



The  
Scotland  
**5G** Centre

# Digital Scotland 2022

## 5G Masterclass

Julie Snell (The Scotland 5G Centre Chair)

Prof Muhammed Imran (University of Glasgow)

Prof Robert Stewart (University of Strathclyde)



University  
of Glasgow



University of  
**Strathclyde**  
Glasgow

## The Scotland 5G Centre - National Presence, Regional Focus

We support Scotland's industry and the public Sector harness the power of digital transformation:

- Our 5G Innovation hubs and test beds are spread across Scotland
- We offer free access to cutting edge 5G test beds, to enable: new products, services, efficiency savings and innovative solutions.
- We provide advice to organisations wishing to set up private 5G networks
- We work with our partners to enable connectivity solutions for remote/rural businesses
- Our Business Engagement Managers are available to discuss how we can support your business.



The  
Scotland  
**5G** Centre

# Digital Transformation is good for business

The Scotland 5G Centre supports both the public sector and business of all sizes to unlock the benefits of digital transformation.

5G is part of a suite of game changing technologies that is revolutionising how we do business, enabling for example:



## Increased Productivity

Faster turnarounds,  
Smart factories,  
Remote Operations,  
Upskilling,  
Lowering Carbon Use,



## Decreased Downtime

Realtime Monitoring,  
Optimised  
Maintenance  
Smart Inventories,  
Autonomous  
Logistics,



## Improved Customer Experience

Immersive  
Experience  
AR/VR Visualisation  
Smart Supply  
Chains  
New services and  
products



## Increased Digital Security

Secure Digital  
Identity  
Secure data  
transport  
Threat monitoring



## Reduced Costs

Smart logistics  
Lower energy (than  
existing networks)  
Reduced transport  
Automation



# Digital transformation for all

5G enabled technology is a game changer for all organisations - some examples include:

- **Agriculture:** optimisation agricultural workflow - water management, crop/animal welfare & feeding, monitoring harvest, optimising production etc.)
- **Healthcare:** remote patient care and remote and immersive consultations, decreased waiting times, faster and more secure data transfer, supporting assisted living, improved healthcare logistics
- **Manufacturing:** VR/AR to support remote training, maintenance and repair, powering the smart factory (IoT, automation, AI), digital twinning of critical operations
- **Logistics & supply chain:** Vehicle to Vehicle communications, road traffic management, autonomous transport systems, real time monitoring of the products transported (temperature, moisture...).
- **Energy:** Remote monitoring and maintenance of field assets, smart power management, environmental monitoring



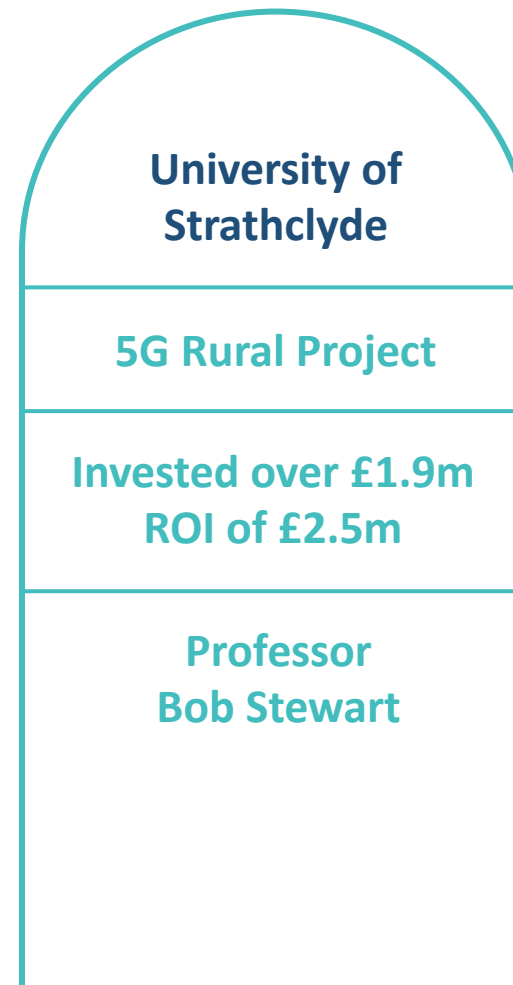
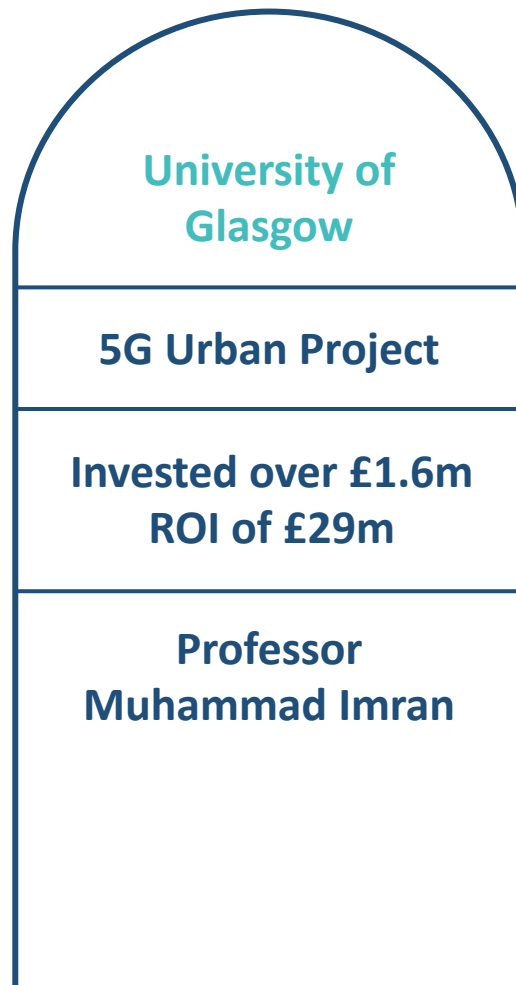
## S5GC Case Studies

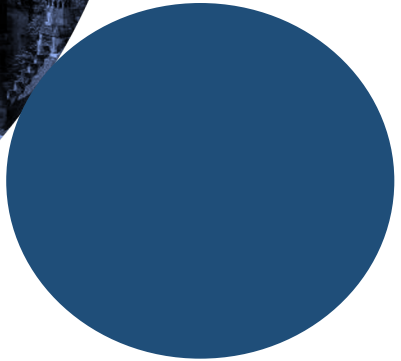
	DDM Health	Safehouse SSID	Care Reality
<b>About the company</b>	Developing digital apps to provide provision care and achieve a cutting-edge digital health ecosystem	Wireless monitoring services for at-home social care	Built a solution to elevate skills training for care home workers, and remote and rural carers
<b>Why 5G?</b>	Tested app over 5G to future proof its development	Data file transfer not available over 4G; deployment without setup not possible through Wi-Fi	Lag and buffering unacceptable for user experience and comfort
<b>Results</b>	<ul style="list-style-type: none"> <li>• Increase service capacity</li> <li>• Reduces waiting time</li> <li>• Saves £100,000 per GP Practise, every year.</li> <li>• Currently being used by 25+ social care services across the UK</li> <li>• Available in 19 languages &amp; all coaching and advice is localised and adapted for different cultures, ethnic and faith groups.</li> </ul>	<ul style="list-style-type: none"> <li>• Non-invasive sensors and GPS assistance buttons</li> <li>• Monitors temperature, electricity and alarms</li> <li>• Listens for panic button alerts</li> <li>• Instant detection of any falls (95% accuracy)</li> <li>• System alerts the emergency contact with optional voice and live streaming video link in real-time</li> </ul>	<ul style="list-style-type: none"> <li>• Available to use anywhere – in cities and rural areas</li> <li>• Consistent quality &amp; high mobility</li> <li>• Users report a 76% skills and confidence improvement;</li> <li>• 230% knowledge retention rate</li> </ul>



## Supporting

The Scotland 5G Centre has invested in three core projects (through our partners University of Glasgow, University of Strathclyde and the Scottish Futures trust) to develop innovative 5G solutions, boost connectivity, develop skills, and develop cutting edge technology.





University  
of Glasgow

# 5G Urban Digital Innovation

Prof Muhammed Imran (UoG)



The Scotland  
5G Centre

# Glasgow 5G Urban Testbed



University  
of Glasgow



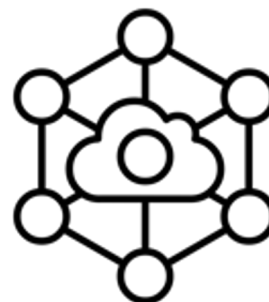
The Scotland  
**5G** Centre

## Self Organising Network



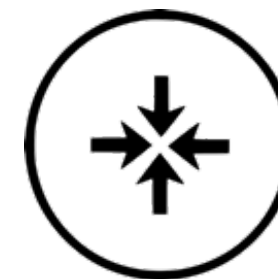
Automated configuration,  
optimization and healing of  
mobile networks

## Internet of Things



Supporting IoT  
technologies including  
WiFi-6 and LoRaWAN

## A Local Network










Alternative to wired  
technologies to reduce  
CAPEX/OPEX



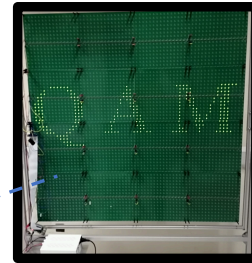
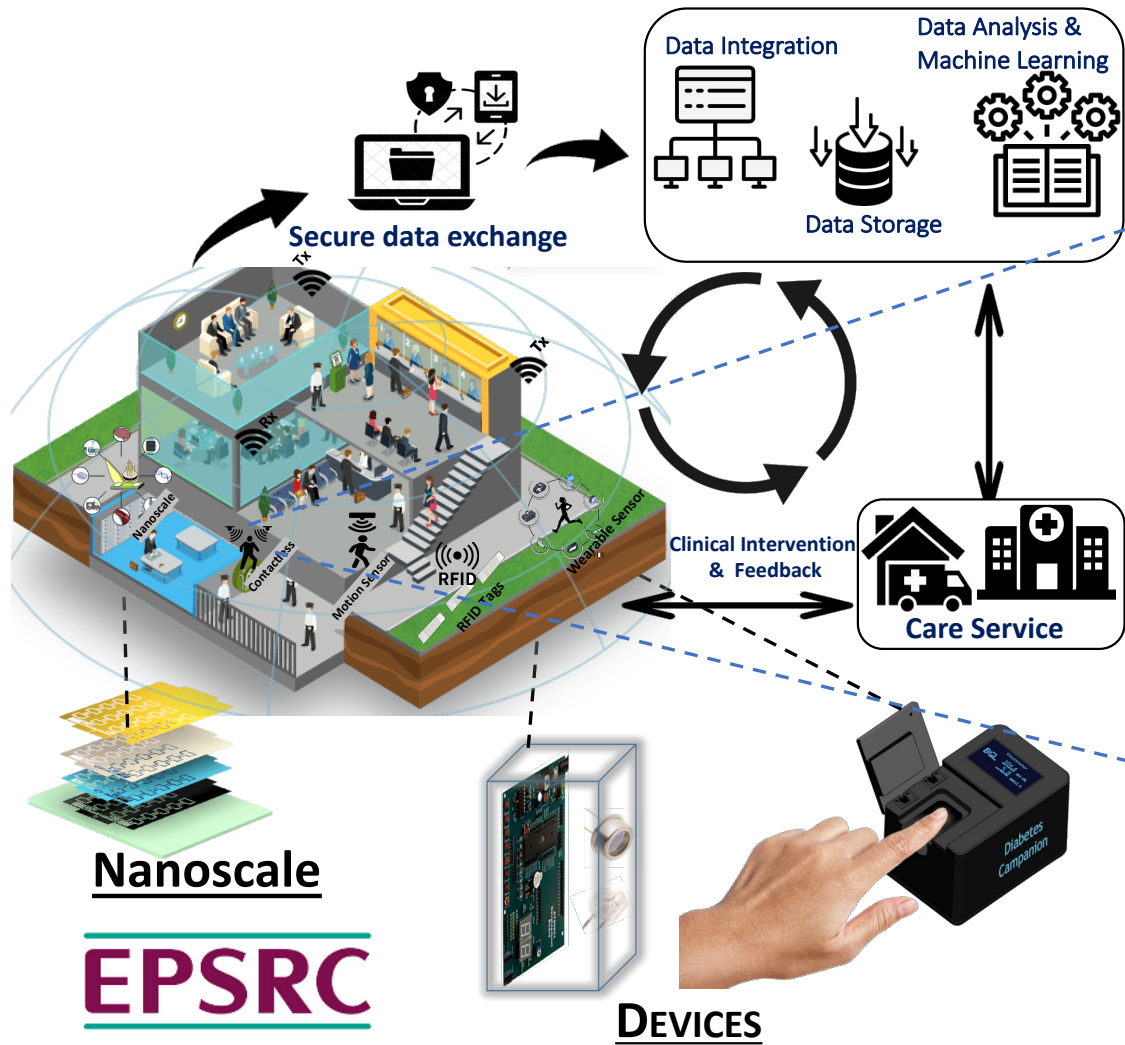
# 5G Smart Campus



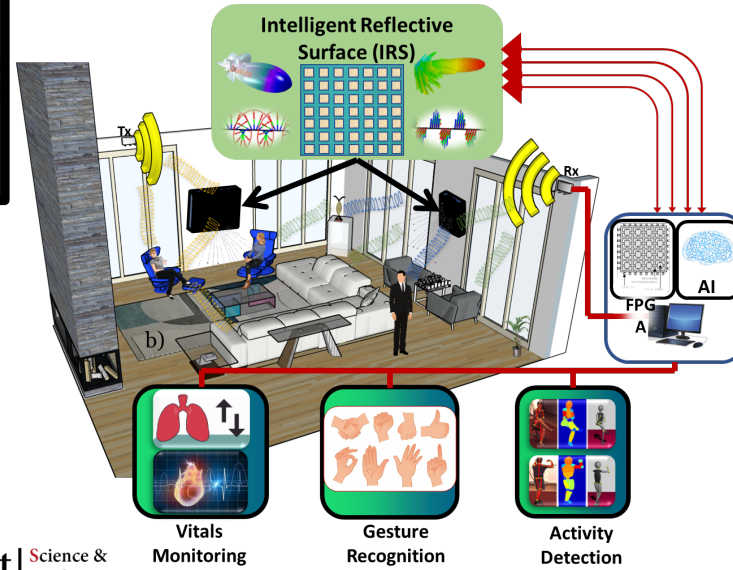
# Overview of Use Cases

Scalable Use Cases Platform	Partners	
 <b>Contactless Activity Monitoring</b>	5G New Thinking, BT, H&S Alliance Scotland, Quest	URLLC, MEC, eMBB, Smart Mobility Management, QUEST
 <b>Live Augmented/Virtual Reality (AR/VR)</b>	Eon Reality, BT, VRtuoso	URLLC, MEC, Education 4.0
 <b>Connected Health Devices</b>	Quest, Holoxica, BT	mMTC, Contact tracing, Contactless monitoring, COGMHEAR, Telepresence
 <b>Secure IoT Platform</b>	Berringar, Victory Bench (beep trace)	mMTC, RFID Space and Asset Management, Persuasive Energy Conscious Network
 <b>Pop-up Network</b>	AWTG, Nokia	SON, Agile deployment
 <b>Wireless Control</b>	Shadow Robot Company, Oxford Robotic Institute	URLLC, MEC, AI/ML, Industry 4.0, Education 4.0
 <b>V2X</b>	Telefonica, Arwin	URLLC, MEC, AI/ML, Industry 4.0

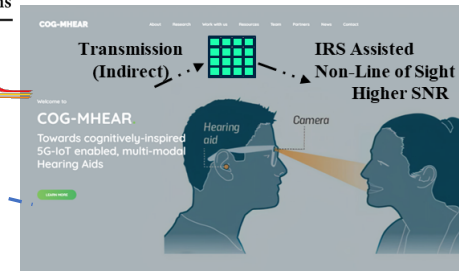
# Connected Healthcare



## CONTACTLESS SENSING



Light | Science & Applications  
nature.com/lsa  
nature COMMUNICATIONS



SCIENTIFIC REPORTS  
nature  
eLight

COG -MHEAR 2050  
~£4M

QUEST for healthcare  
2050 ~£5.6M

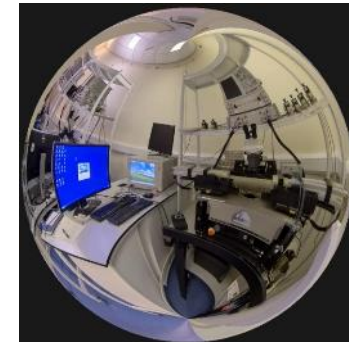
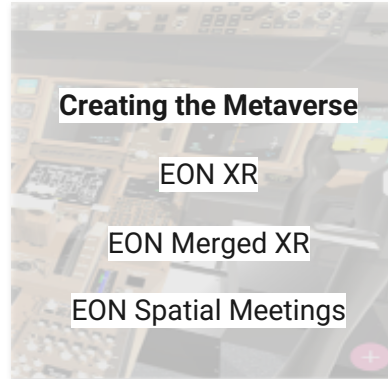
# Immersive Training



Edinburgh



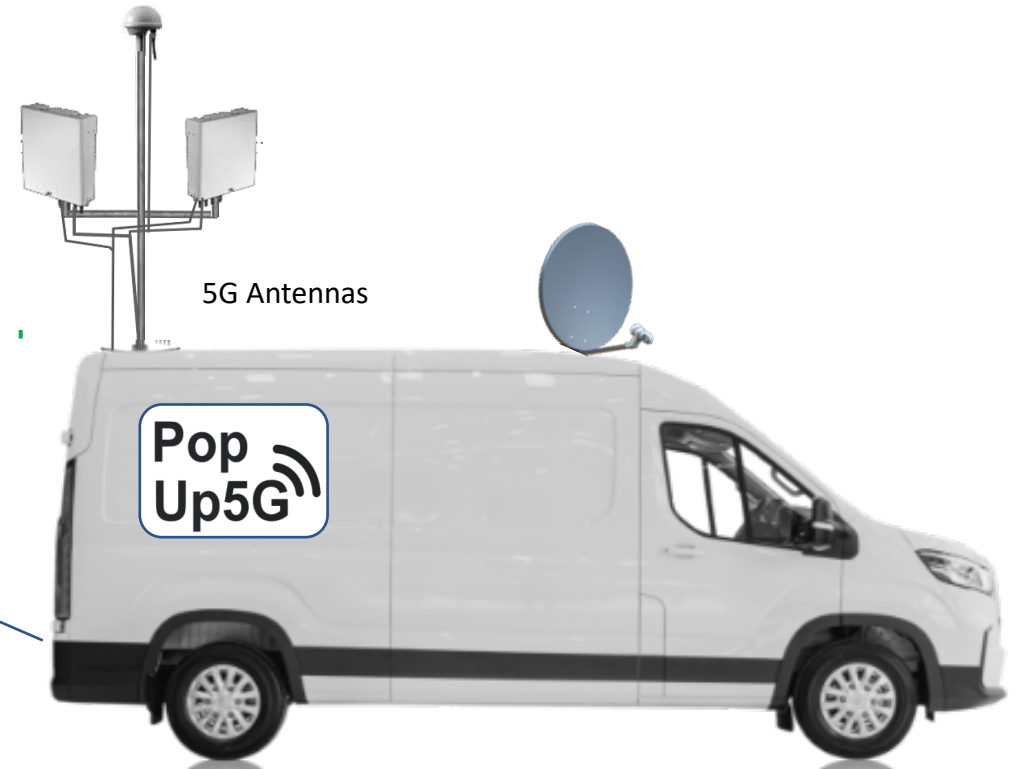
University of Glasgow



EON – Glasgow XR Centre

# SON - 5G - Pop up Network

- OFCOM Shared access license (3.8-4.2GHz)
- Agile Deployment for temporarily bridging the coverage gaps
- Commissioning/Decommissioning in minutes
- Backhaul Agnostic with secure IP tunnelling to G5G Core



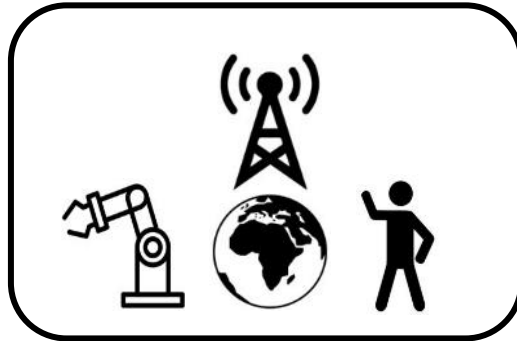
# 5G - Teleoperations



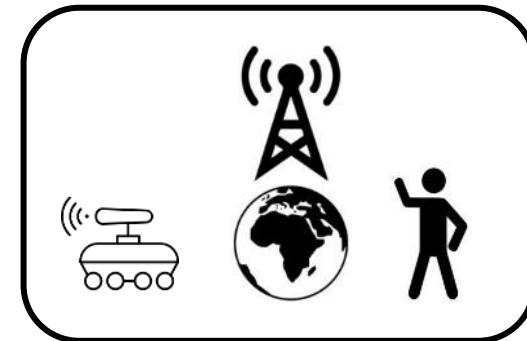
University of Glasgow



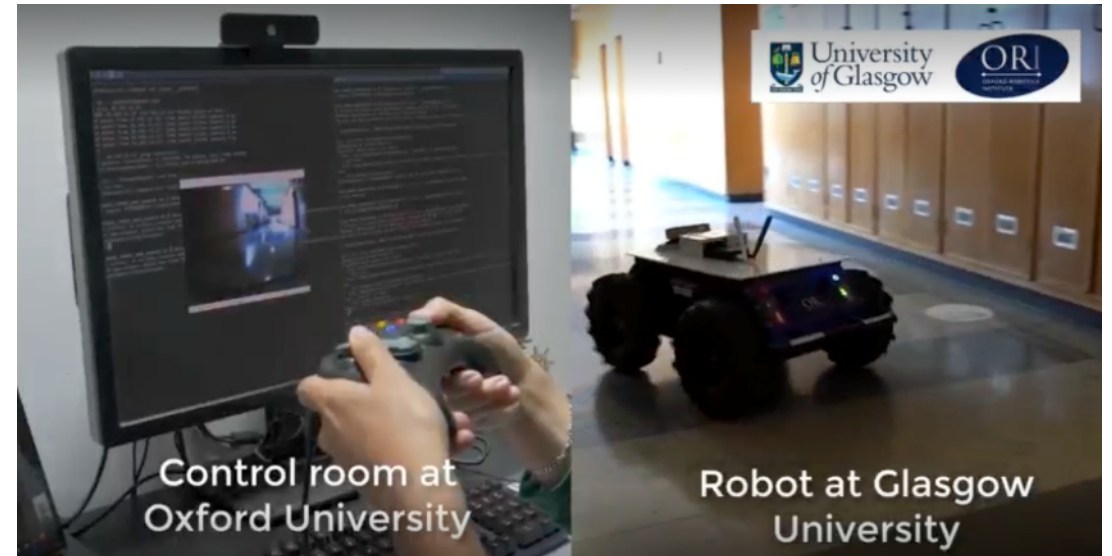
The Scotland 5G Centre



Remote Robotics Control



Remote AGV Control



# 5G Wave 1 Rural Testbeds:

What (just!) happened next ?

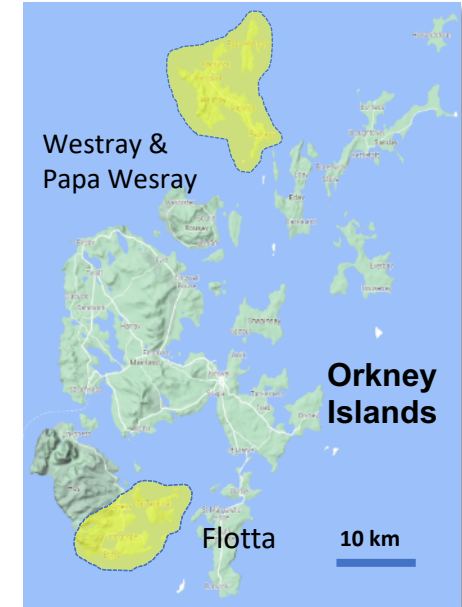
From Scotland to the World

Professor Bob Stewart  
University of Strathclyde  
Glasgow, Scotland, UK



# 5G Rural Testbed: Orkney & Loch Lomond

- Rural Shared Spectrum Testbed: Oct 2019 to March 2022





# 5G (Rural) Private Networks - Ingredients

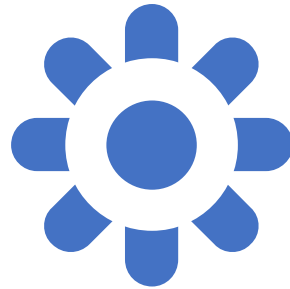
*RAN &  
Backhaul*



*(Shared)  
Spectrum*



*Cloud &  
Core*



*Market  
Demand*



*Community  
& Civic*

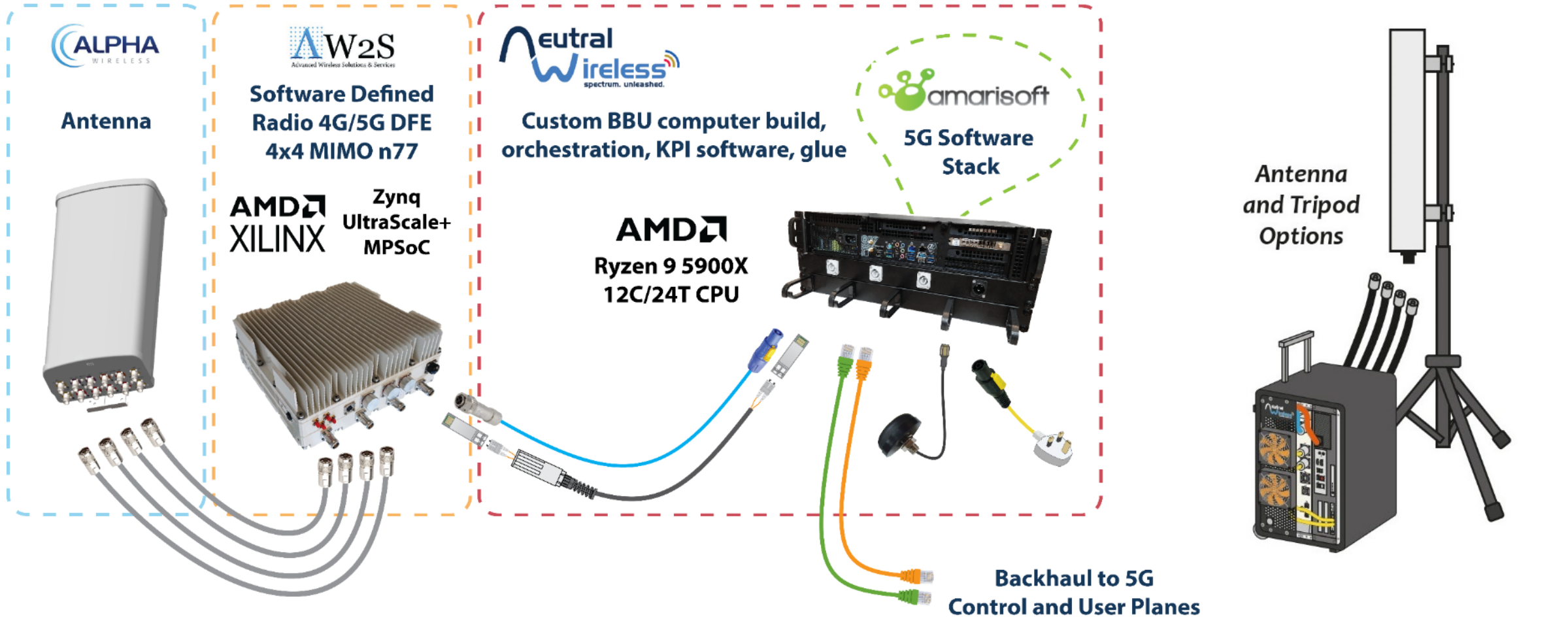


*5G Radios and  
UEs*



?

# Design your own 5G Software Defined Radio (with Partners!)



University of  
**Strathclyde**  
Glasgow

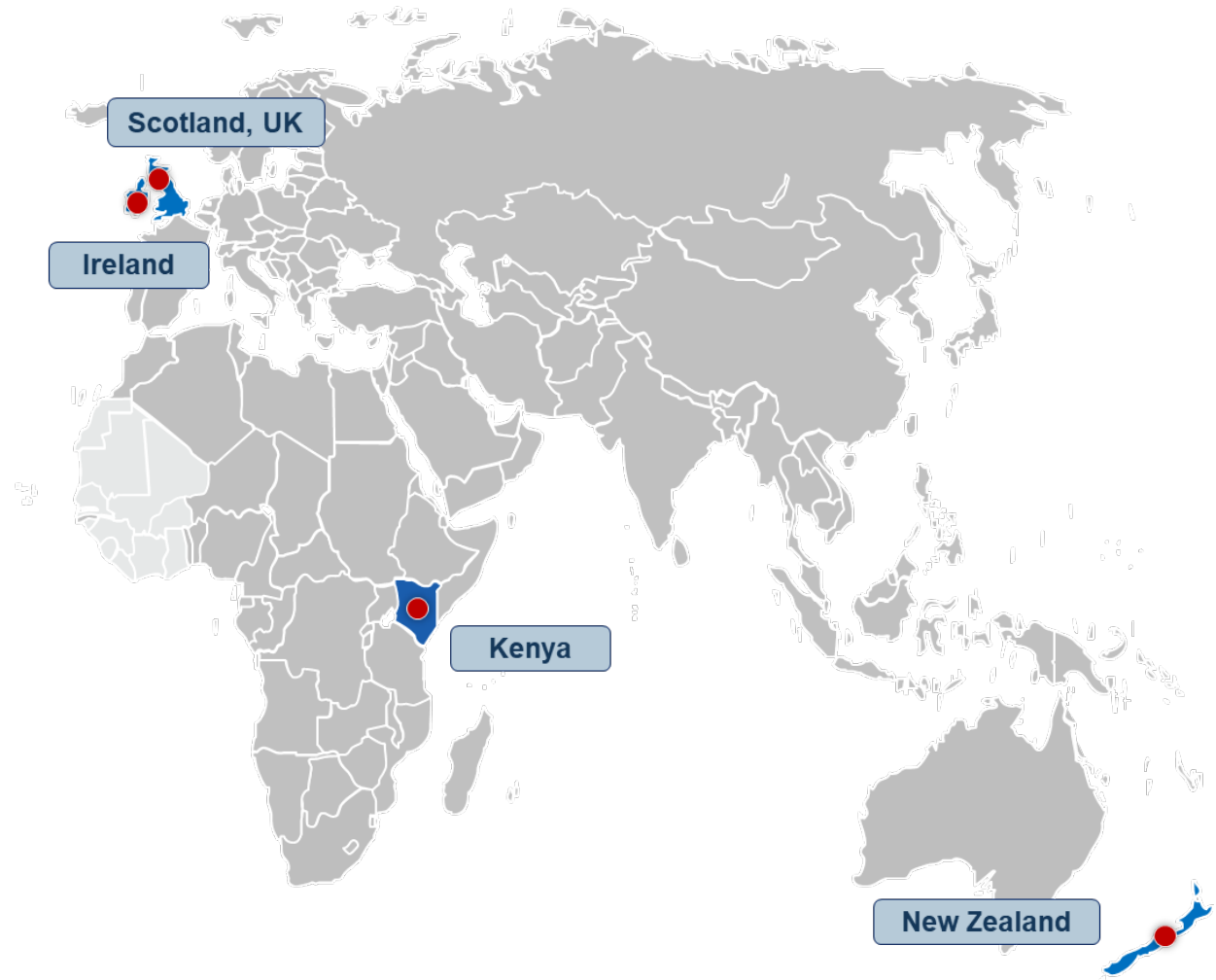


The Scotland  
**5G** Centre



## 5G Rural ... Same Challenges Everywhere ...

1. Backhaul limitations – (Satellite, Fibre or MNO)
2. No mains electrical power – (Battery and/or Renewable)
3. Private or Non-Public Network (NPN)
4. Local cloud/core facility for remote production
5. Portable – deployable in <30 mins



University of  
**Strathclyde**  
Glasgow

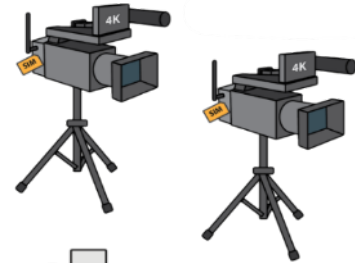


The Scotland  
**5G** Centre

# 5G Rural Networks in the Middle of Nowhere ... High Level Workflow



Multiple Live Camera Feeds  
Backhauled over 5G to Production team

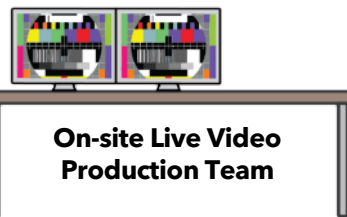


Neutral Wireless Lomond Network-  
In-a-Box (NIB)



Starlink LEO  
Backhaul

Live Video Feed out  
to Broadcast Servers  
over WAN Interface



On-site Live Video  
Production Team



Starlink Routers, CGNAT



Starlink  
Internet  
Connection

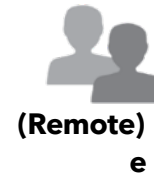
(Remote)  
Video  
Broadcast  
Servers



Public  
Internet



(Remote) 5G  
Core Control  
Plane



(Remote)  
e



University of  
**Strathclyde**  
Glasgow



The Scotland  
**5G Centre**

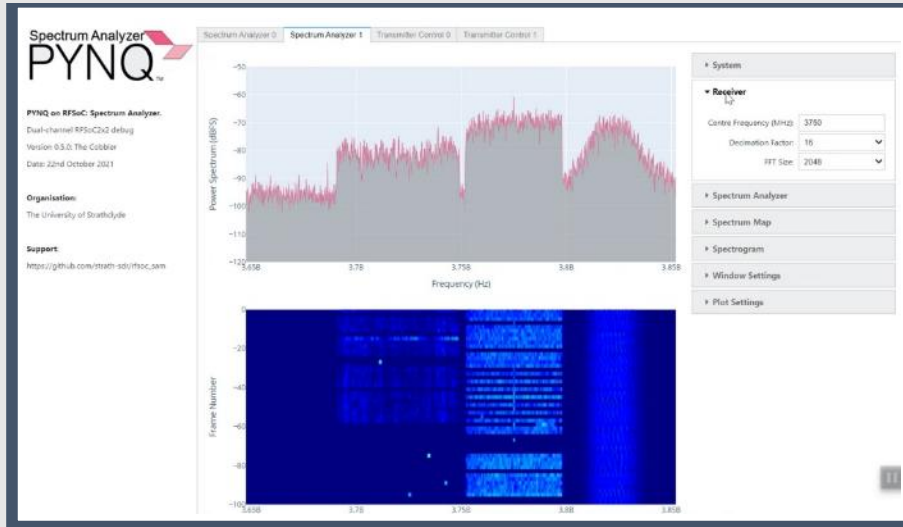
# Fleadh Cheoil – Mullingar ‘The Homecoming’ traditional music festival

Live in Ireland, August 2022



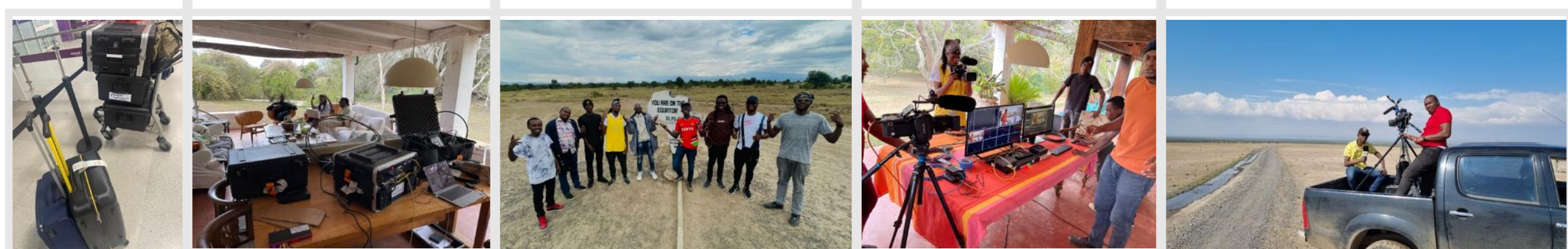
# Te Kura Kaupapa Maori o Bernard Fergusson (school) – Mau Rākau

Live in New Zealand, August 2022



# OI Pajeta Conservancy – Live YouTube Streaming with Sheng Talk

Live – from the Equator - in Kenya, August 2022



## And the 5G Rural Finale from Scotland, Sept 2022

- **Private 5G Standalone (SA)** live from the Highland Games
- Operating in **5Gn77 shared spectrum band** (3.9GHz)
- **Satellite/Starlink Backhaul** to broadcast in Amsterdam IBC Show (40,000 attendees, Live stage event and trade show with Media Accelerator)
- **Live HD Camera feeds on uplink** optimised networks, 8 hours of continuous operation and no packets dropped
- **International visibility for S5GC, StrathSDR and partners.**
- <https://show.ibc.org/5g-remote-production-middle-nowhere>
- **Pitlochry 5G Live:** <https://youtu.be/QJC4s3xHxR8>



# Pitlochry Highland Games, Sept 10th 2022

Live 8 Hours Broadcast, 5g sa Over Starlink



IBC Media Accelerator 2022, Pitlochry Highland Games by 5G SA Over Starlink



# Pitlochry Highland Games, Sept 10th 2022

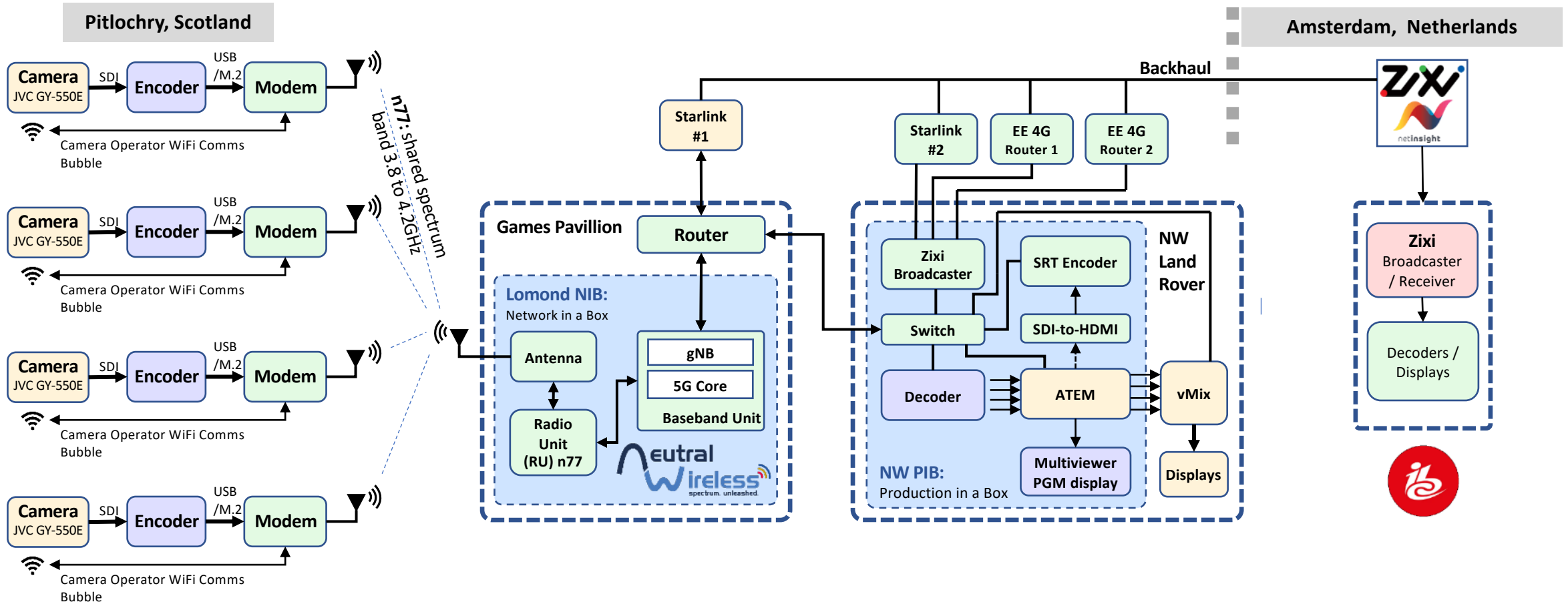
Live 8 Hours Broadcast, 5g sa Over Starlink



MEDIA AND BROADCAST



# And for the technical in the audience ...!



And then in Sept 2022 ...

[About](#)

[5GConnect](#)

[Projects](#)

[Learning 5G](#)

[News/Videos](#)

[Events](#)

[Contact](#)



The  
Scotland  
**5G** Centre

[Back to News](#)

**5G private network delivers world first live broadcast of  
Queen's final departure from Scotland**



The  
Scotland  
5G Centre





## Events

Look out for S5GC events happening near you by visiting [scotland5gcentre.org/events](https://scotland5gcentre.org/events)

## Contact Us for Questions

The Scotland 5G Centre  
[info@scotland5gcentre.org](mailto:info@scotland5gcentre.org)

## Monthly Newsletter

Get the latest events and developments at the Scotland 5G Centre by signing up to our online newsletter.

Thank you  
Follow us



[www.scotland5gcentre.org](https://www.scotland5gcentre.org)

