WEST OF ENGLAND
Combined Authority

5G-enabled Smart Tourism in the West of England

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About the West of England

- West of England Combined Authority - WECA
- Led by Mayor Tim Bowles
- Population of 1,131,300
- 90% of residents work within the region
- Skilled workforce – 4 Universities
- Diverse economy – Aerospace, FIN TECH, Digital, Creative
- Smart City – Bristol recognised international leader
- Broadband connectivity –
  - Bristol average currently 64mbps down and 5.6mbps up
  - Bath average currently 37.4mbps down and 5.1mbps up
- We need a world class 5G infrastructure to enable inclusive growth
Why Smart Tourism?

The project operates at the interface between 5G networks, high tech applications and digital creativity. This is one of the WoE region’s “sweet spots.” It is also a fun and engaging “front door” for wider 5G engagement.

- Internationally significant World Heritage attractions
- 28 million day visitors and 3 million overnight stays
- Tourism sector employs 55,000 people
- Visitors contribute c.£2 billion to the region’s GVA
- Bristol & Bath is the “most significant and fastest growing digital cluster outside of London”
- The high tech sector supports 36,000 jobs
- High-tech contributes £1.7 billion to the region’s GVA
Smart Tourism – a step towards our 5G Vision

We aim to be a model smart urban connected community and leading 5G Smart Region
5G-enabled Smart Tourism will generate benefits across the whole Visitor Economy value chain.

- **For Visitors:** Compelling experiences that add value to high-quality destinations; enhanced visitor safety; wide awareness of 5G benefits
- **For Tourism Providers:** Increase relevance and accessibility, attractive for younger audiences; new business models and revenue generation
- **For Creative and High Tech Sectors:** A high profile showcase for the talents of the WoE and UK SMEs, including Augmented, Virtual and Mixed Reality content and apps
- **For 5G Network and Service Providers:** Demonstrate 5G KPIs; showcase 5G benefits to the public; add to the investment case for UK 5G roll-out

Experimentation with Smart Tourism will develop 5G learning to numerous urban challenges and business sectors

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**Smart Tourism Vision:** innovative 5G infrastructure, end-to-end 5G services and new business models
Our Smart Tourism Eco-system
LTE-A 2.6GHz with ~20 dedicated AR/VR terminals
3.5 GHz M-MIMO and 3.5 GHz RAN in place by Nov.’18 with a handful of terminals
26 GHz CCSL technology for backhaul
Wifi: Ruckus & Nokia
Fixed Fibre / Ethernet for back-haul and transport
LiFi in the Museum
OpenStack Controlled Compute Nodes & Edge Computing

Our current 5G Testbed
Our current 5G Testbed

Service Creation
Test Network Experimenter

MANO

User Interface
OSM Client

Service Orchestrator

VNF Monitor Manager
VNC Configuration Manager
Resource Orchestrator

CloudBand

Openstack

NetOS

SDN Controller

Open Source

VNF Monitor Manager
VNC Configuration Manager
Resource Orchestrator

NetAct Controller

EPC / 5G Core
Nokia-MEC

Optical Circuit Switch
Packet Switch
Wi-Fi

Service Creation
Test Network Experimenter

4G LTE-A
5G NR
WiFi

Nokia

UoB-MEC

Servers
Compute & Storage

Optical Circuit Switch
Packet Switch
Huber and Suhner Polatis // EdgeCore // Corsa ... Switches
Ruckus

UoB-MEC
Nokia-MEC

Nokia
5GUK Exchange – Enabling National and International 5G Collaboration

User and Management Interface

5GUK Exchange (5GUKex)

Island 5GIC
Island UoB
Island KCL

MANO
NFV Control
SDN Control

NFV Control
SDN Control

NFV Control
SDN Control

MANO

Physical Infrastructure

Inter-island Infrastructure

Further Test Networks
5GUK Exchange – Software Architecture

Experimenters

5GUKex

User Authenticator
Network Service Composer
Network Service Manager
Network Service Request Broker
Inter-domain Connectivity Manager

Experimenters

Island Orchestrator

Island Auth
Island Auth
Infrastructure Orchestrator

WIM
VIM

Island Infrastructure

Interconnection Infrastructure

WIM
VIM

Island Infrastructure

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**HPN, University of Bristol**

4G EPC equipment will be installed during Phase 1 5G Testbed and Trial. This will be upgraded to 5G core when available. Existing equipment will connect to new Testbeds.

**SS Great Britain**

- 5G Micro BRRH
- Wi-Fi AP
- Combined Micro BRRH + Wi-Fi Small Cell
- mmWave Mesh (25 & 50GHz)

- Crew cabins
- Galley, etc.
- Dining area
- Combined 5G BRRH and Wi-Fi small cell

**Bath City Centre & The Pump Rooms**

- Existing BANES Wi-Fi used to provision inclusive connectivity. Add another SSID
- BANES Wi-Fi Controller

- 1 x Combined Micro RRH + Wi-Fi Small Cell per location/exhibit. Excluding restaurant and spring room
- 5G Micro RRH mounted outside the Bath complex on adjacent building
- Discretely mounted Wi-Fi in Bath's area

**M-Shed Museum**

- 1 x Combined Micro RRH + Wi-Fi Small Cell per location/room

*Note: WTC This is an existing 5G Testbed*
Access to spectrum?

- Our target carrier frequencies are 2.6 GHz FDD, 3.5 GHz, 26 GHz and 60 GHz
- 100MHz bandwidth will be utilised in the lower than 6 GHz carrier frequency
- The 2.6 GHz FDD is no longer available. We are in touch with Nokia for radio replacement at 2.6 GHz TDD where there is spectrum availability
- UoB is already using T&D licences for operating at 3.5 GHz and 26 GHz until Nov’18. Access to 3.5 GHz is not clear after the auction
- We will apply to Ofcom to extend non-operational test and development licences- in discussion with DCMS for clarity in using spectrum for trials
- BT has commercial licenses in the 2.3 GHz and 3.4 GHz bands- We hope to work with BT towards a viable solution for the project

<table>
<thead>
<tr>
<th>Spectrum Band</th>
<th>Notes</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nationwide and indoor coverage (harmonised)</td>
<td></td>
<td>694-790 MHz</td>
</tr>
<tr>
<td>Ofcom auctioned band</td>
<td></td>
<td>2.3-3.4 GHz</td>
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<tr>
<td>Primary band for introduction of 5G pre-2020</td>
<td></td>
<td>3.4-3.8 GHz</td>
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<tr>
<td>WRC-15 band, candidate for early European 5G</td>
<td></td>
<td>24.5-27.5 GHz</td>
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<tr>
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<td>31.8-33.4 GHz</td>
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<td>WRC-15 band, candidate for early European 5G</td>
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<td>40.5-43.5 GHz</td>
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5G enabled Smart Tourism Use Cases

• Mobile VR for heritage locations – (the Roman Baths, BBC, Aardman); exploring mobile immersive video on demand over 5G in a complex world heritage location

• Network slicing for visitor safety – (Zeetta Networks, Bristol City Council Operations Centre, IBI Group, BiO); demonstrating how 5G network slicing aided by SDN control can enhance visitor safety through real-time managing mission critical comms infrastructure
5G enabled Smart Tourism Use Cases (continued)

- 5G-enabled innovative 3D motion tracker – (Mo-Sys); demonstration of venue-specific content over the 5G network to a person that is moving along a corridor/long space wearing VR kit without the need for secondary tracking sensors, and with contextual content delivered in real-time
- Streaming 4K 360 degree content to multiple users in a small space environment for synchronous play – (Mativision)
- Accelerate digital outreach for regional cultural institutions – will map a series of exhibits and deliver experience over the 5G network – (Smartify)
- Additional use case: (Grand Appeal with Aardman) opportunity to link with the 2018 “Gromit Trail”
- A challenge is to bring the use cases together to aggregate impact.
‘Critical Contribution’ of 5G to Use Cases

• The Use Cases rely on:
  – Use of 5G New Radio and operation at pioneer 5G bands @ 3.5 GHz and 26 GHz
  – Seamless connectivity across heterogeneous networks (wireless fixed & mobile, fibre)
  – High bandwidth to high density of users (1Gbps to 100’s of users)
  – Very low latency (relying on combination of 5G NR+MEC)
  – Mobile Edge Computing to deliver consistent high-quality VR/AR content to users
  – Network slicing and automatic service provisioning (Use case 2 - Public Safety).
  – High flexible network operations responding to different user/application requirements
  – Offering flexible network platforms (NFV/SDN + MEC) within the network infrastructure
  – Open access framework with open APIs for easy 3rd party use and access to underlying technologies, facilitated through the 5G software architecture
Delivered and Demonstrated by March 2019

- An extended 5G testbed across the region
- 5G deployment in high-density, city centre locations
- Flexible and seamless 5G connectivity over different wireless and wired networks
- 5G services outperforming current delivery methods
- Evaluation of demand and public acceptance of 5G services
- Market development
  - Create advanced mixed reality content (BBC) and content-driven network services
  - Trial of new 5G network technologies (Zeetta, CCS)
  - Insights on possible commercial offerings (creative, tourism venues)
Opportunities for Wider Collaboration and Impact

- UoB is founding member of the DCMS 5GUK testbeds (with 5GIC/Surrey & KCL) - Know how transfer and skills development within the region
- KCL and the Digital Catapult are partners and physically connected through 5GUK Exchange - Transfer and demonstrate selected use cases in London
- Strong existing international partnerships on 5G - e.g., Barcelona is already connected to the Exchange for joined experimentation
- Ready to connect and collaborate with city/regions across the UK
- Rich existing portfolio of EU 5G and Smart City projects - the largest number in the UK
- Bristol VRL Lab is now live (Watershed)
- Strong SME pipeline, e.g., via Engine Shed
- Links to region’s LFFN ambition
- Strong City and Regional political buy-in
Summary & Contact Details

- Large and exiting project – 25 partners (21 funded)
- £8 million budget (£5 million grant)
- Led by WECA – part of big ambition to be leading 5G Smart Region
- 6 use cases to demonstrate 5G network KPIs and add value to telecommunications, tourism, digital, creative and other sectors
- Lots to do but we are building on existing strength – University of Bristol - Layered Realities, Bristol VR Lab

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