5G for Museums, Galleries and Heritage - Unlocking the Full Potential
The National Gallery, London

5th March 2020

Welcome & Introduction

Alex Connock
Deputy Chair of the UK5G Creative Industries Working Group
Fellow at Said Business School, Oxford University

Chris Michaels
Director of Digital, Communications and Technology,
The National Gallery

Agenda

13:00 Arrivals and registrations

13:30 Welcome & Introduction from UK5G and National Gallery

13:45 Overview of 5G – presentation by Alex Connock

14:00 Discussion panel and Q&A

14:45 Refreshment break

15:10 Workshop session and feedback

16:00 Summary and final remarks by Anna Lowe and Alex Connock

16:10 Networking

17:15 **Close**

Overview of 5G – presentation by Alex Connock

Alex Connock
Deputy Chair of the UK5G Creative Industries Working Group
Fellow at Said Business School, Oxford University

UK 5G Innovation Network

Introduction to UK5G

Alex Connock, Deputy Chair, UK5G Creative industries committee
Fellow at Said Business School, Oxford University

@dralexconnock

5th March 2020

What is UK5G here to do?

- Support the development of the UK5G ecosystem
- Manage information about 5G activities and learning
- Promote the capabilities of UK 5G internationally

UK5G by numbers

2500+	registered users
1100+	organisations
16	projects registered
500+	articles, resources & case studies
~60	events, supported or delivered per annum
1	Advisory Board
6	Working Groups

UK5G magazine two issues – more planned
Fortnightly newsletters & active social media

web www.uk5g.org

twitter @UK_5G

5G Community

Sellers

- Mobile Network Operators
- Equipment and terminal vendors
- Digital Service & Content Providers
- BSS/OSS Software Vendors
- Researchers
- Fixed Network Operators
- Public Network Operators

Enablers

- Standards Organisatons
- Regulators

DCMS Testbeds & Trials Programme

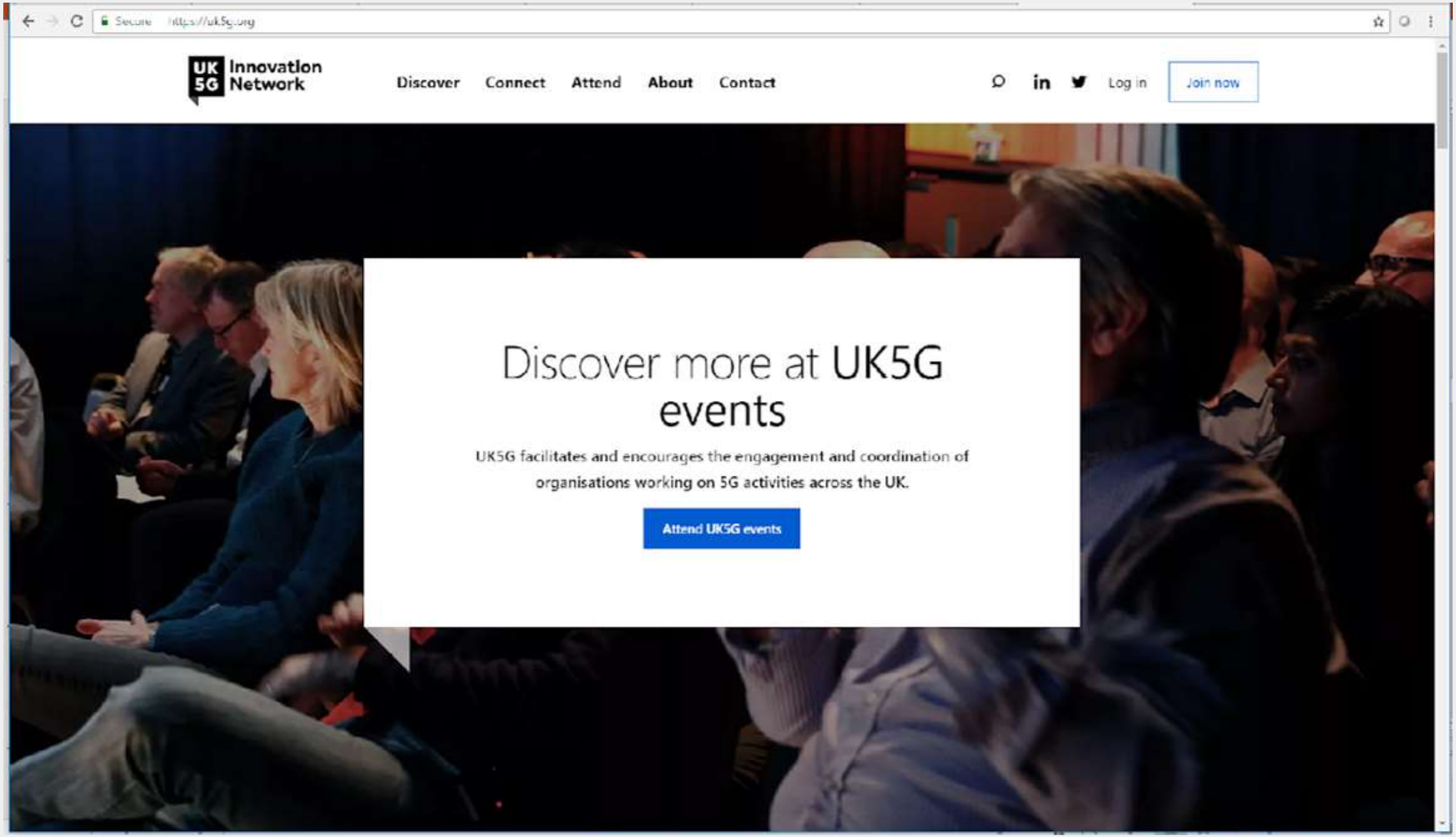
- Test Beds
- Trials
- Test Network

Phase 1
Phase 2
etc

- Investors
- Industry Forums
- Analysts & Press

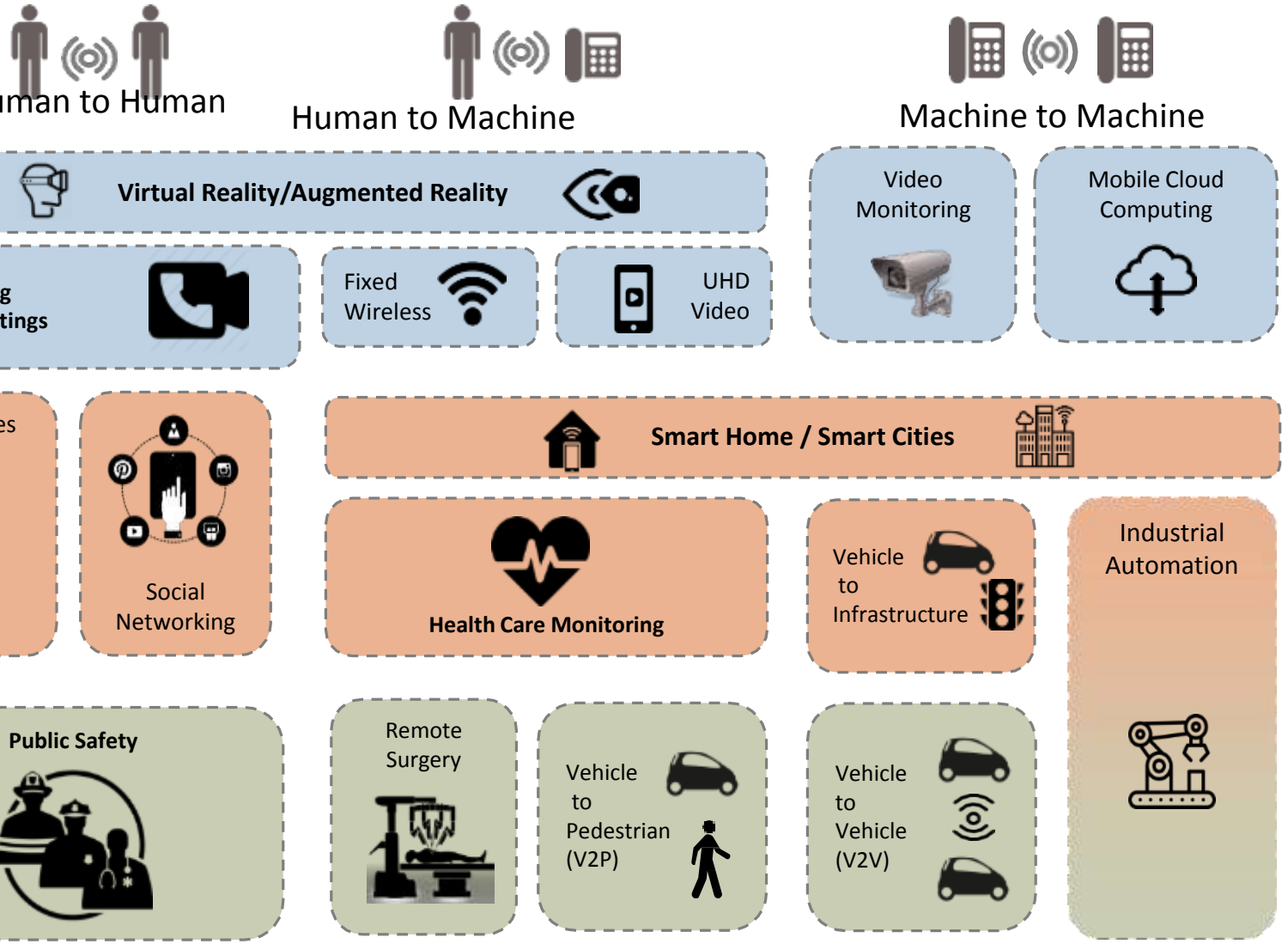
Buyers

- **Consumers / Citizens**
- **Public Sector** (Central and Local Government)
- **Private Enterprise** - Vertical Industry Segments
- **International**


Secure https://uk5g.org
UK 5G Innovation Network
Discover
Connect
Attend
About
Contact
Log in
Join now
Discover more at UK5G events
UK5G facilitates and encourages the engagement and coordination of organisations working on 5G activities across the UK.
Attend UK5G events

What is 5G?

Summary of 5G Use Cases



Enhanced MBB
- 20/10 Gbps DL/UL*
- 4 ms user plane latency
- 500 km/h mobility

Massive MTC
- 1 million devices / km^2
- 10+ years battery life
- 20 dB coverage enhancement

URLLC
- 1 ms user plane latency
- Highly secure / resilient
- 99.99999% availability

* Peak theoretical rate

Source: 5G Americas

Source: 3G4G – see www.3g4g.co.uk

3G4G

Initial 5G Use Cases:
demonstrating the possibilities of 5G

5GRIT

Lead: Cybermoor
Field: Consumer, Tourism, Agriculture

Liverpool 5G

Lead: Sensor City
Field: Health, Social Care

5G Rural First

Lead: Cisco
Field: Agriculture, Utilities

5G Smart Tourism

Lead: West of England CA
Field: Tourism

AutoAir

Lead: Airspan
Field: Connected Autonomous Vehicles

Worcestershire 5G Consortium

Lead: Worcestershire LEP
Field: Manufacturing

5G RuralFirst

Connectivity for the UK's rural businesses and communities. Demonstrating technologies, strategies and new business models.

29 Partners and 3 testbed sites in Orkney, Somerset and Shropshire.

5G Cloud Core Network – the world's first deployment of a CUPS based packet core

Dynamic Spectrum Sharing – demonstrating how it can promote competition, encourage investment and provide high speed data transfers throughout the UK

5G Radio Access Technology - enhanced mobile broadband to communities

Agri-tech - wearable technology on cows

Broadcast - the UK's first 700 MHz/3.5 GHz radio network

Industrial IoT - accurate remote monitoring of fish health and water conditions

Community and Infrastructure - high speed connectivity to moving tour buses

autoair

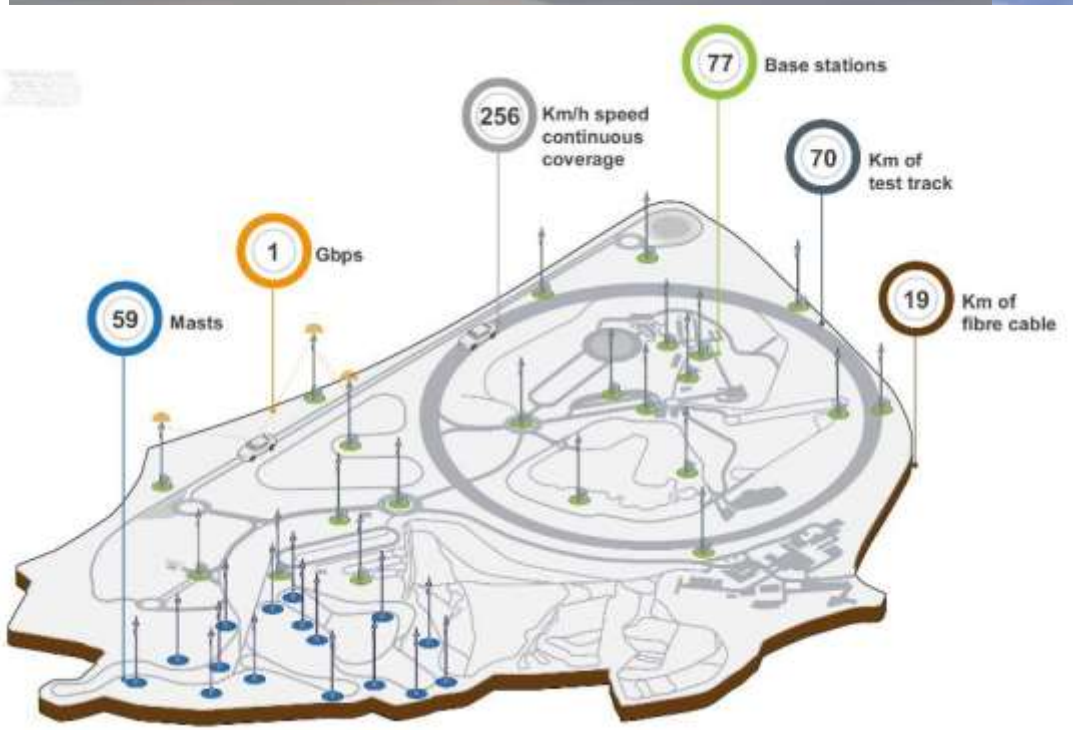
Millbrook Proving Ground + 11 organisations

Hyper-dense smallcell network (89 cells deployed over 59 locations)

Backhaul using a mix of fibre and mmWave

5G-NR, 5G-Core emergence

Download speed of 1 Gbps+ @ 160 MPH (250



Applications

- Connected and autonomous vehicles
- Connected trains
- Video heavy lifting: “seeing” traffic ahead, warning of emergencies
- Exploring **neutral host models**: Techno-economics of networks along transport routes

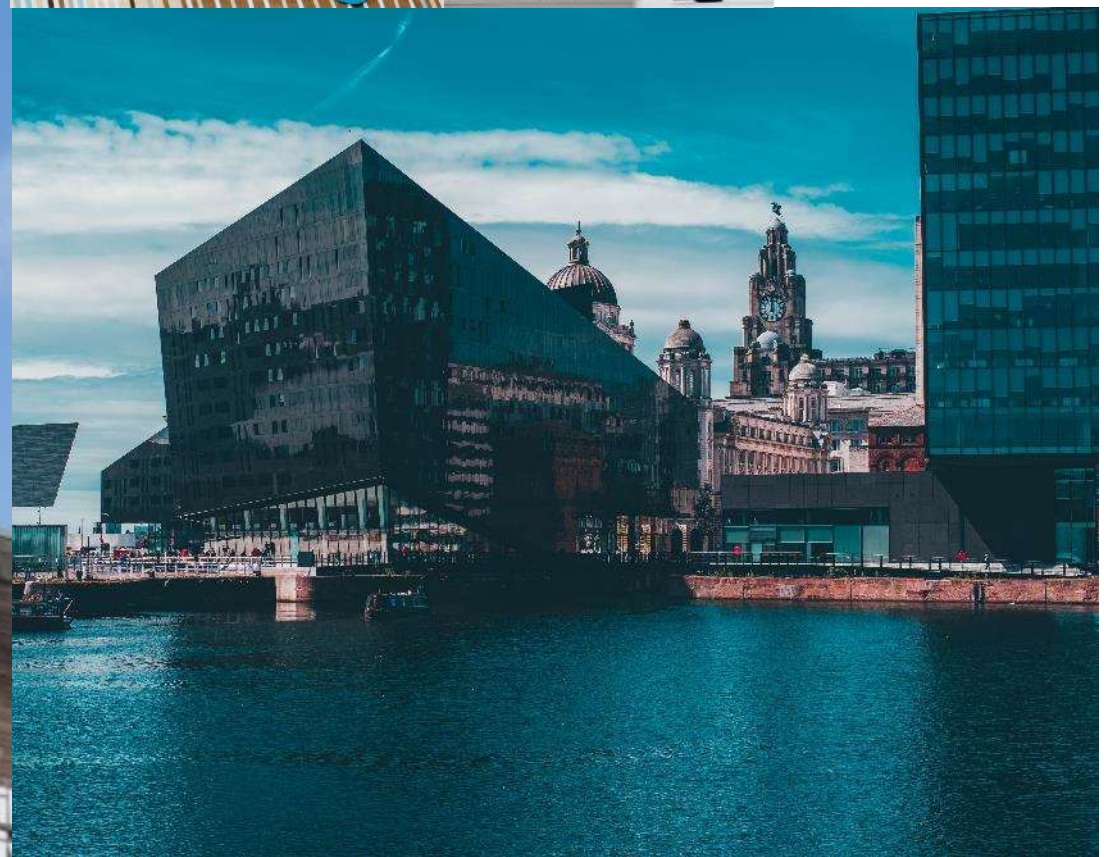
NHS, Universities, Liverpool City Region and businesses

Improving quality of life and reducing costs

80 cells installed on street lamps - guaranteeing coverage & Wi-Fi

Applications

- Assisted living: sensors on chairs, fridges, mains plugs, taps, in beds and doors can detect changes in routine
- Communications: portable, one-way 4K video and two-way audio device - patient to pharmacist
- Loneliness: push to talk wireless calls - connecting patients and carers; tablet-based quiz games



5G Smart Tourism

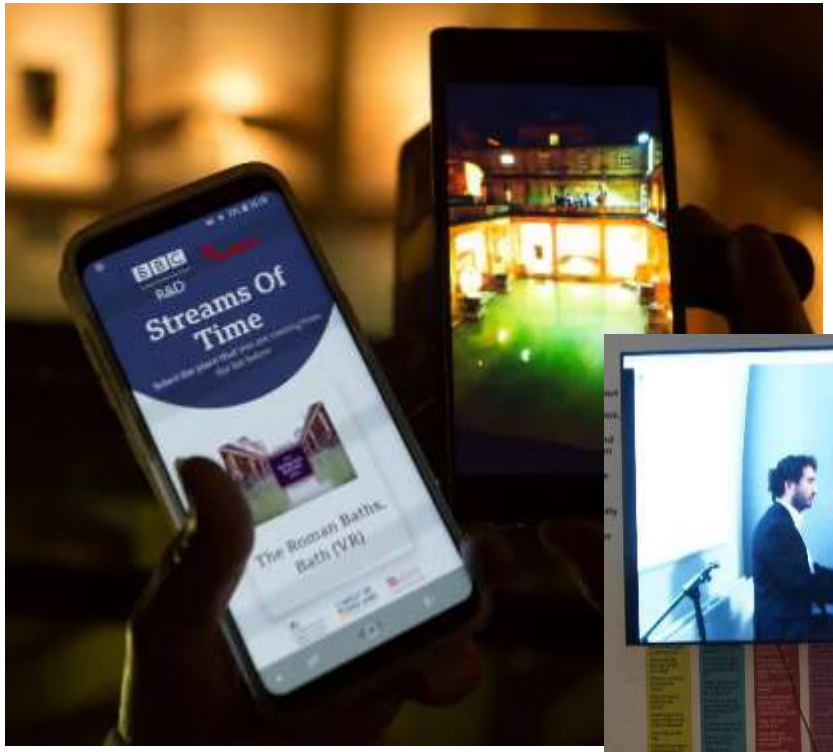
University of Bristol, Local Authorities, Businesses

Bristol City, Bath

- Roman Baths : high resolution augmented reality - geo-located 360° videos on a smartphone with multiple users and low latency. Animations showing different ages of the Roman Baths
- Museum and artwork guides using standard smartphones
- Immersive 360° video for 50 x multiple users simultaneously
- 5G Concert - linking musicians in Bristol and two separate locations in London (Euston Road and the Guildhall) playing together with a latency of under 20ms.

Bristol Smart City applications

- Extensive fibre and wireless systems eg: 2,000 connected street lights
- CCTV safety applications. Thermal Imaging covering Bristol harbour with mmWave installations that allow detections, swift emergency response, and operations centre staff to engage with public through speakers



But what about the rest of media and the arts?

That's why we are here today

Get involved!

You are invited to:

- Register at **www.uk5g.org** and ask your contacts to register as individuals, organisations and projects
- Upload relevant content using your dashboard
- Send any queries to **hello@uk5g.org**
- Follow us on LinkedIn and Twitter - just search ‘uk5g’

The UK5G Advisory Board

Rosalind Singleton
Chair UK5G

Paul Beastall
Cambridge Consultants

Adam Beaumont
aql, University of Leeds

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Founder, TM Forum

Wenbing Yao
Huawei

UK 5G Innovation Network

Any questions?

hello@uk5g.org

Panel Discussion: impact of 5G on museums, heritage and the wider tourism and creative industries sectors

SPEAKERS

Chris Michaels
The National Gallery

Mischa Dohler
King's College London

Ian Smith
DCMS

Gabrielle Jenks
Manchester International Festival

MODERATOR

Alexandra Lowe
UK5G/Smartify

MIF Manchester International Festival

- MANCHESTER
- INTERNATIONAL
- FESTIVAL

- MIF launched in 2007 as an artist-led festival presenting new works from across the spectrum of performing arts, visual arts and popular culture
- The Festival is staged every two years in Manchester, to live audiences of over 300,000
- The next edition will take place in 2021 at venues all over the city
- In just over a decade, MIF has been pivotal in building Manchester’s reputation as a cultural hub, becoming one of the world’s most successful and innovative festivals

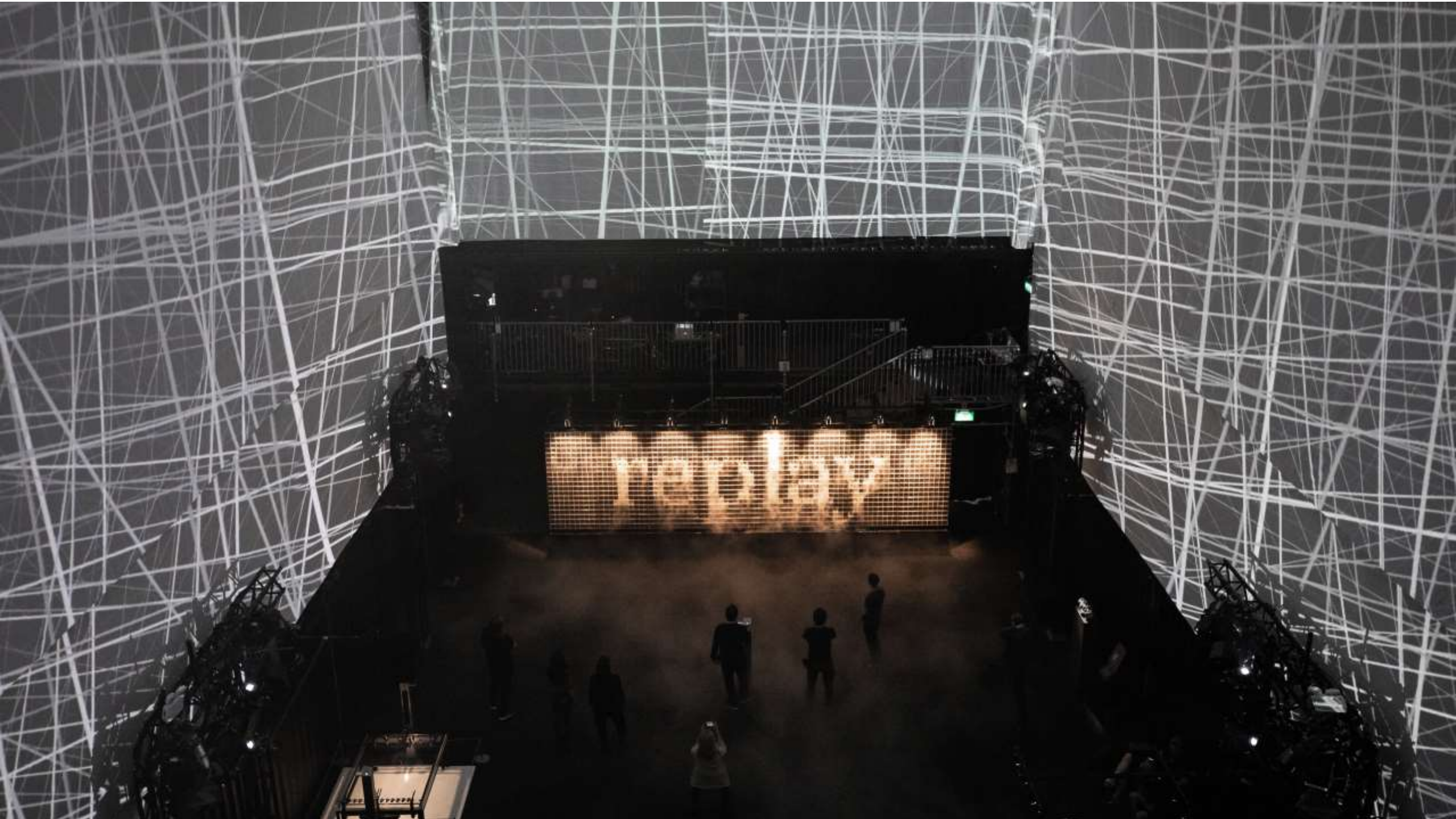
- Bjork Digital / VR

LA PHIL PRESENTS
BJÖRK
DIGITAL
MAY 19-JUN 4 / LOWER LEVEL
Bowers & Wilkins
vive

- Dystopia987, Skepta
- MR in live performance

I CAN
PLEASE
THE OTHERS
YOU WILL

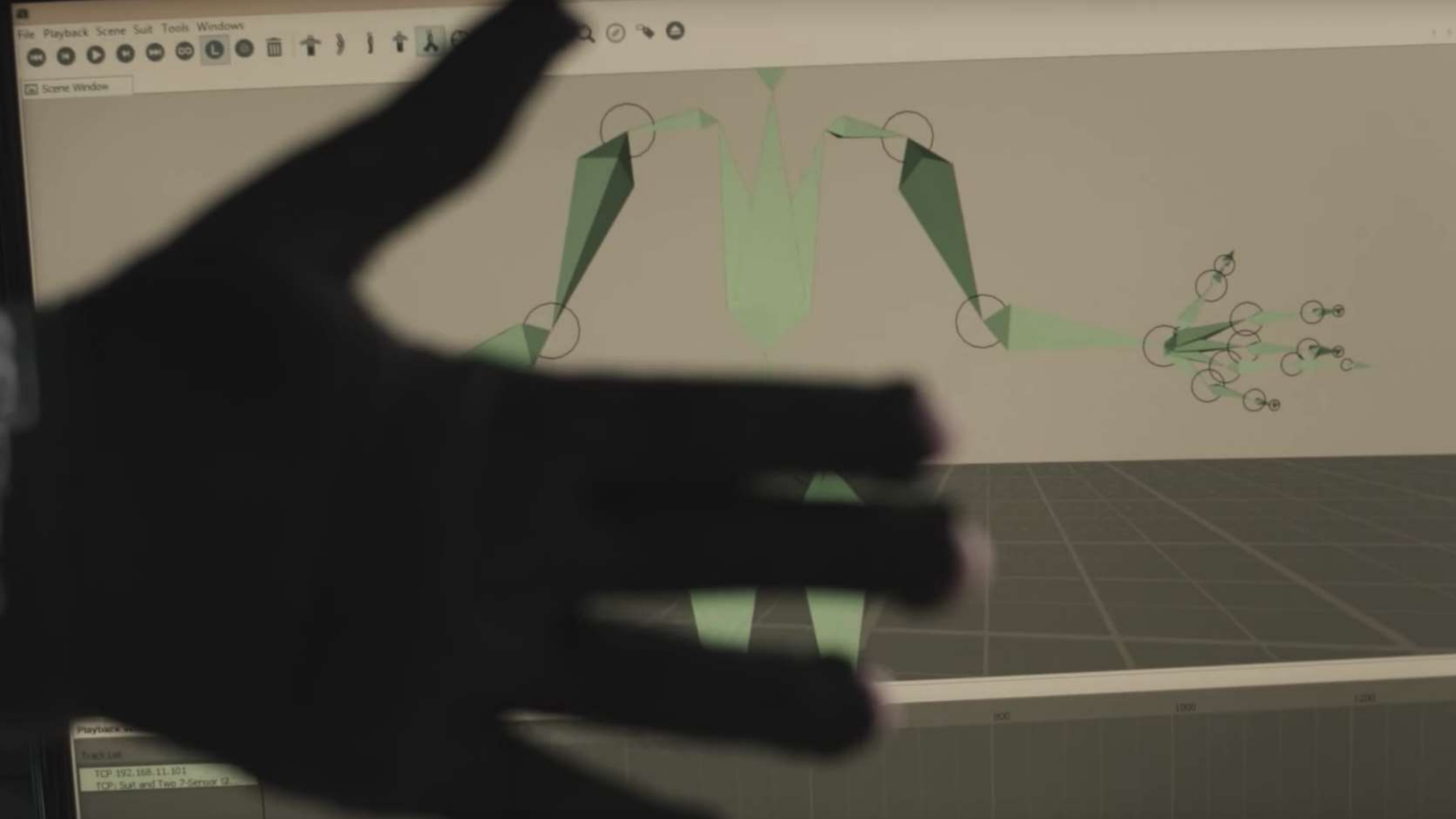
- Atmospheric Memory, Rafael Lozano-Hemmer
- Installation


relax

remote

- Performance Capture, Ed Atkins
- Installation

praxes.
Just like that.
Routed entire limbs, whole systems,
Breaking the surface
But properly strip-mined the interior
Through brush contact
Molar-pulped white lolly-
-Gagged stick and spatula lickers
weapons.


File Playback Scene Suit Tools Windows
Scene Window
Track List
TCP: 192.168.11.101
TCP: Suit and Two 7-Sensor (2

King's College London

Department for Digital, Culture Media & Sport

ERICSSON

5G and The Internet of Skills In Action

Prof Mischa Dohler

Fellow of the IEEE, Royal Academy of Engineering, Royal Society of Arts & IET

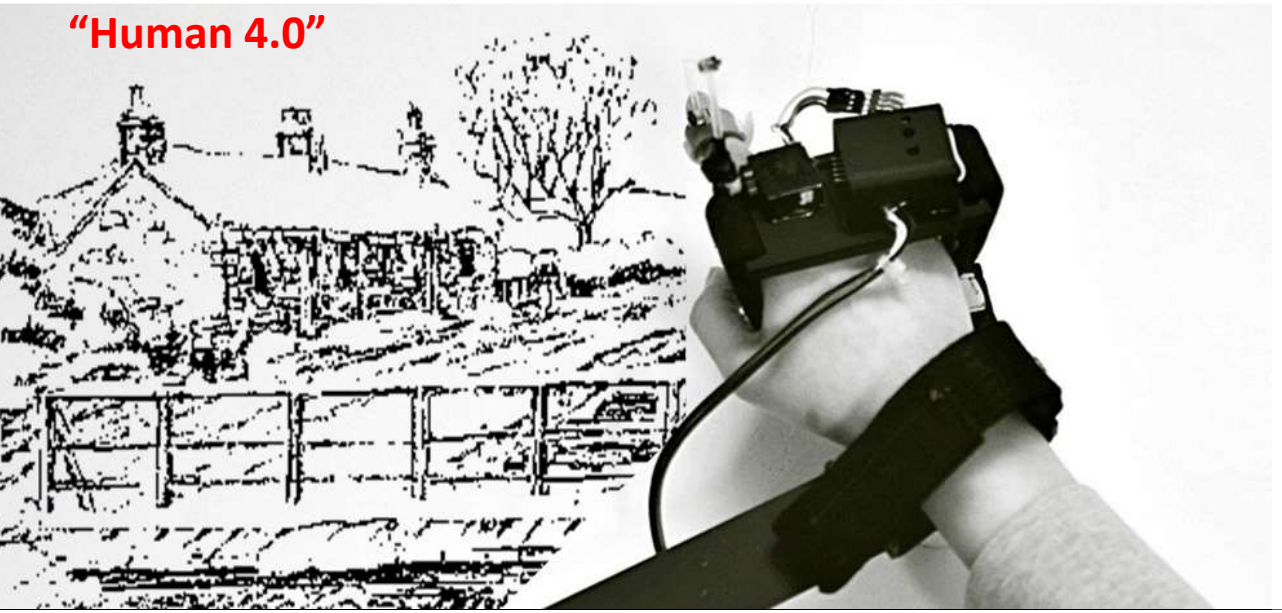
Chair Professor, King's College London

Cofounder, *various companies*

Composer, *various albums*

NGX 5G Panel, March 2020

Spotify Google Play iTunes



- pioneering the next generation Internet, the Internet of Skills, which is underpinned by 5G and beyond
- will be an enabler for remote skillset delivery and thereby democratize labour globally the same way as the Internet has democratised knowledge
- http://money.cnn.com/2018/02/05/technology/business/5g-internet-of-skills/index.html

Vision: Internet of Skills

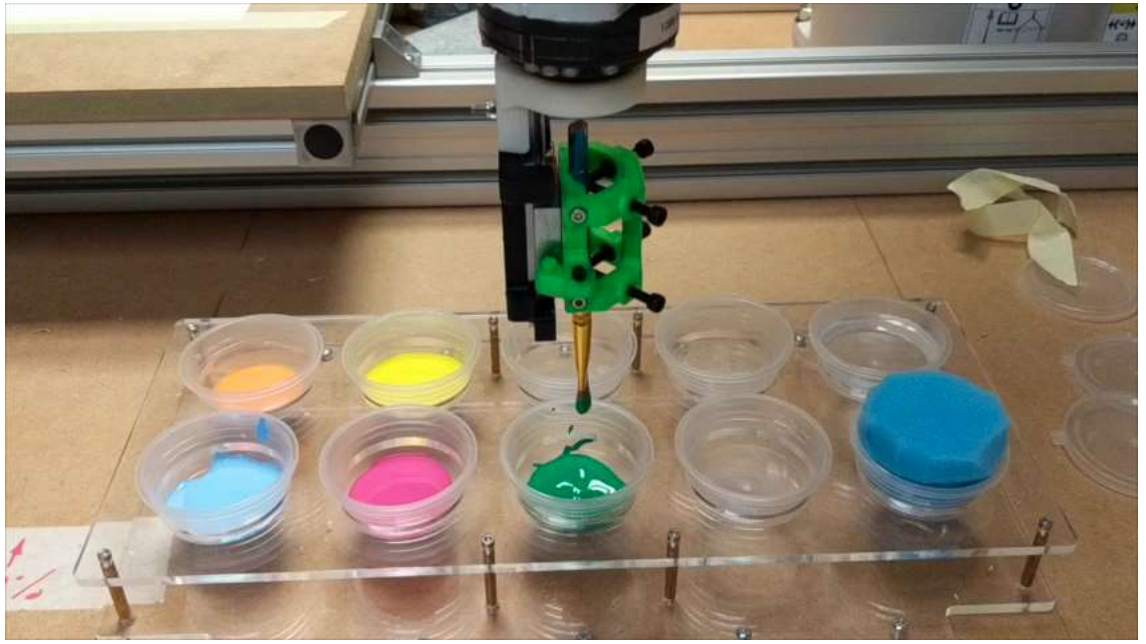
- Virtual Reality brings the consumer into another world.
- **The immediacy and immersion of 5G enables Synchronized Reality which brings two or more environments together.**
- Pioneering concept covered by CNN: www.youtube.com/watch?v=l7Kd4MgKFFU

DJ'ing: Synchronized Reality

- **braud.io** is a novel technology for immersive sound recording, synthesis and rendering, developed by Prof Zoran Cvetkovic, et al., King's College London
- It enables unprecedented control over soundscape designs and real time rendition of dynamic scenes, and is currently being "5G-cloudified" to support scalability

5G Spatial Audio (Cloud)

- Redefining the artistic act of painting by using robotics and AI
- Bridging creative arts and innovative tech with Massive Attack artist Rob del Naja
- First results are very promising!



Arts: Future of Painting

https://bit.ly/2yYvLnU

A night at the museum – with 5G

Rostelecom and Ericsson have launched a 5G trial network at the State Hermitage Museum in St. Petersburg, Russia – one of the largest art museums in the world.

As part of the launch, two new 5G use cases were demonstra using a mix of virtual reality, haptic technology, and robotics.

In the one case, an object of art was restored with the help of remote-controlled robotic arm. The high bit rate, low-latency characteristics of 5G enable art masters with rare expertise to conduct restoration work with a high degree of accuracy – fr anywhere in the world.

In another use case, the partners demonstrated the possibilit of 5G for remote learning. As part of this, an art master used remote-controlled robotic arm to show students precision techniques for restoring works of art. Both demonstrations us 4K video stream transmitted to VR glasses to create an effect presence for both master and students.

Arts: Remote Restauration

- Guildhall, London – Brandenburger Tor, Berlin
- World's first distributed concert using ultra-low latency 5G, with an end-to-end delay of 20ms (!)
- Ambition is to make commercial applications with major music brands
- Reported in **The Times:** bit.ly/2OGO5Vu

My 5G Distributed Concert

Thank you!

National Gallery X

UK5G

March 2020

National Gallery X - the story so far

- An **‘infinite studio’** launched in September 2019
- A **partnership** between the Gallery and King’s
- A **programme** of residencies, events, research and learning
- An **operational space** with core technology competencies
- A focus for different kinds of **funding**

Residencies - the story so far

Peter Wiegold & and Kier Vine

- Live performance and spatialised audio inspired by Turner's *Rain, Steam and Speed*
- Using immersive sound technologies by Prof. Zoran Cvetkovic
- Performance at launch event
- New showcase event in May (TBD)

Residencies - the story so far

ANALEMA Group

- Immersive light and sound installations based on 6 Gallery paintings
- Working with Gallery and KCL researchers on colour data transformation
- Showcase week 16-22 March

Residencies - the story so far

MIMA School of Art and Design

- Live performance and installation based on history of access, disability and mobility
- R&D week April
- Showcase week JuneJune

Refreshment break: 25 min - (start again at 15:10)

Workshop and feedback: 30min + 20 min (stop at 16:00)

How can we accelerate 5G adoption?

Table 1: AR & VR - content production and distribution

Table 2: Connected Tourism

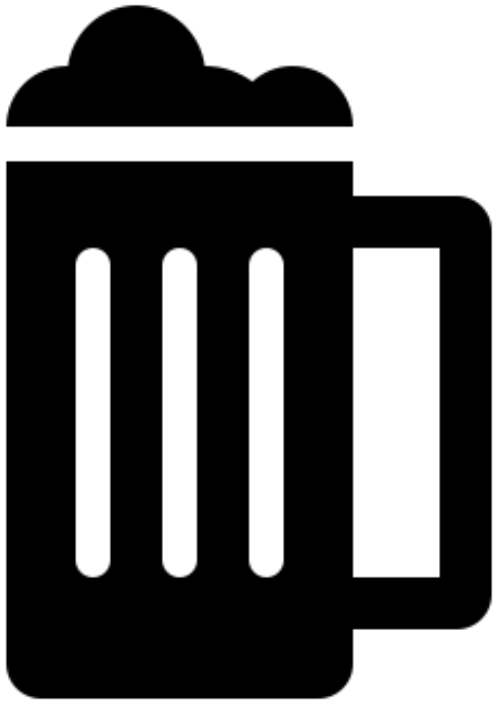
Table 3: Government & Regulations

Table 4: Infrastructure & Technology

Table 5: The Virtual Museum

Summary & final remarks

Anna Lowe
UK5G Creative Industries Working Group member
Smartify Co-founder

Alex Connock
Deputy Chair of the UK5G Creative Industries Working Group
Fellow at Said Business School, Oxford University

Networking drinks