Deploying private 5G connectivity solutions for live sports broadcasting

From Silverstone MotoGP to the Paris 2024 Olympic Games … and beyond

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Chief Executive Officer – Neutral Wireless Ltd

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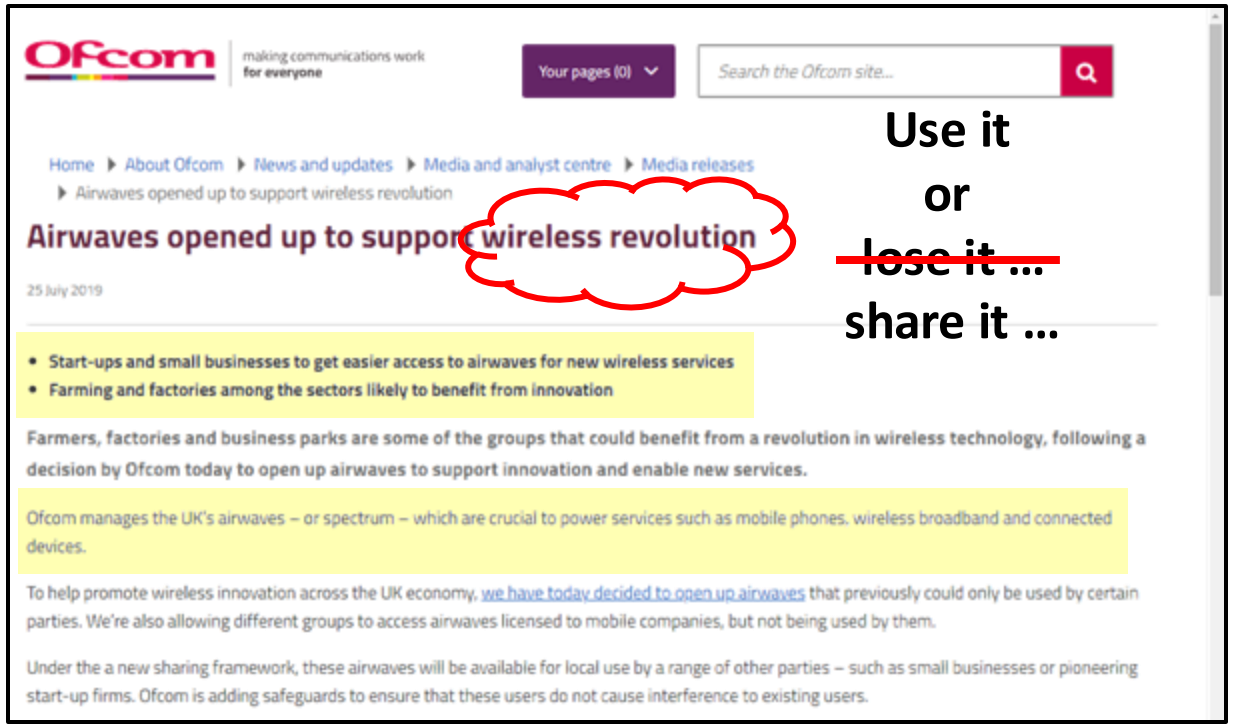
How we got here … and why 5G SA 'Broadcast'?

- 2019 – Ofcom (🇬🇧) opens up **n77 RF band for Spectrum Sharing**
- ***No show without spectrum***
- **Equipment challenges** in n77 band
- **No n77 band radios** to buy!
  - So, we designed our own SDR radios with French partners (🇬🇧 🇫🇷) ✅
- **No compatible handsets** – spec says n77
  - Whitelisting issue … or firmware issue
  - We can hack them. Not a solution!



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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.

Use it
or
~~lose it …~~
share it …

We need a new use case – fast!

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5G SA 'Broadcast' – Use Case Requirements

- ***Uplink*** for HD Cameras (20 Mb/s per camera)
- ***Downlink*** for control, talkback, return video
- Capable of ***Ultra-Low Latency***
- ***Wide-(ish) area*** *networks* – low and mid bands

Custom modems (Qualcomm chipsets for n77)

Plenty of battery power for camera clip-on

Form factor (size) not really and issue!

- The ***market requirement*** right now – all about the ***uplink*** and ***not handsets***!

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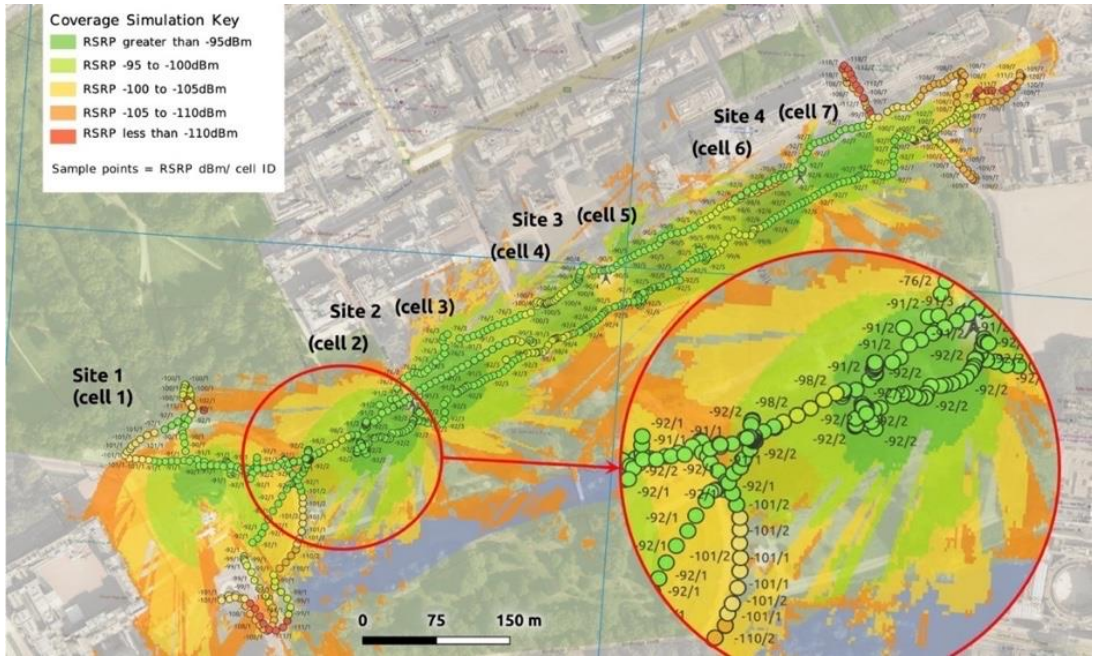
Broadcast: a ‘Killer’ P5G Use Case

- 5G SA Broadcast became our …

  ‘killer’ P5G use case

- Taking in a Queen’s funeral, a King’s Coronation, and many sporting video challenges



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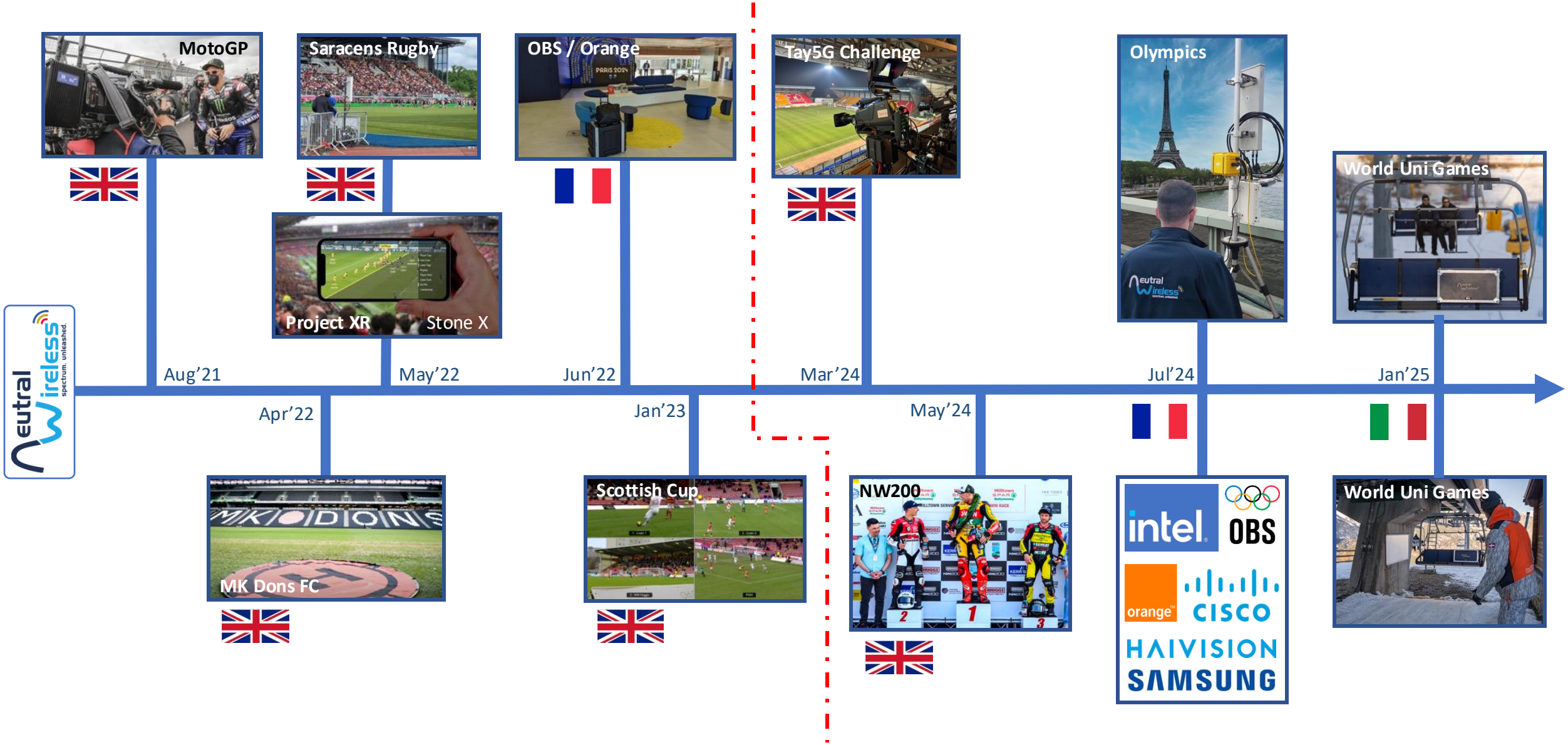
Building Private 5G Networks Across the World



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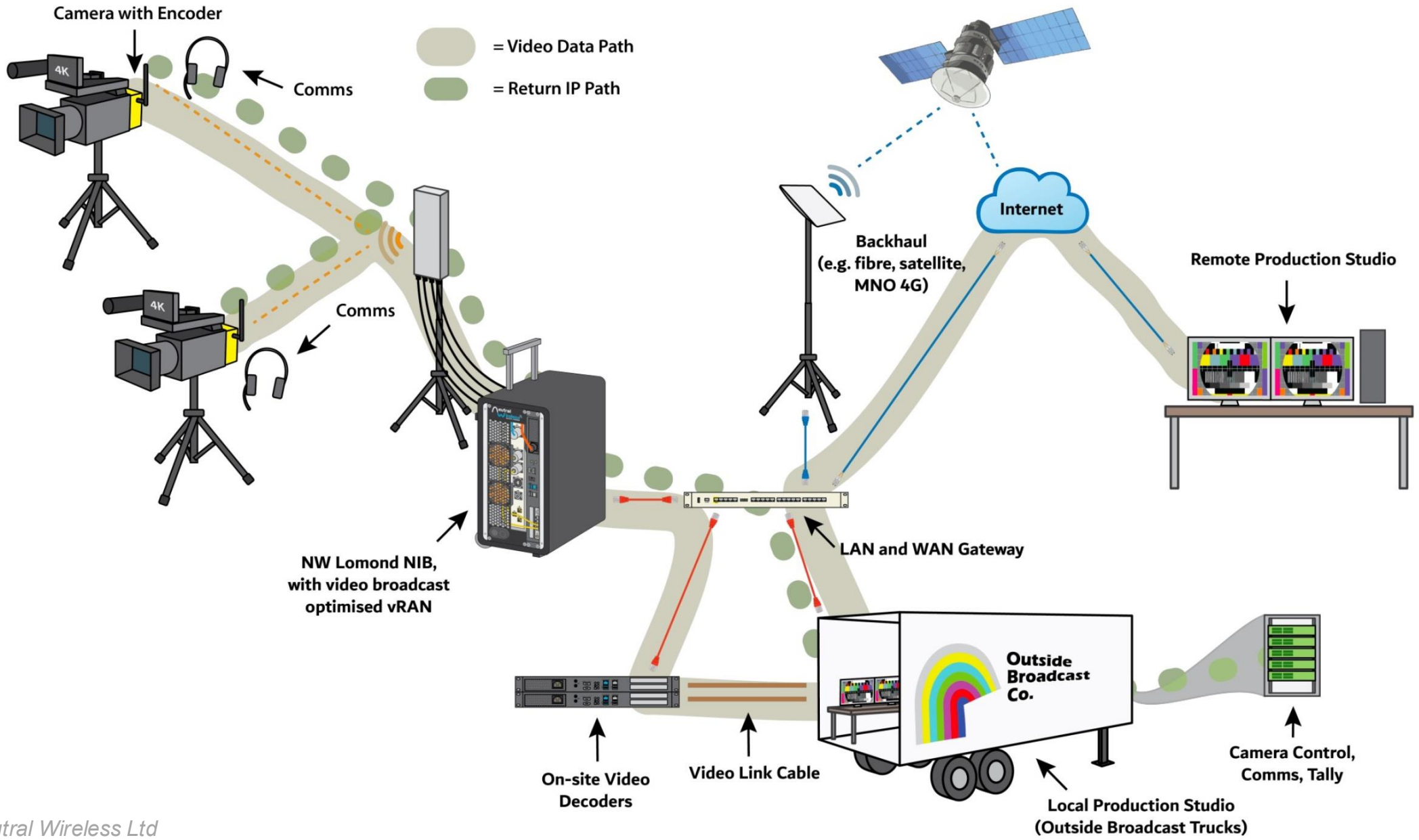
Design & Build – Hi-Level Network Deployment



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Bi-directional 5G-enabled Camera Connectivity and Control for Video Broadcast Production

Single-cell pop-up P5G SA network deployed

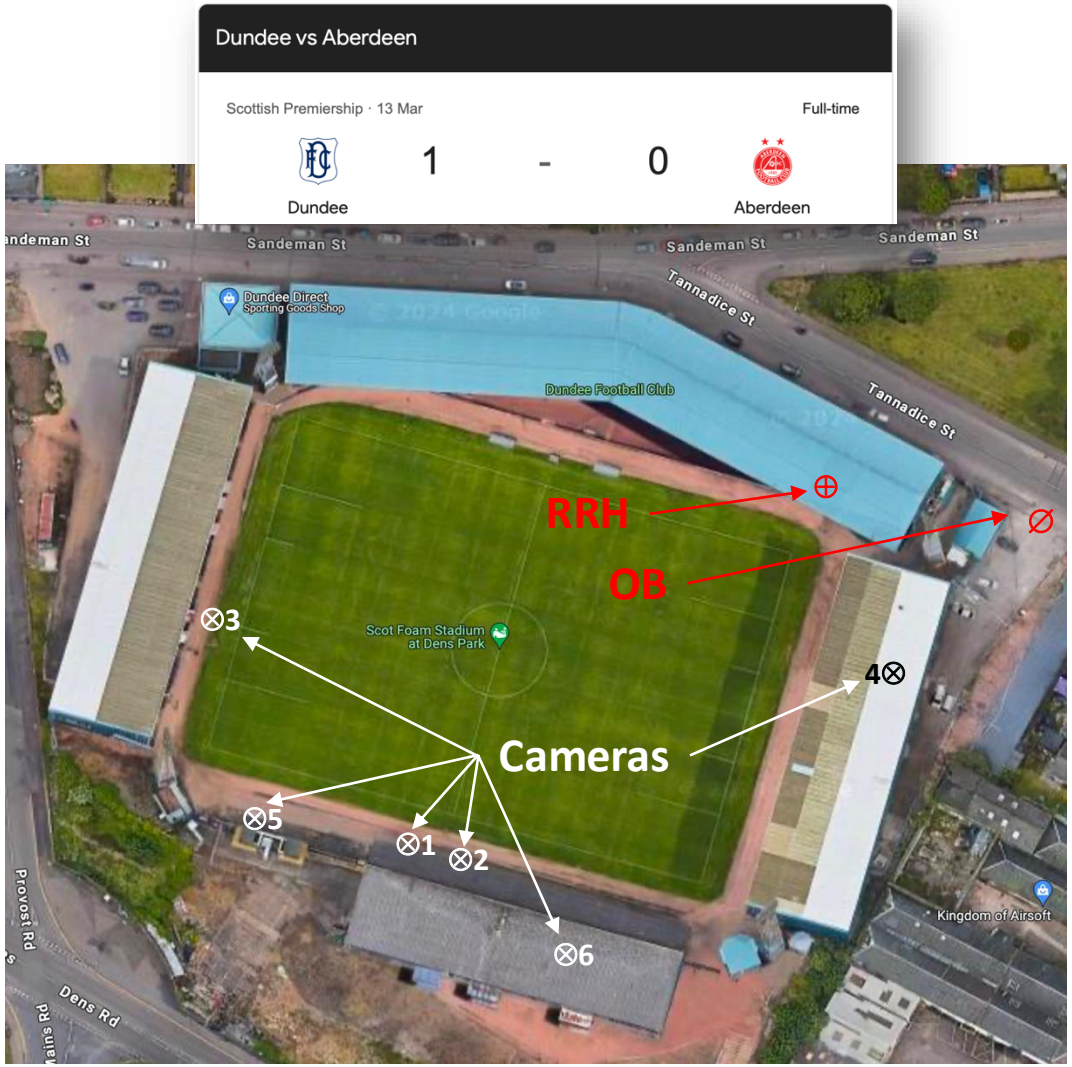
N77: 100 MHz	Bi-directional (IP)
3950 MHz	Remote Camera Control
37 dBm (5 W)	Tally Light / Talk-back
Uplink-biased TDD	Return Video

Before the game:

- 4x 25 Mbps 1080p50 HEVC 100 ms + 4x 10 Mbps

During the game:

- 6x 25 Mbps 1080i50 HEVC 800 ms + 3x 12 Mbps
- Wireless operation to shadow wired VAR cameras
- VAR operations bay (Glasgow) dedicated to receiving and evaluating the 5G video feeds – tested alongside the formal VAR system



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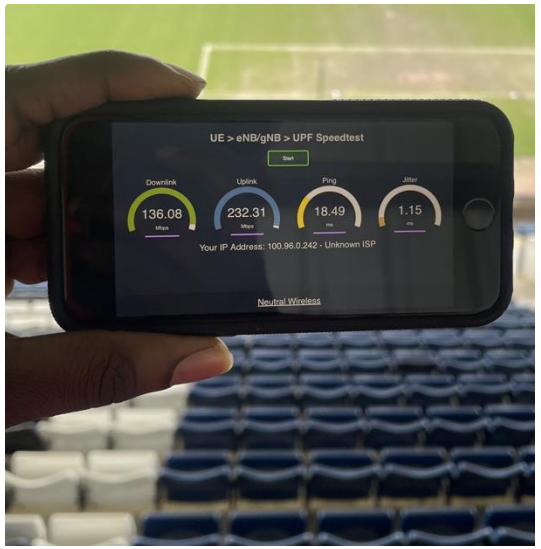
Showcase Match Deployment



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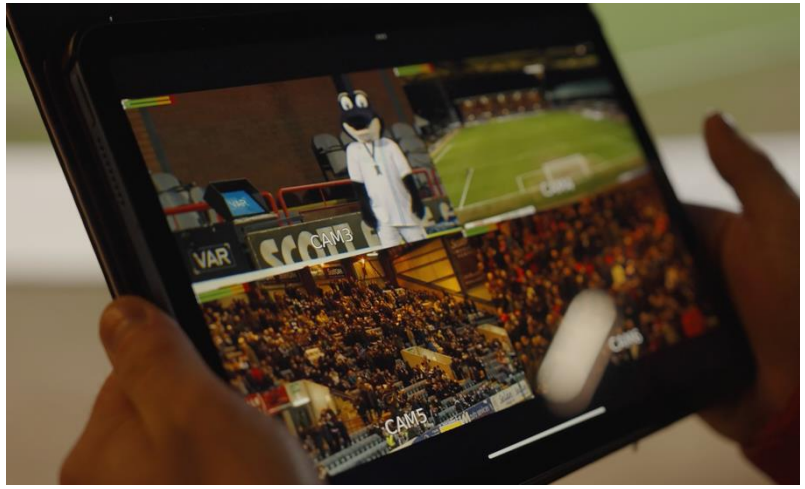
Showcase Match Deployment



Drive forward the development and integration of private 5G systems to deliver the **user requirements for wireless broadcast production in live sports**

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North West 200 MotoTT

BBC

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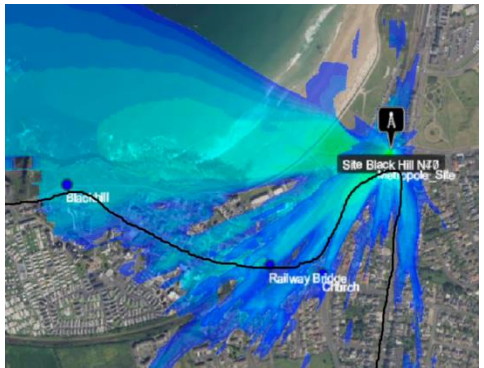
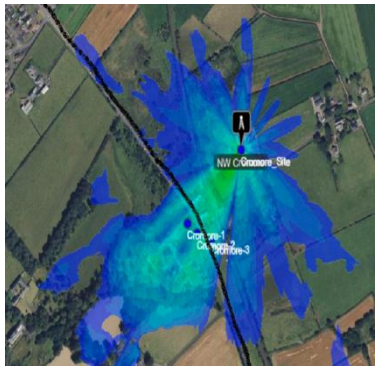
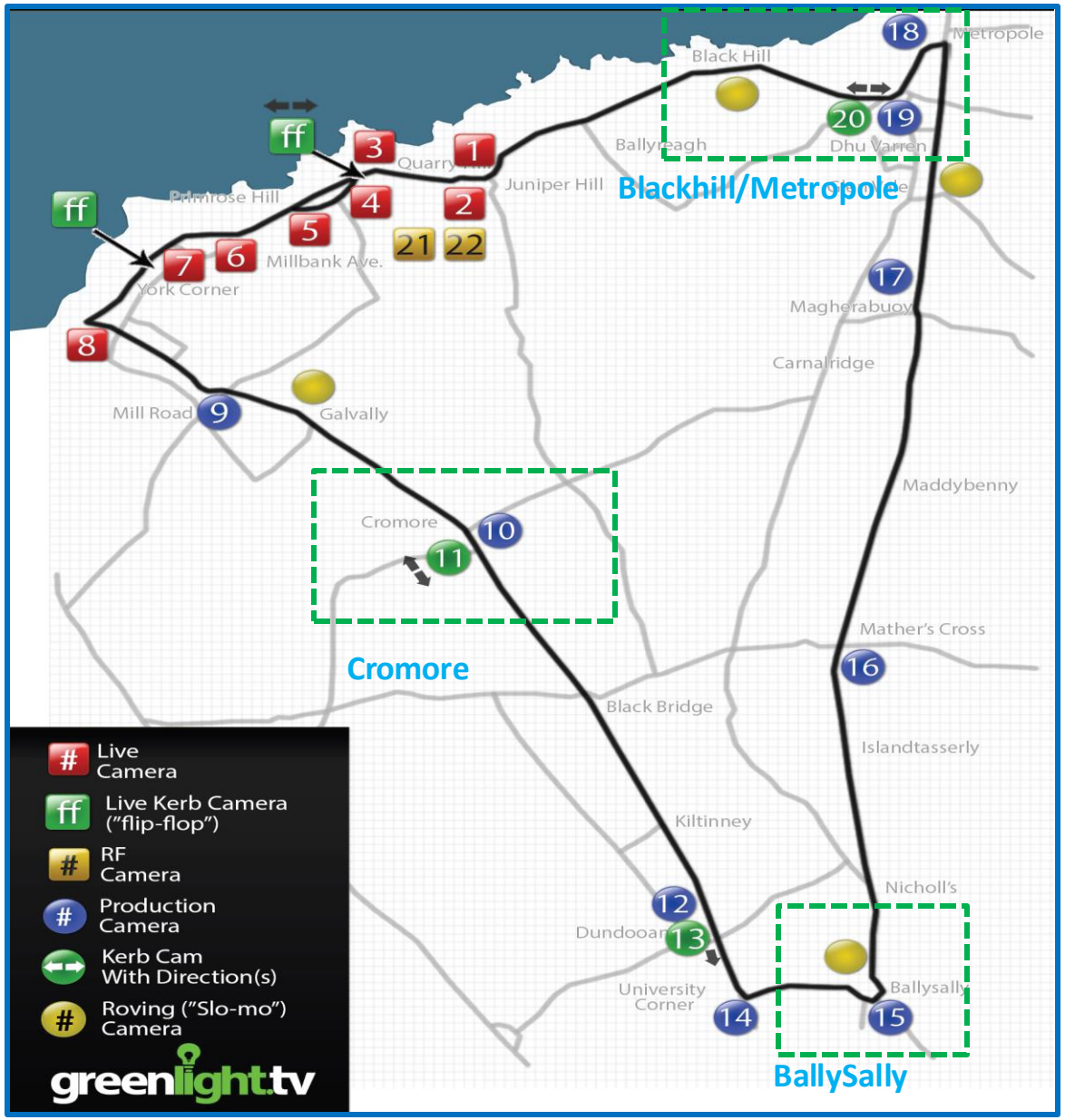
BBC SPORT NORTHERN IRELAND
NW200 COVERAGE

North West 200 MotoTT – BBC Sport NI (2024)

- Cabled cameras + **rely heavily on helicopter** feeds
  - Required to **add more live (action) cameras**
- LiveU/MVP encoders with remote production on Isle of Man
  - Concern about public network **coverage** and **congestion**
- Three locations:
  - **Metropole:** 1 x 100 MHz n77 cell
1 x 10 MHz n40 cell
  - **Cromore:** 1 x 10 MHz n40 cell
  - **Ballysally*:** 2 x 50 MHz n77 cells



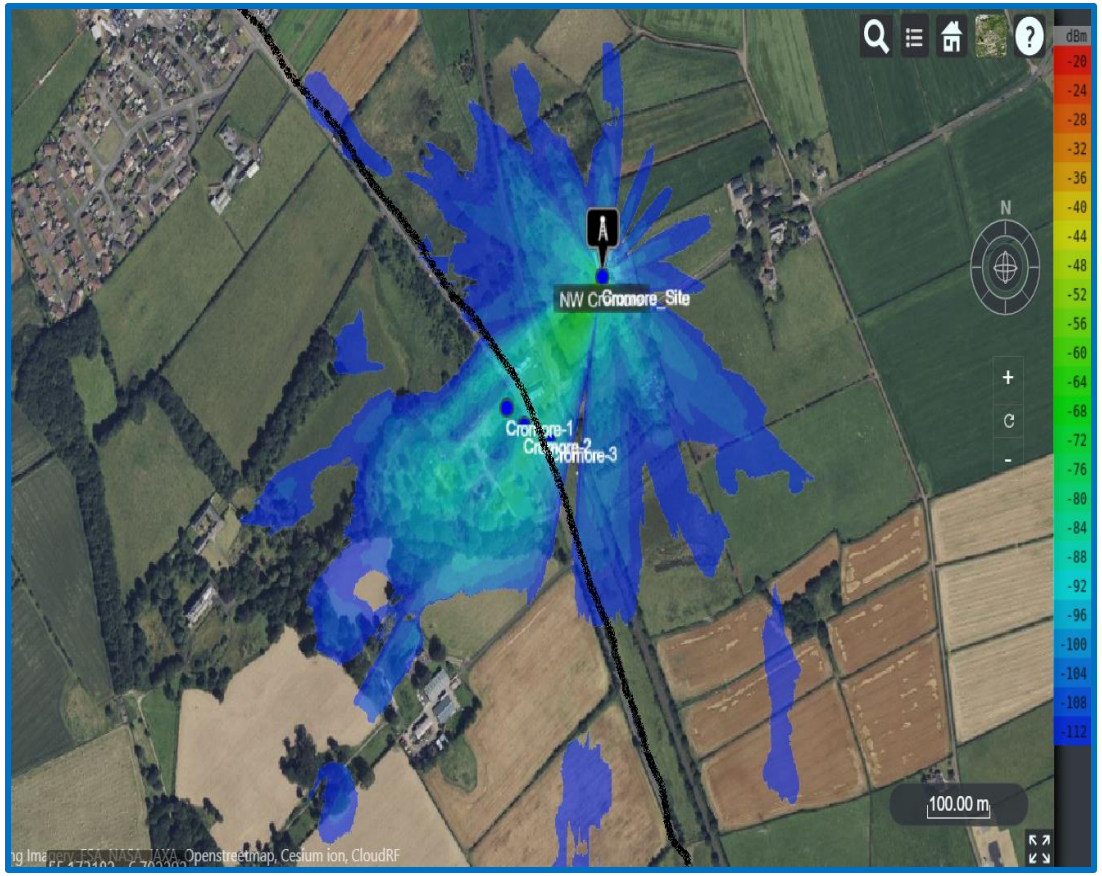




Example – Deployment at CROMORE location

Cromore Site

Waveshare Deployment at Cromore



Band-40 Coverage Map for Cromore Site

BBC Sport NI live broadcast footage from multiple cameras (including flip-flops) that has previously only been shown in post-race highlights

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Paris 2024

- Opening Ceremony on River Seine
- 3 Event Stadiums
- Sailing Events, Marseille

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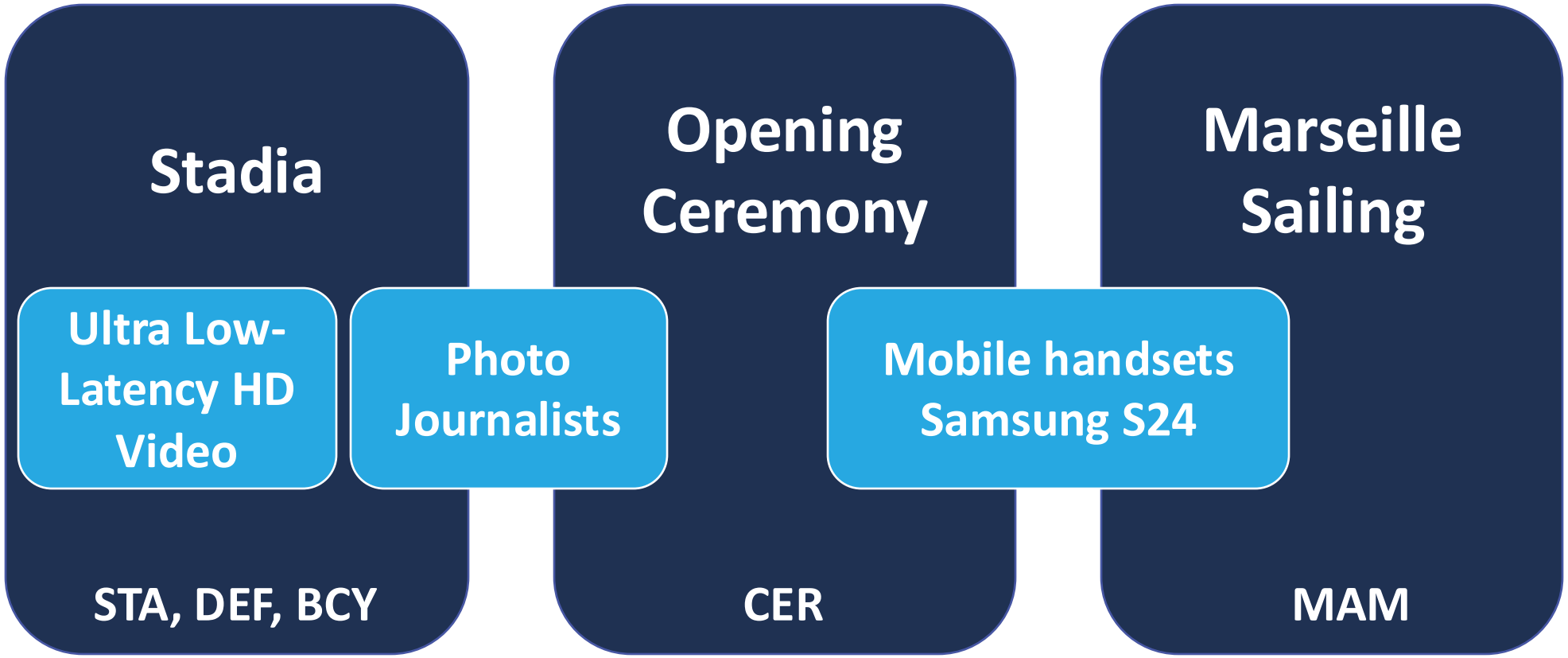
Private 5G

P5G SA was used extensively at Paris 2024



STA	Athletics
DEF	Swimming
BCY	Gymnastics

1st Olympic Games Opening Ceremony **not** to take place in a Stadium

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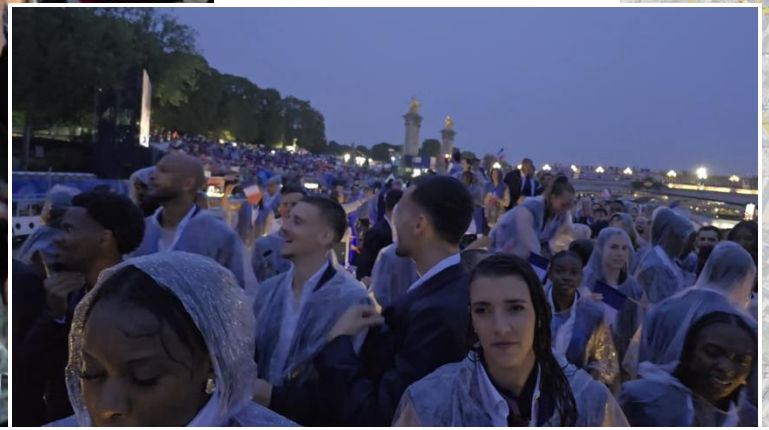
Paris 2024 – Opening Ceremony – River Seine

Boat procession along 6 km of the river

- 22× Uplink-biased private network cells:
  - 11× 60 MHz video cells (2.64 Gbps uplink)
  - 11× 40 MHz photo cells (1.76 Gbps uplink)
- 217× Samsung S24U handsets on 85 boats
- Hundreds of video feeds!



Example RF simulation of n77 cells in Paris

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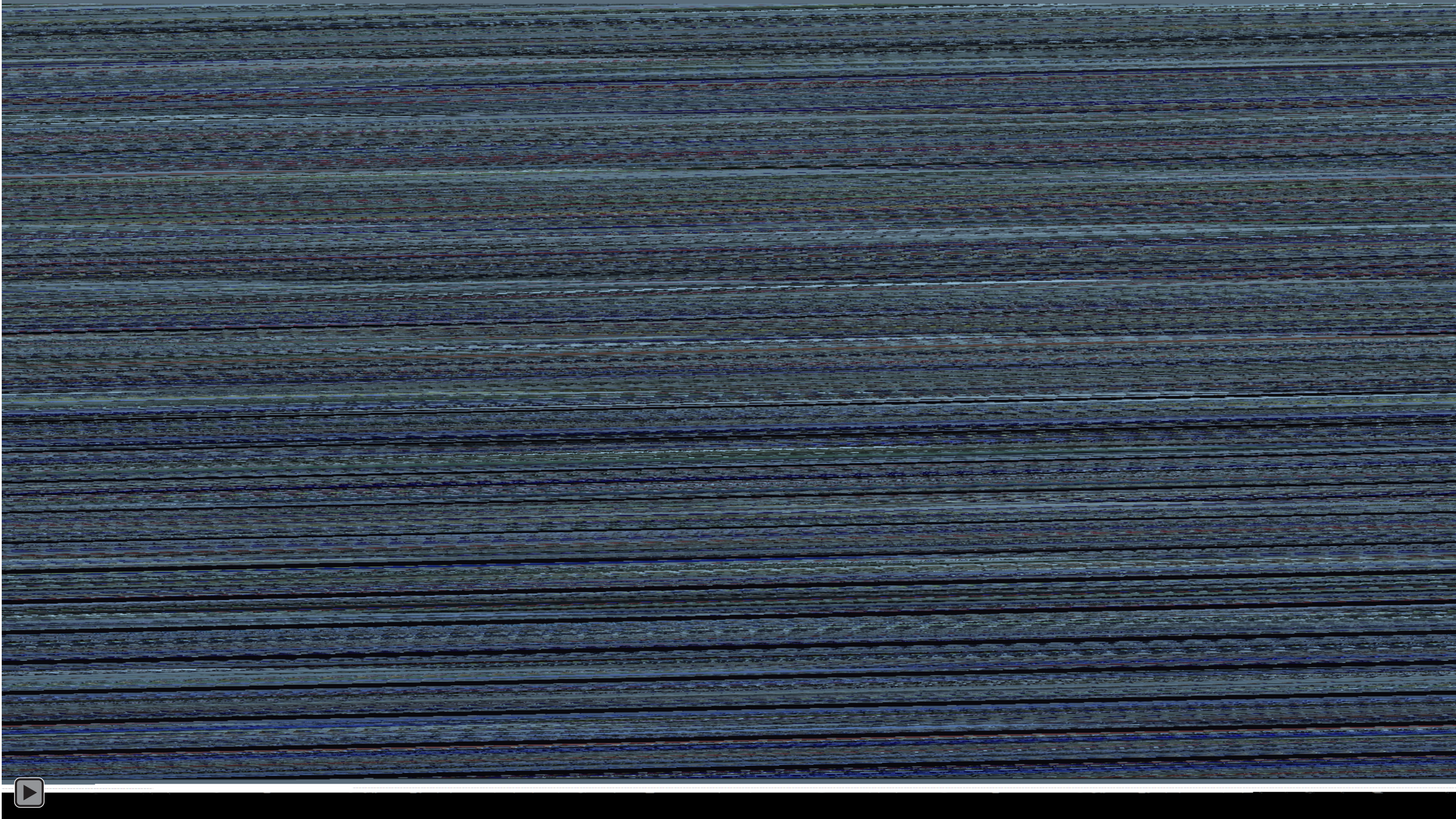

Paris 2024 - Stadia

- **Stade de France** / **Bercy Arena** / **La Defense**
  – 2× 60 MHz cells per stadium (500 Mbps uplink)
- Wireless cameras with **ULL UHD video** (90ms)
- Used every day for wireless cameras on the events floor, able to move between events and capture athlete emotions
- Instant **FTP photo** upload
- Used by many press agencies, called out publicly by Getty
- Used heavily for the **Closing Ceremony**

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Paris 2024 – Sailing in Marseille

- Multi-cell P5G “out on the water” – a “mobile” mobile network
- 3× **gNodeBoats** move with the field of play (2× n77 + 1× n38)
- Backhauled using high-power highly-directional WiFi 6
- Up to **12× video feeds per race** (S24U / S23 + helmet camera)
- Bluetooth microphones on athletes to provide **on-board audio**

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Torino 2025

FISU World University Games

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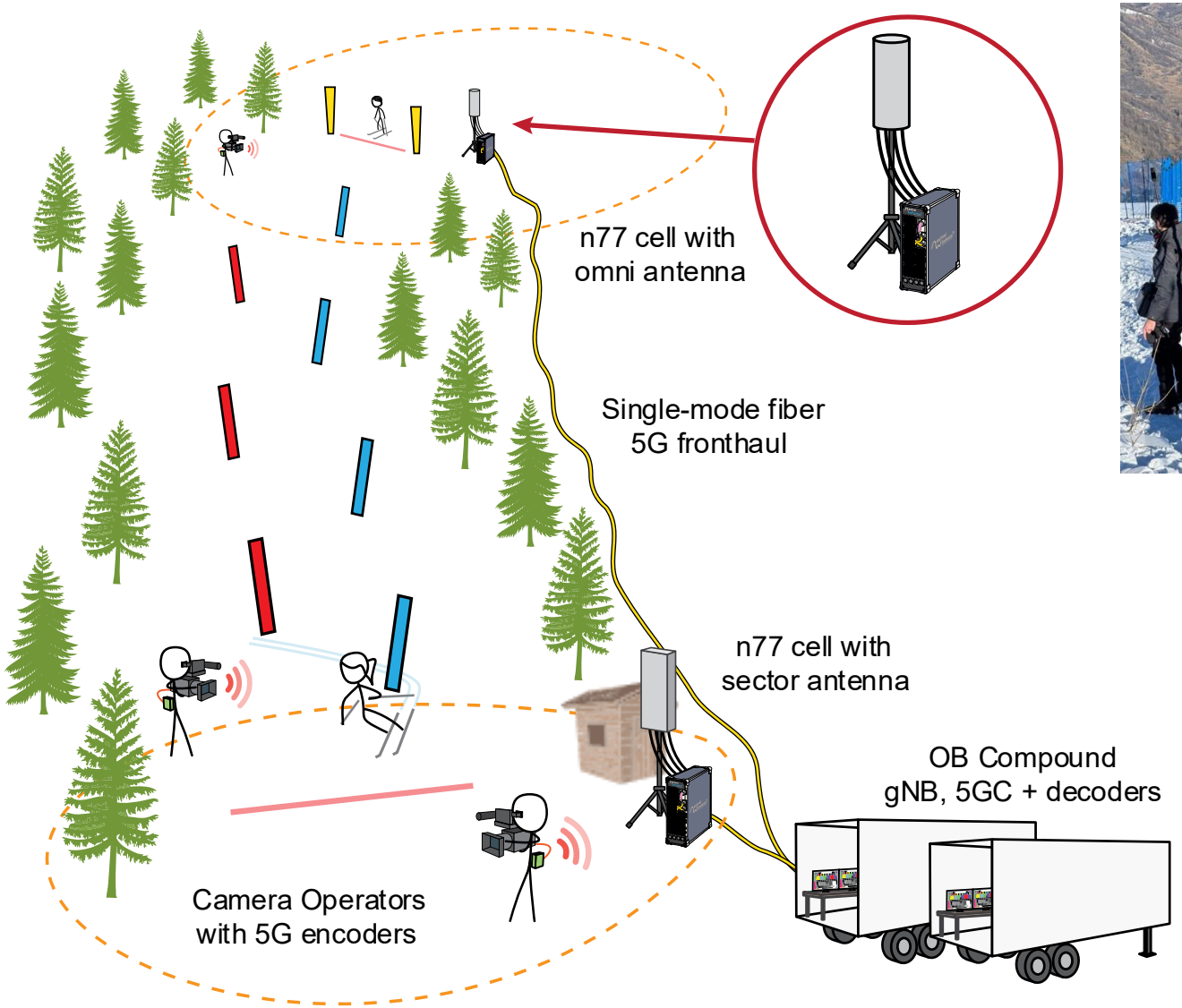
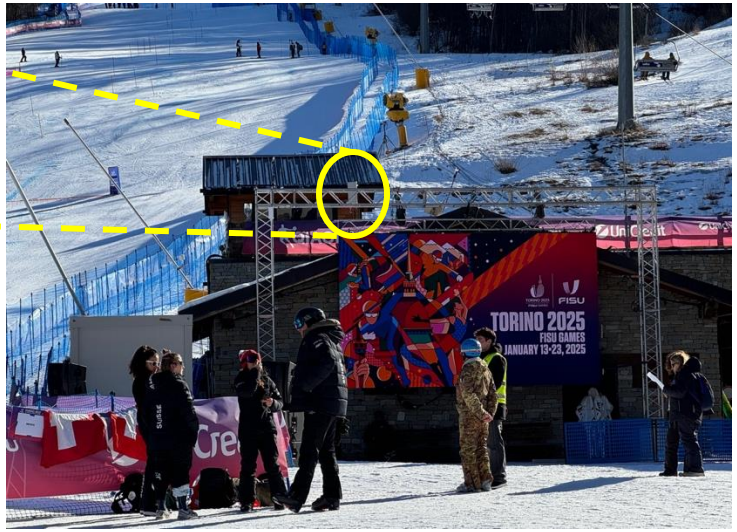
Alpine Downhill Skiing – P5G ULL Broadcasting



- RAI licensed spectrum
- Two n77 cells – 100MHz
- One BBU in OB truck
- UL-biased frame structure
- Four LL camera feeds + mobile handsets



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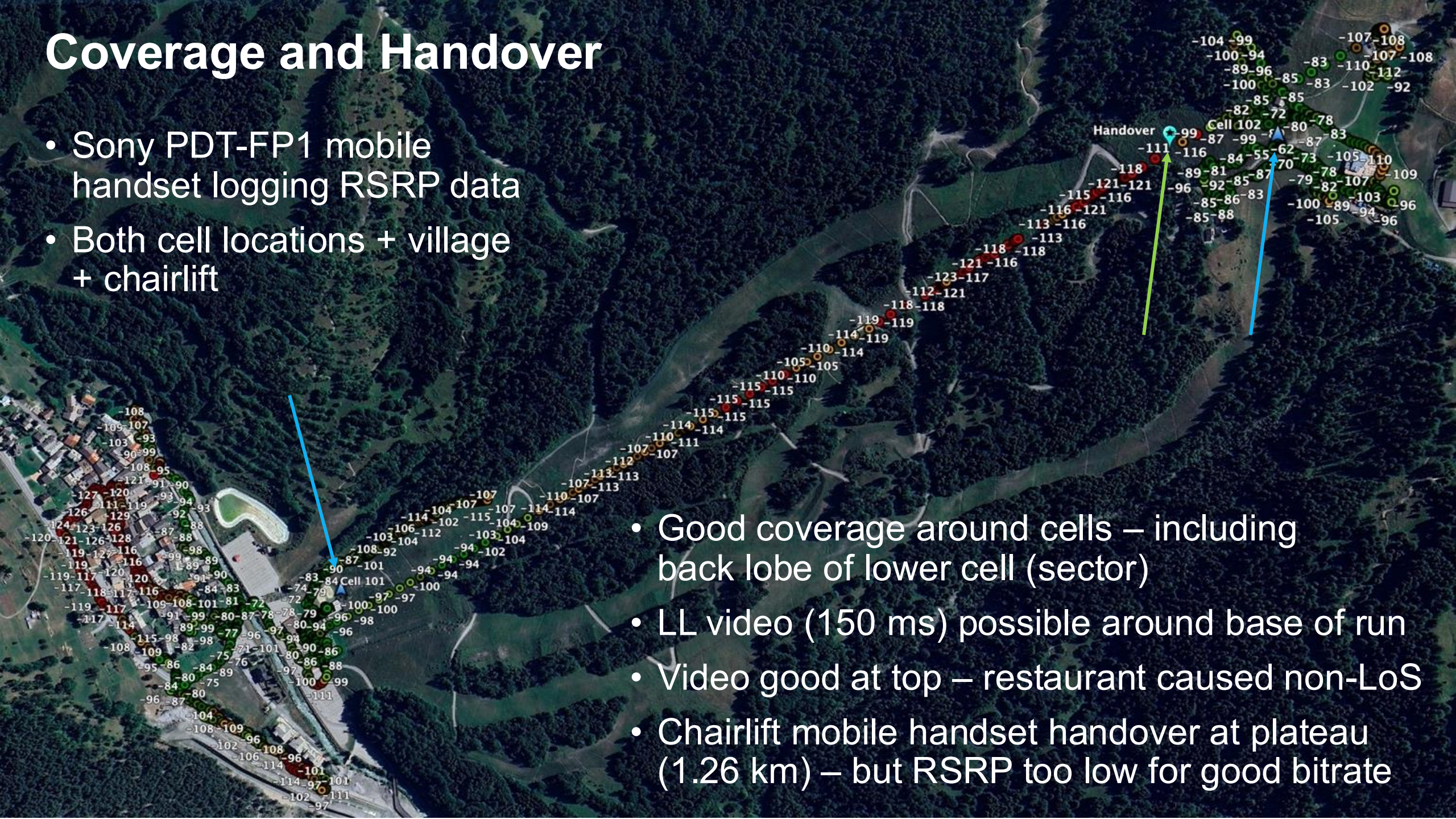
Coverage and Handover

- Sony PDT-FP1 mobile handset logging RSRP data
- Both cell locations + village + chairlift



- Good coverage around cells – including back lobe of lower cell (sector)
- LL video (150 ms) possible around base of run
- Video good at top – restaurant caused non-LoS
- Chairlift mobile handset handover at plateau (1.26 km) – but RSRP too low for good bitrate

Screen capture video output

- LL video feeds using codecs from Haivision and Sony + contribution feeds from mobile handsets
- MojoPro app used to capture live content from chairlifts and piste as colleague skied down
- Note iPhone streaming the MojoPro feed and camera with Sony encoder are filming each other

- Potential for cameras to deliver new content from new perspectives and locations (even from the athletes themselves)
- Opens up host of new angles and opportunities for storytelling, bringing audiences closer to the athletes and action

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Some key takeaways on P5G enabled ‘Broadcast’

- **No show without Spectrum** – opening up of (upper) n77 band has been key to private 5G SA broadcast successes
  - **Available in UK** since 2019 – and **growing in Europe**
- Private 5G SA bi-directional wireless comms **enables:**
  - Robust **high-throughput** and **low latency** workflows – especially useful in HDD environments
  - **Innovative** and **creative content capture** – e.g. fan cams, athlete POV, immersive
  - **Pop-up** or **fixed deployment** scenarios
- **Successful E-2-E solutions in broadcast** deployments achieved through willing **partnerships** between production rights holders, content creators, **technical comms specialists**, and broader infrastructure providers

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For your attention

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