

# UK SPF Future Spectrum Policy Summit 2024

**techUK**  
FOR WHAT COMES NEXT

15<sup>th</sup> February 2024

## Shared Spectrum – the n77 Band

Ready to Roll with a Sandbox Licence ...

**Bob Stewart**

Professor, University of Strathclyde

Director and CTO, Neutral Wireless Ltd





# Glasgow n77 100MHz Spectrum 'Sandbox'



# Glasgow City n77 Shared Spectrum Testbed

- In 2023 we applied for support from DSIT Open Networks Programme with a key part of the project to create a wide area testbed/‘sandbox’ across the Glasgow area.
- Evolve experience of running networks, to **quantitative** RF and interoperability measurements ... rather than qualitative demos/use-cases (*eureka its works!*)
- The collaborative **On-Side** Project was co-funded and with key components:
  - **700 km<sup>2</sup> n77 testbed area** (radius 15km around Glasgow G1 1XW postcode)
  - **100 MHz T&D spectrum available** in 3.8 to 4.2 GHz n77 band
  - **23dBm across the city** and environs, with higher power via request
  - A **plethora of use cases**, environments and more ...
  - **5G SA n77 radios** from multiple vendors, and **UEs** (user equipment)
  - **Locations:** urban, rural, indoor locations, stadium/sports/civic events



# ON-SIDE Partners

## Open Network Shared Spectrum Innovation & Design Environment





# How did OnSide get here?

# The Wireless Revolution is just beginning (???)



*Of course not! ...*

**We all have mobile comms.**

**We all have Wifi.**

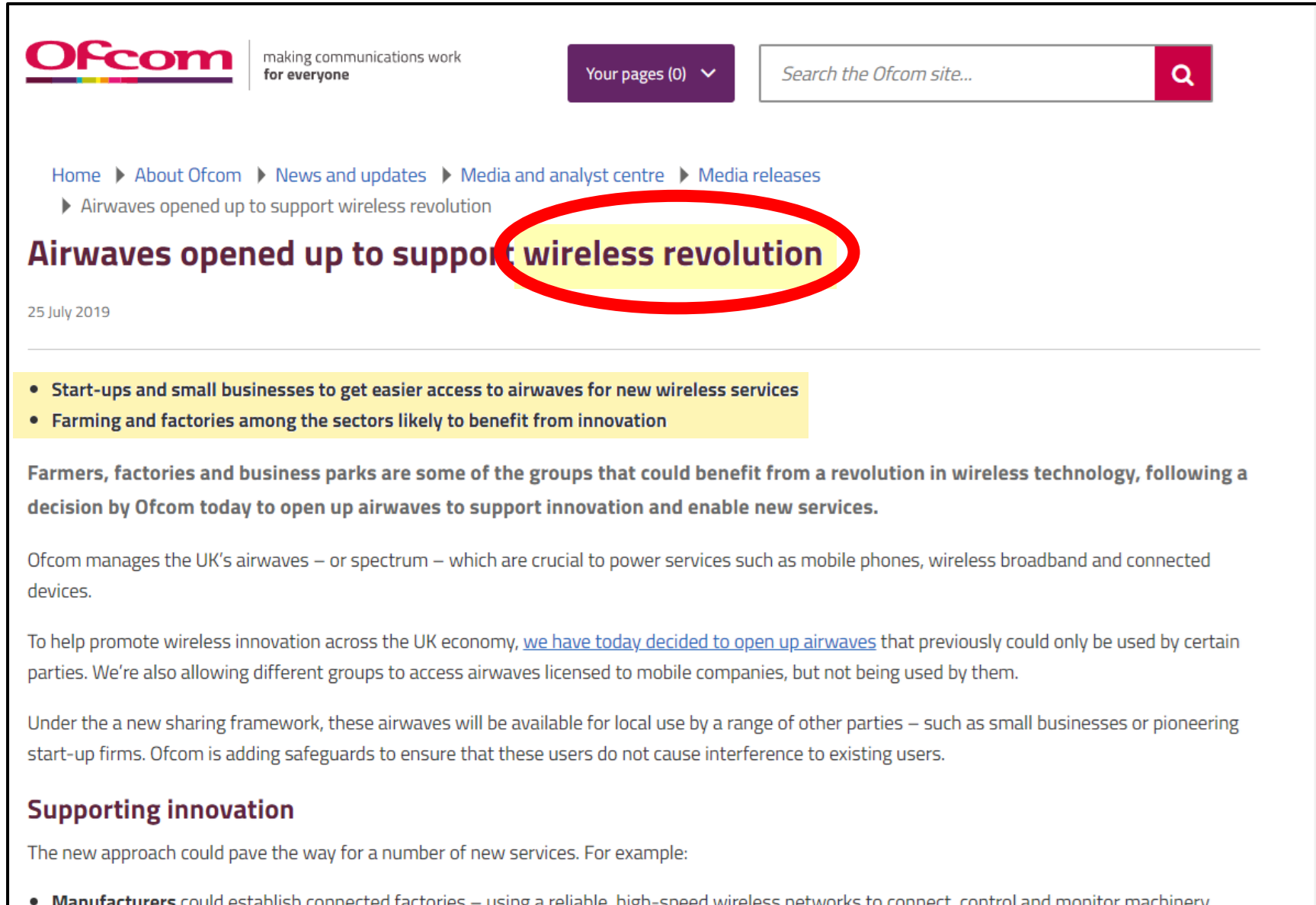
**We have LEO Satellite.**

**So ... the Wireless Revolution  
is well underway!**

***And for quite some time ... 1G to 5G***



# UK Spectrum Sharing – New Revolution was Hailed in 2019



The screenshot shows the Ofcom website with the headline "Airwaves opened up to support wireless revolution" circled in red. The page includes a navigation bar, a search bar, and a list of bullet points highlighting the benefits of the new wireless technology.

**Ofcom** making communications work for everyone

Your pages (0) ▾ Search the Ofcom site... 🔍

Home ▸ About Ofcom ▸ News and updates ▸ Media and analyst centre ▸ Media releases  
▸ Airwaves opened up to support wireless revolution

## Airwaves opened up to support wireless revolution

25 July 2019

- Start-ups and small businesses to get easier access to airwaves for new wireless services
- Farming and factories among the sectors likely to benefit from innovation

Farmers, factories and business parks are some of the groups that could benefit from a revolution in wireless technology, following a decision by Ofcom today to open up airwaves to support innovation and enable new services.

Ofcom manages the UK's airwaves – or spectrum – which are crucial to power services such as mobile phones, wireless broadband and connected devices.

To help promote wireless innovation across the UK economy, [we have today decided to open up airwaves](#) that previously could only be used by certain parties. We're also allowing different groups to access airwaves licensed to mobile companies, but not being used by them.

Under the a new sharing framework, these airwaves will be available for local use by a range of other parties – such as small businesses or pioneering start-up firms. Ofcom is adding safeguards to ensure that these users do not cause interference to existing users.

### Supporting innovation

The new approach could pave the way for a number of new services. For example:

- **Manufacturers** could establish connected factories – using a reliable, high-speed wireless networks to connect, control and monitor machinery.

*Shared Spectrum  
Revolution!*

*25<sup>th</sup> July 2019*

*Shared and Local Licences*

**Use it or  
~~lose it~~  
share it...**

# *Shared Spectrum* might just be the next wireless (R)evolution?

*It's just taken 5 years to really land ...*



2019

Shared Spectrum

# The Wireless Revolution is just beginning!

*So let's start building*

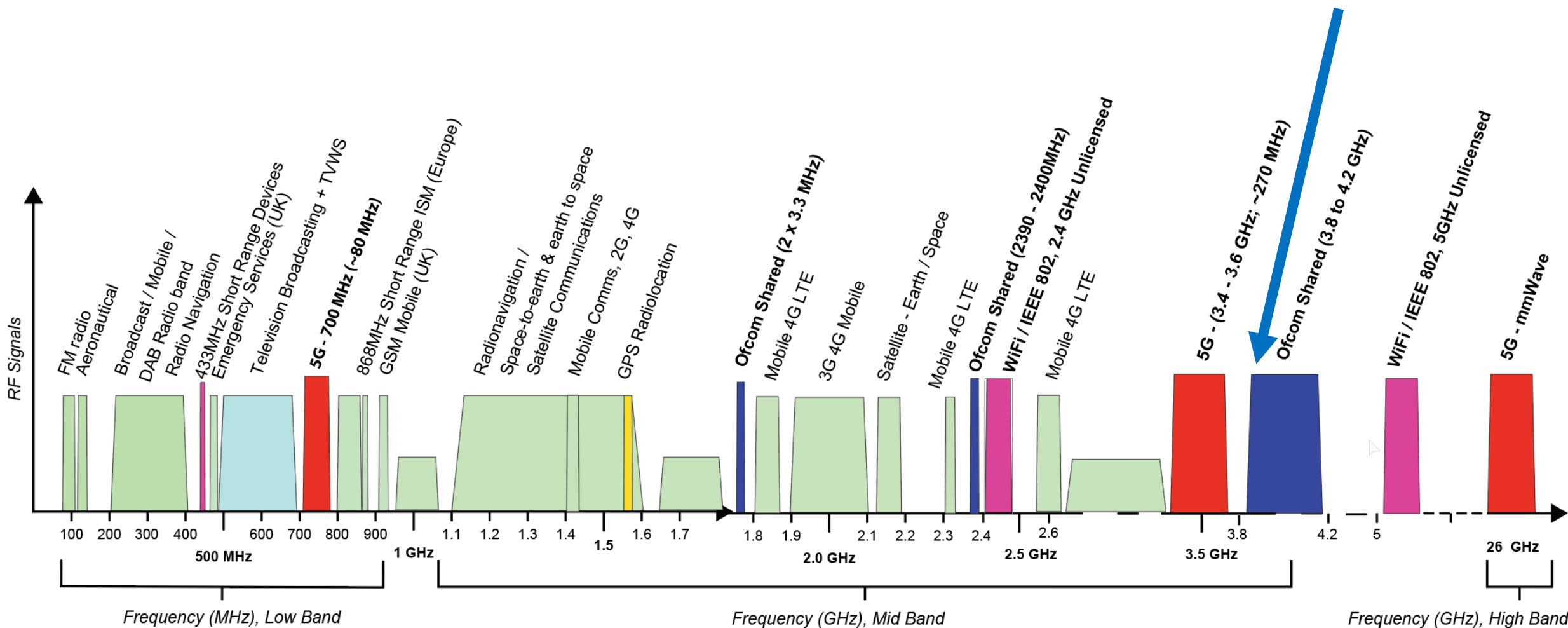
**We need radio spectrum to  
run any communications or  
broadcast network**

**And it needs to be licenced by Ofcom**



# Spectrum – Licensed, Unlicensed & Shared (low, mid, high bands)

**n77 – Shared Spectrum: 3800 – 4200 MHz**



# Quick Recap:

## Our 14 years of 'spectrum sharing' experience

2010

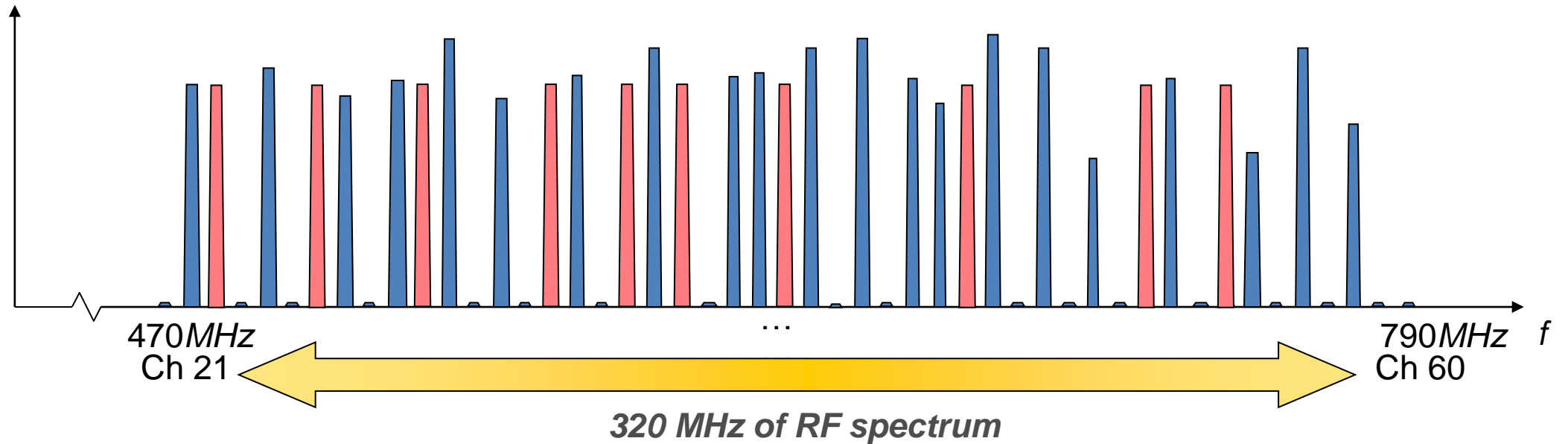
It's 2010 here comes ...  
TVWS Shared Spectrum  
licensing from Ofcom

*Lets build a (4G?) network*

# TV White Space

2011

Unused spectrum – “White Spaces”:



Benefits of using the white spaces include:

- More efficient use of spectrum
- More effective network coverage
- Good propagation characteristics (e.g. fewer 'not-spots')

2012

# Isle of Bute TVWS (TV White Space) Shared Spectrum Testbed

*(Our renewable days (daze?))*





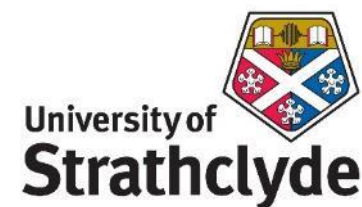


# Ofcom TVWS (TV White Space) City Demonstrator (Glasgow)

2014



Connecting ferries and hard-to-reach rural premises in Orkney



2011-16

**TVWS: There is spectrum, an Ofcom database managing access**

**... But no affordable hardware for  
basestation nor 'handsets'.  
The dream is fading, and ...**

2019

**And then Ofcom 'delivered' n77.**

**400 MHz from 3.8 GHz to 4.2 GHz**

**Accessible licensing**

**Almost as much as all of the 5G spectrum**





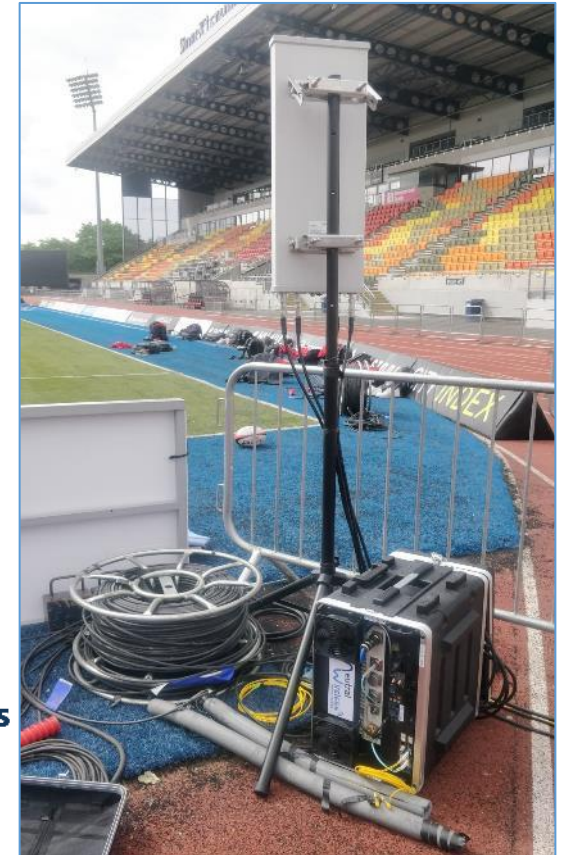
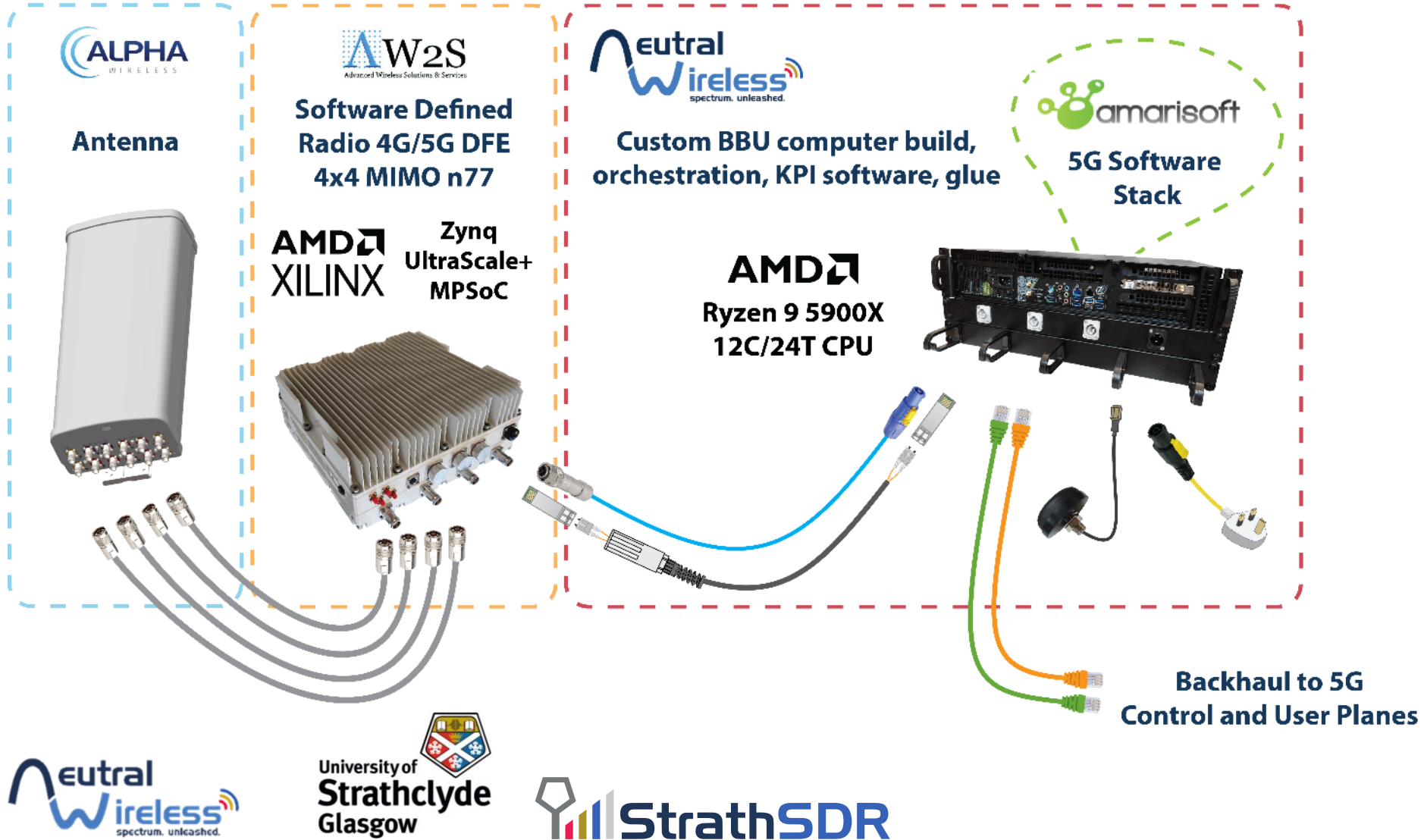


2019

**But in 2019 no n77  
band radios to procure!**

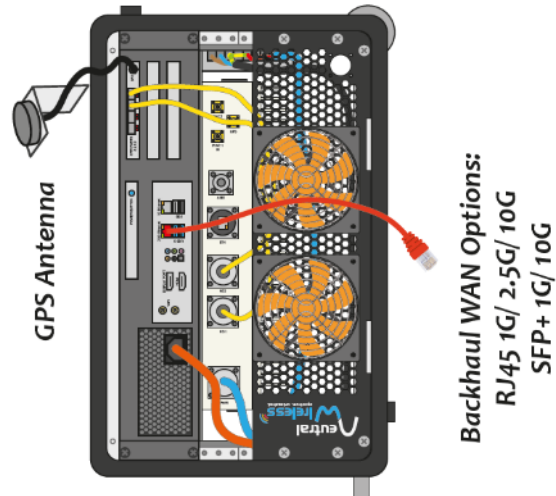
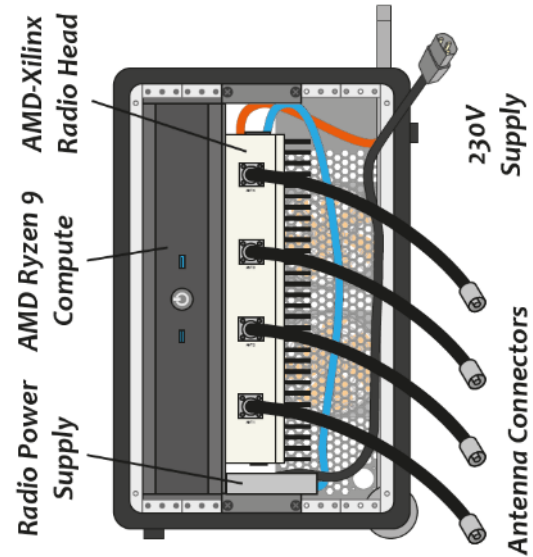
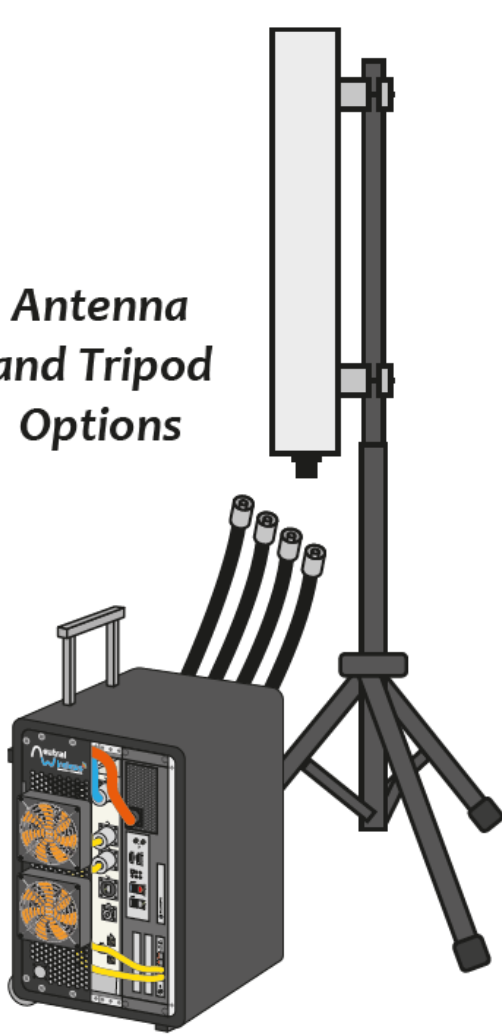
**So, we designed our own (tier3) with two EU  
French partners. Software Defined Radio**

# 5G Standalone Non-Public-Network NPN

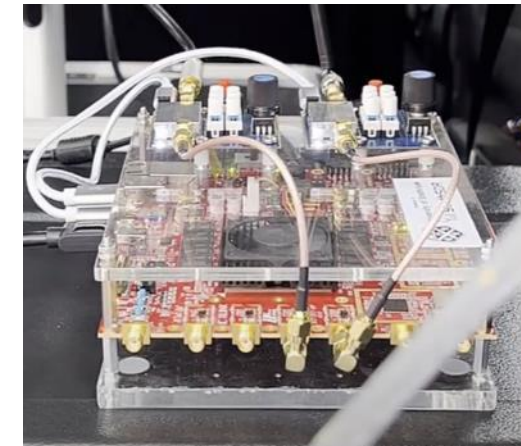
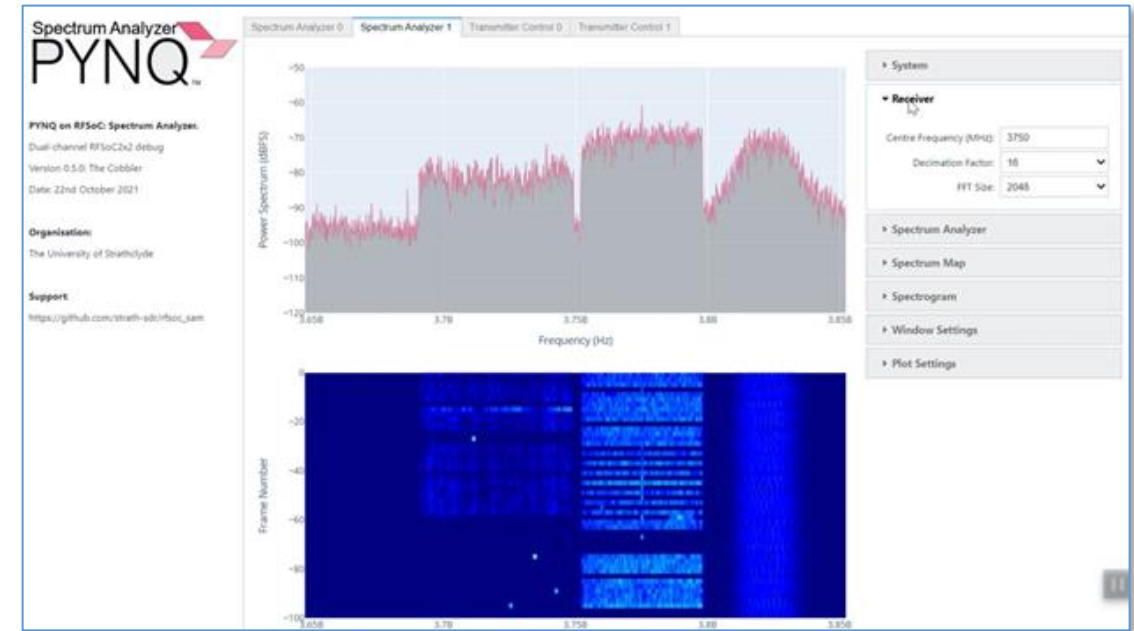


# 5G SA NPN Components

Antenna  
and Tripod  
Options



## Xilinx RFSoc based Spectrum Analyser 100MHz to 4GHz





## Production line – Ready to Test ...



2021

**So we have an n77 radio!**

**But there are no compatible handsets!**

**What?**

**But many handsets spec n77 private 5G?**



2021

**It's a whitelisting issue ...  
Or it's a firmware issue ...**

**We can hack them. Not a solution!  
We need a new use case - fast!**

# The 5G SA 'Broadcast' Use Case

Custom modems (Qualcomm chipsets for n77)

Plenty of battery power for camera clip-on

Form factor (size) not really an issue!

***And its all about the uplink and not handsets!***

# The 5G SA 'Broadcast' Use Case

**Now we have Unencumbered Deployment!**

We have radios, UEs, core ... and spectrum!

# Silverstone MotoGP – The Worlds first 5G SA Broadcast

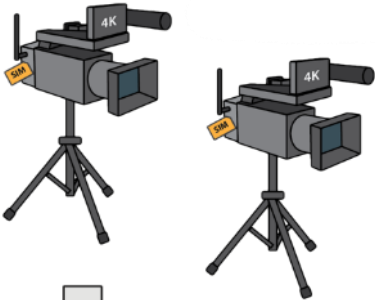


# And next to the middle of nowhere

2022



Multiple Live Camera Feeds  
Backhauled over 5G to Production team



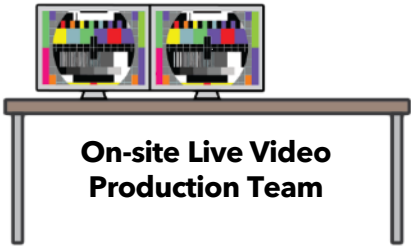
Starlink LEO  
Backhaul



Live Video Feed out  
to Broadcast Servers  
over WAN Interface



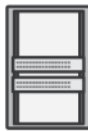
Neutral Wireless Lomond  
Network-In-a-Box (NIB)



On-site Live Video  
Production Team



Starlink Routers,CGNAT



Starlink  
Internet  
Connection

Public  
Internet

(Remote)  
Video  
Broadcast  
Servers



(Remote) 5G  
Core Control  
Plane



(Remote)  
Audience



# Live in Scotland, September 2022

## Pitlochry Highland Games – Traditional Scottish Sports and Culture





# Stone-X – Saracens vs Nottingham

2022

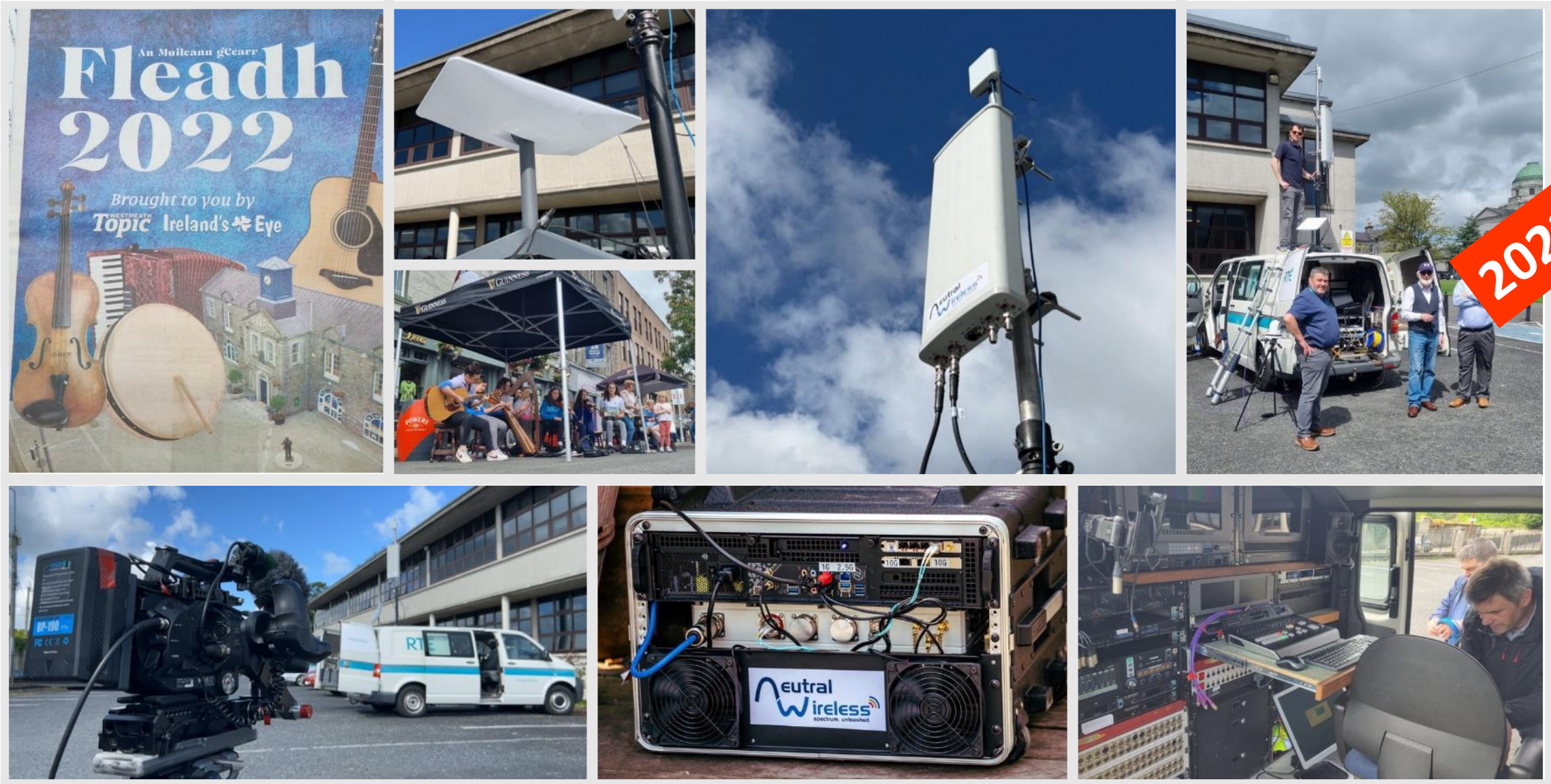


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# Live in Ireland – August 2022

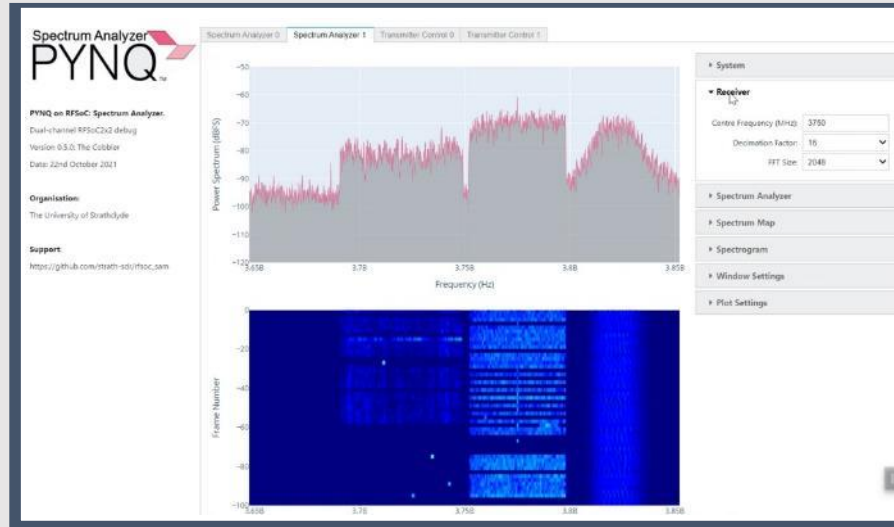
Fleadh Cheoil – Mullingar 'The Homecoming' traditional music festival





# Live in New Zealand – August 2022

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





# Danish Parliament Opening – Nov 2022

5G SA – inside and outside of Parliament – n77 T&D





# Live in Kenya (from the Equator) – August 2022

## Ol Pajeta Conservancy – Live YouTube Streaming with Sheng Talk

2022



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# n77 in Rural Locations and Over Water

2023









# The final journey of HRH from Scotland – September 2022



2022



# The Coronation of His Majesty King Charles III – May 2023

Supporting international broadcasters on the world's largest private 5G network



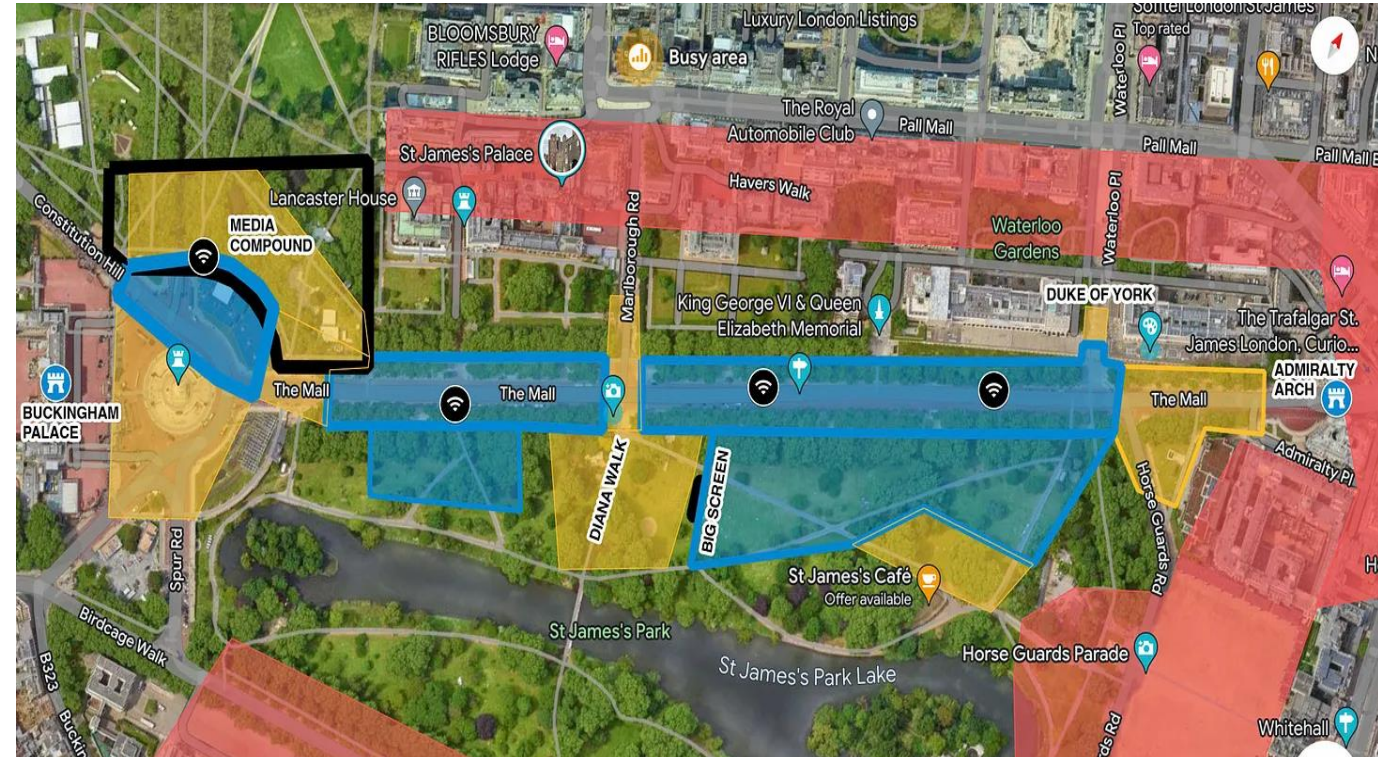
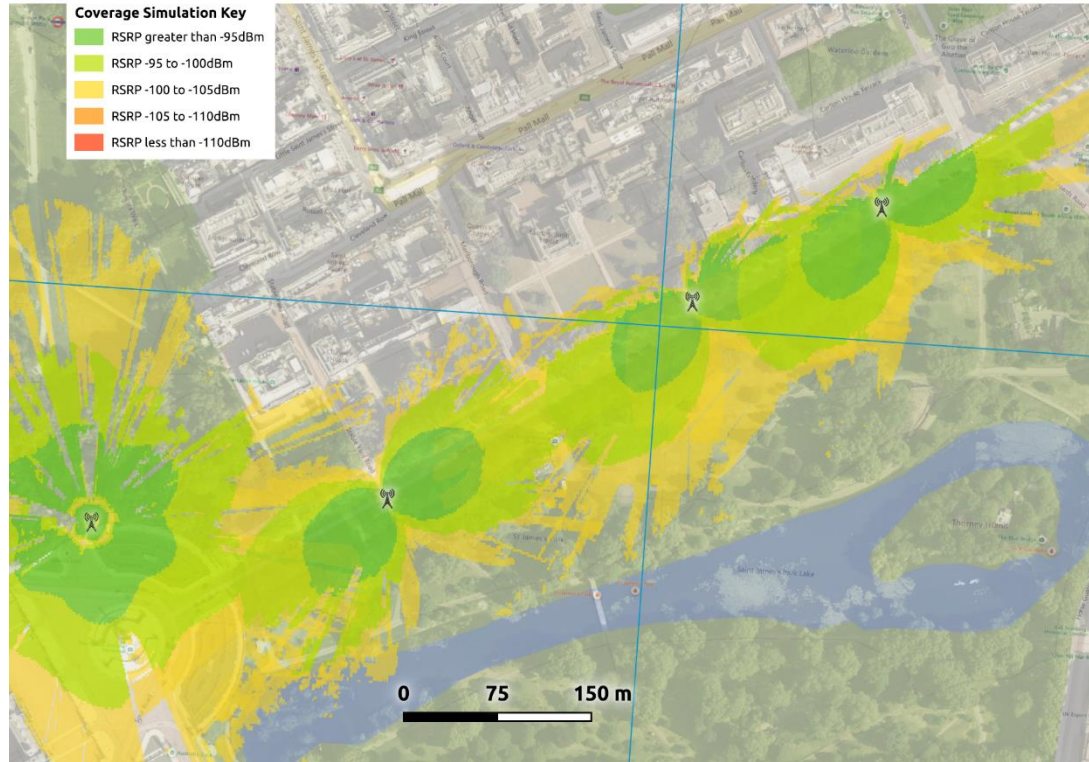
2023

*Thanks to all our partners and collaborators*



# The Coronation of His Majesty King Charles III – May 2023

## Assessing the RF - Propagation Planning, Measurement, and Testing

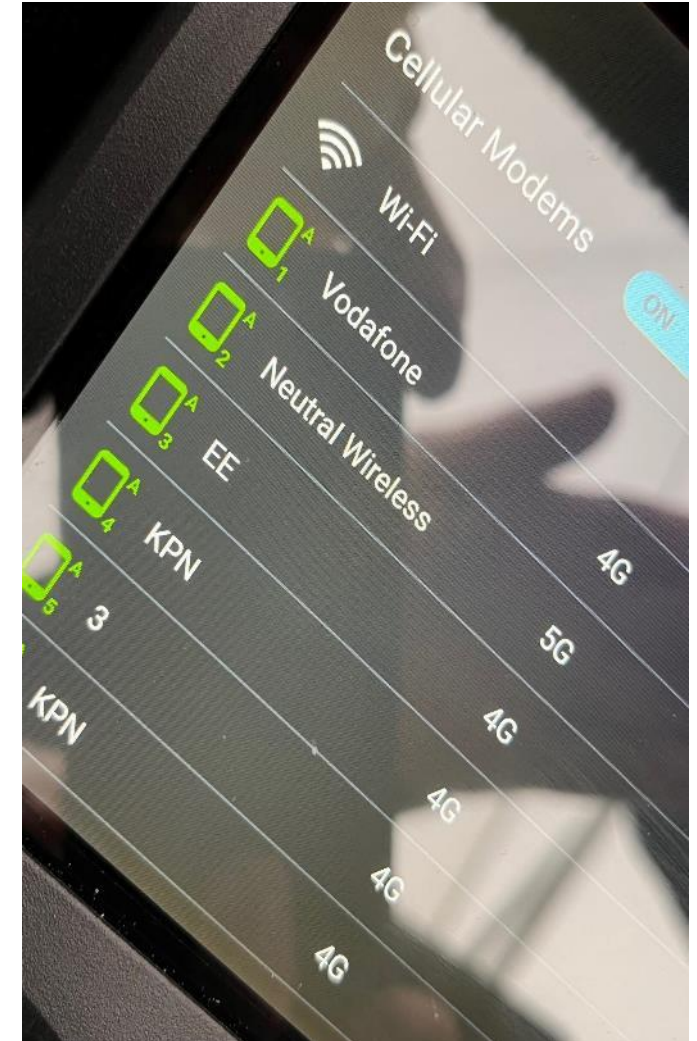


2023



# The Coronation of His Majesty King Charles III – May 2023

## On-location tests with the broadcasters





# The Coronation of His Majesty King Charles III – May 2023

The World is Watching



Meanwhile, we are looking at this





# Where to next?

***Well. The handsets are here!***

***Apple open private 5G in n77***

***In September 2023!***





**Neutral Wireless** @NeutralWireless · Jul 20

**Neutral Wireless** have verified iOS 17 compatibility with our **n77** 5G SA private networks. In June **Apple** announced this new support connectivity contingent on a set of privacy and security requirements. It's happening now! [neutralwireless.com/2023/07/privat...](https://neutralwireless.com/2023/07/privat...) @Apple @\_UKTIN @BBCRD @Ofcom



Sept  
2023

# Private 5G SA in n77

## Ready to roll.

# Cisco Live! RAI Amsterdam

<https://nw5g.org/ciscolive>

- 4 x Private 5G SA gNodeBs live in RAI in Amsterdam; 4x4 mimo 3.775GHz (n78)
- Cisco, Intel, NTT, Logicalis and Neutral Wireless ...

2024



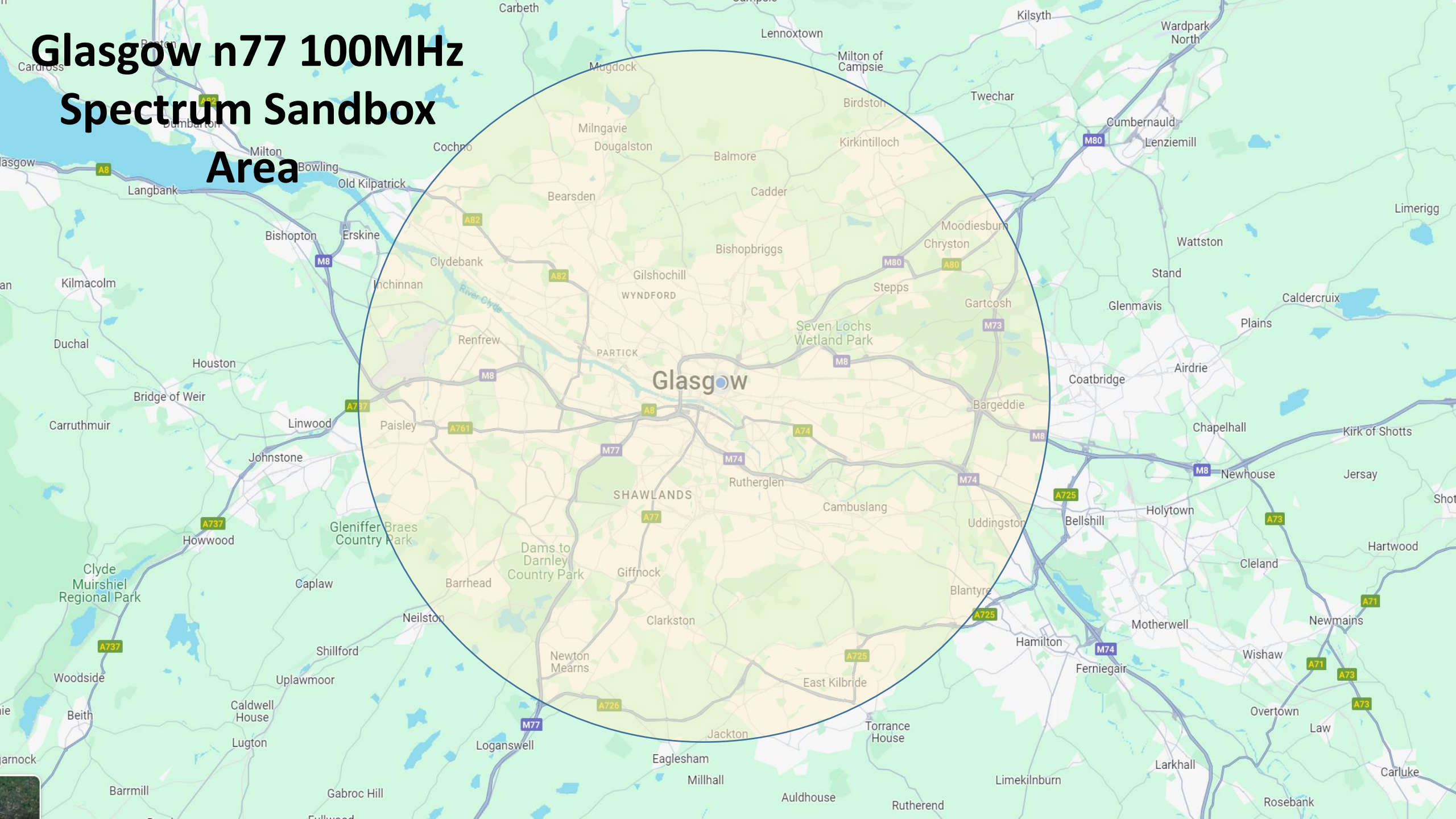
# ON-SIDE

## Open Network Shared Spectrum Innovation & Design Environment





# Glasgow n77 100MHz Spectrum Sandbox Area



# High Level Objectives of OnSide Project

- Developing **5G private network technology for applications and use-cases** that are not currently well served by public mobile networks.
- A **'living lab' research, development, and design environment** for testing and demonstrating state-of-the-art communications across the Glasgow City area.
  - ...including spectrum sensing & monitoring and innovative spectrum management
- **Spectrum sandbox** – 'special' licence covering the Glasgow City area for a period of 2 years, during which time we will aim to explore innovative ways of managing spectrum for pop-up 5G SA networks in the 3.8-4.2 Shared Access band.
- **100 MHz of n77 spectrum** allocated in 3.8-4.2 GHz band for interoperability, interference testing, distance, indoor/outdoor testing.
- **Engaging and reporting to Ofcom** throughout the project, disseminating our findings and learnings and discussing potential innovative approaches to spectrum management.



# Glasgow n77 Testbed is open

## Thank You!

Come see our shared spectrum private 5G SA in Hall 3 at MWC, and see you in Summer 2024