered in April 2017 and has since been seen by more than 8200 paying audience members. This 1-hour performance combines physical theatre with VR and AR technologies, including 3D sound and an art installation. Their follow up production – OAR – premiered in October 2018 and, at just 9-minutes long, is an AR experience suitable for all ages .

Aoi and Estaban are also developing plans for an Art and Tech hub in Ashford, Kent, with flexible space to encourage collaboration between industry professionals . They are looking for partnerships and collaborators. **You can connect with them on twitter @aoiesteban** (please say that you heard about them from us by using the tag #EIRA5G).

6) **Panel discussion – key learning points**

Following the talks, there was a short panel discussion where the speakers made the following points.

**Start with fact finding.** Start with desired outcomes. What experience are you trying to create? Technology can help you create visual and physical sensations that you cannot replicate in real life.

**Authenticity and integrity still matter in art.** Artists need to remember their purpose in making art and ask how technology can improve on that. It's not just about making the experience


*WHIST is one of the projects by AOE*

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more WOW!  We should ask if tech can make art more social, more human, more creative, more educational – does it add value to the experience or just add volume to it? Are the special effects so overwhelming that they drown out other sensations and thoughts? What is more important to the artist and audience?

**Try testing rough ideas first.** At this stage you are exploring both the message and the medium. Then work out the right tech (if any) to use– don't cook up an idea simply to use the tech. Don't allow the tech to dictate the experience or the story – try to only use it to enhance the piece.

**Don't be afraid to DIY and make mistakes.** The tech is increasingly affordable (to rent or buy), making it easy to film and stream content. It is the creative process – deciding what to film and stream – that remains the real challenge. Try not to lose sight of your artistic motivation, the emotional, philosophical idea you are trying to capture and express.

**Technology – particularly 5G when widely available – has the potential to open up the arts**, not just performances, to a wider audience. Technology can help close distances and cross otherwise closed borders. But it's not just about geographic accessibility but also accessibility in terms of age, ability and social diversity. It could be a great way to 'level up' people's involvement in and appreciation of the arts.

**Focus on storytelling.** If you are interested in immersive storytelling, check out StoryFuture Academy in London. It is run by the National Film and Television School and Royal Holloway, University of London.

**''It opened up new potential avenues of creative work to explore.''**

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**Round table discussions**

We asked participants to explore the possibilities of 5G for live performance generally and their visions for the next five years. We then asked them what the challenges and opportunities might be for them or their organisation specifically. These were highly productive conversations covering a range of topics, including ethical concerns.

The following notes summarise the main challenges and opportunities commonly raised by the groups. Not everyone agreed on every point but most accepted they were fair, if subjective, reflections on the sector in general. We hope these help spark debate in creative practices about how they could best use technology.

In short, the opportunities and challenges tended to fall into five broad categories: people (skills / attitudes), place (venue / infrastructure), performance (creative need / desire), priorities (finances / audiences), and planning (what will be possible and when).

**What are the challenges?**

*1 - People (skills / attitudes)*

Have we got the knowledge and skills to make the most of new technology? If not, how do we get them?

There are limited knowledge sharing opportunities in the region to demonstrate technology and inspire creativity. As a result, people lack a shared understanding of the opportunities and challenges. There is also lack of certainty about demand or desire for more tech – a fear of investing in gimmicks, a fear of failure.

**"We are all interested in other people's challenges and vision and ambitions. How do we use tech not just as a functional tool but to do things differently?"**

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There appears to be a lack of basic tech knowledge among directors, trustees and other stakeholders at many creative organisations. Some don't accept tech as important to art, others are concerned about adopting new tech with no real understanding of how or why people would use it. Buy-in is an important first step.

Changing attitudes to tech is a slow process – it's important not to alienate people. Not everyone is ready for the new – particularly traditional audiences with fixed ideas about what venues should and should not do. We need to understand the needs, wants and desires of all stakeholders not just audiences and artists.

It's a challenge working with schools and artists who are not ready for the experience. Too many don't see the benefits or are thinking too short term. When working with children, use the tech they feel comfortable with and their schools/parents can support.

Challenge – internal and external perceptions about what creative organisations – particularly theatre – could and should provide – some very traditional – some radical.

*2 - Place (venue / infrastructure)*

Too many venues lack basic connectivity (broadband, WiFi, 4G), shouldn't we invest in that first? Or can 5G leapfrog the gaps? Sometimes practical things matter more. Do we have enough plug sockets?

What are the energy demands of tech – how will we power all the 5G devices and at what cost?

How do we know if we have the right equipment to make the best use of 5G? Will it remain relevant as the service evolves?

*One of the delegates enjoying one of the experiences from AOE*

**''It was a great opportunity to network with other people in the field of interactive technologies.''**

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Where can we see the tech in action – test facilities / showcase experiences?

What are the physical challenges of setting up 5G infrastructure in existing buildings? What does it take and who has the skills to ensure it is done properly? Who has the mandate to make such investment?

Perhaps we should leave room for performers to use tech but not invest in it without a clear idea of how and why it will be used.

*3 - Performance (creative need / desire)*

How does technology fit with our artistic identity / purpose / culture / creativity / audience? It is important to bring the audience with you. Start small and encourage audiences to experiment too.

Do we risk losing an essential human connection with our audiences? People often enjoy low or no tech performances because it feels intimate, natural and not contrived (art for art's sake).

How does the physicality of the tech affect the experience? Will it be comfortable or intrusive – a distraction for users or others? Can we make it 'invisible' so people focus on the performance?

Touring companies are not yet calling for 5G – so venues are yet not thinking of it as a priority. Should demand drive adoption or should venues get ahead of the curve?

How does tech work with dance, music, spoken word, film and other mediums? Can grass-roots artists test 5G – gain inspiration and experience to be sure it delivers, before making it integral to a production?

**''Audiences don't tend to care about the tech used – they care more about the experience. How does it make them feel – does it provide the escapism they crave, the emotional kick or intellectual stimulation?''**

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We probably need a common language / shared understanding between artists and technologists, if they are going to collaborate effectively – so they can each understand what they are trying to achieve.

*4 - Priority (finances / audiences)*

Organisations are wary of buying kit they can't afford and don't need. How does technology fit with other demands on organisational time and budgets? How does it fit with the daily workflow and other projects?

Will tech help us keep and grow our existing audiences – or do we risk losing them in pursuit of the new?

Many organisations face a fight for survival, with stretched human and financial resources. If adopting 5G is a strategic choice – what other things do they choose not to do?

Many struggle to provide basic facilities. Shouldn't we put physical accessibility first – rather than making people dependent on tech for enjoyment of arts?

What technology should we invest in first to make the most of 5G – and how quickly will it become obsolete? Will we be able to rely on the public network or will we need our own network on site?

Getting funding for projects is already a challenge – will featuring tech in our bids add risk to our applications or help us? How do we convince funders of the need?

*5 - Planning (what will be possible and when)*

Is technology changing too fast for creative organisations to build it into long term plans / aspirations?

**''Refreshing and lively mix of artists and technologies sharing their practice, knowledge and potential for future collaborations.''**

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When and where will 5G rollout? What will be the cost of using it?

**What skills will we need to operate 5G enhanced creative technology? Do we need to train technicians in digital arts, or digital artists in production skills?**

What will audiences need to do to benefit from 5G experiences?

**What are the ethics of immersive – when does it become brainwashing? If we can build empathy, we can create antipathy. Like all technology, it can be used for good or ill – who is responsible for deciding?**

We need more R&D to support artists not just the development of tech.

What, if any, are the Intellectual Property issues with creating virtual performance for mass distribution?

Can EIRA provide safe space and access to funding specifically to take risks – to run test and learn projects? There are lessons in failure but we can't ask one person to take all the risks – we need collective support.

**What are the opportunities?**

*1 - People (skills / attitudes)*

We'd like to see more collaborative training – perhaps skills swaps between venues and businesses. Can we make more use of the knowledge exchange networks like EIRA – if so, how?

Emphasise the social engagement benefits of new technology to

**''A great introduction for the Arts to the potential of super-fast connnectivity.''**

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win over sceptics. It should enable us to build cultural bridges with more diverse communities, particularly those who never engage with the arts.

Let's hold Bring Your Own Device (BYOD) days – encourage the public to take part in experimental events (such as creating your own short film) – celebrate audience generated works and participation.

Create a common vocabulary for all stakeholders – so we know what we mean by terms like VR, AR etc.

Make room for failure to learn – aim for 80% secure revenue generators and 20% riskier endeavours.

*2 - Place (venue / infrastructure)*

Encourage more local businesses and leading tech companies to sponsor tech for arts entertainment and education. It is a great way for brands to build their corporate social responsibility credentials with consumers.

If we can "sell 1 seat 1,000 times" we can grow beyond our existing physical space for considerably less expense than building a new venue.

Build 'sandbox' facilities – smart studios – in the East of England that mimic the 5G experience. Take the lead, become a centre of excellence. Create VR tours of the facilities – and other tech enabled venues – to market the region to international producers and give them confidence to come here. Attract experts.

*3 - Performance (creative need / desire)*

Think about the art and experience, not just the tech. Good ideas

**''Whatever level you're at, there was a way in to learn more about revolutionary technology.''**

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stay relevant. Create new forms of experience so art evolves to meet society's changing needs.

Use tech to bring performances to people in hospitals, care homes and communities with limited access to the arts.

**Engage with people who don't think of themselves as art lovers – draw them in so they enjoy the experience without thinking of it as art.**

Encourage students across the country to collaborate online to create virtual performances with less fear.

Use tech to bring history and heritage to life with more immersive and interactive displays – creating virtual walks with famous people perhaps or virtual tours of lost cities (e.g. Roman Colchester).

Use better connections and lower latency to embrace remote collaboration and co-creation – combining different disciplines in multi-media experiences.

*4 - Priority (finances / audiences)*

Build audiences of the future by streaming more live performances into schools. Work with schools to encourage them to use streaming to bring in specialist teachers. Use remote learning with virtual instructors to give more young people the opportunity to develop dance, music and drama skills.

Use VR and live streaming to 'host' international artists that venues would never get otherwise.

Justify tech investment by using it to improve marketing first. Start small – build audience engagement outside the auditorium

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– make better use of the venue throughout the day, not just in the evening. Get people into the venue and give them an opportunity to 'taste-test' production before buying their ticket. Grow their appetite for tech enhanced productions.

Show how tech can de-risk the creative process by enabling realistic trials of performances, set designs, casting and so on. It's cheaper to build a virtual set than a real one.

Hire or borrow equipment where possible. Perhaps set up a second-hand scheme to support new entrants. Remember that prices tend to fall as demand rises.

Consider using pop-up networks to live stream big events, particularly festivals, so people experience them remotely – encourage them to visit for real next time.

*5 - Planning (what will be possible and when)*

Be ready to work with producers who want to use their own tech – it's a chance to see what is possible.

You don't have to invest in the productions. Instead look at investing in sufficient infrastructure to enable producers to come in and develop ideas with no commitment from the theatre

Learn how to use the tech by making it part of the creative process. See how far you can push it. Use development process to create strong ideas that are not dependent on one specific type of tech.

Manage expectations of artists, audiences and stakeholders.

Dream first – think big – and develop concrete ideas before you worry about execution. Then ask how tech can make it real.

**''The Hothouse helped me to sharpen my digital discernment and to apply it to my professional practice.''**

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**Talk to EIRA today**

Would you like to know more about this topic? Do you have ideas for projects that you'd like to explore? Send us an email to join our knowledge exchange network for the creative industries. Let's learn and explore the possibilities together.

*Email us at e.wakeling@essex.ac.uk*

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**Further inspiration**

Check out this WAVE VR video interview with composer **Imogen Heap** to see a creative performance using motion capture and 3D graphics. Imogen lives in an 18th century roundhouse in Havering-atte-Bower, Essex. As well as composing, she is known as the inventor of mi.mu gloves, which use movement to create music.

**Further reading**

Ericsson research: The future of **AR** gaming https://www.ericsson.com/en/blog/2019/10/5g-and-the-future-of-ar-gaming. The consumer potential of **5G** https://www.ericsson.com/en/reports-and-papers/consumerlab/reports/5g-consumer-potential.

**''The 5G Hothouse gave me the opportunity to see my current projects in context of digital creative thinking in a variety of fields, and to think through the applications of the technology to enrich life through creative interventions making use of the tech.''**

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