IBC Accelerator:

Conquering the Air(waves)

Private 5G from Land to Sea to Sky

shaping the future

Google Cloud

Headline sponsor

hp | AMD

SHURE

Associate sponsors

Champions and Participants

Champions:

adapt media services

BBC

EBU
OPERATING EUROVISION AND EURORADIO

france tv

orange

globo

QTV

Rai

RTÉ

University of Strathclyde Glasgow

Participants:

d&b solutions

eutelsat
eutelsat GROUP

HAIVISION

Neutral Wireless

OPEN
BROADCAST SYSTEMS

SHURE

Inspiration

- Project idea emerged from the success of the mobile P5G used at the Paris 2024 sailing (in Marseille)
- Incredible **immersive** video *and audio* **transformed** the relationship with the audience
- **Storytelling** and **connection** were the central themes to explore

Objectives

- Bring audiences closer to the action with **storytelling**
  - New angles, new content, new data, new opportunities
- Produce engaging content at **lower cost**
- Reduce **environmental** impact
- Explore new opportunities to **share spectrum**
- Enhance **safety** and operational coordination
- Develop new **innovative** production workflows

Motivation

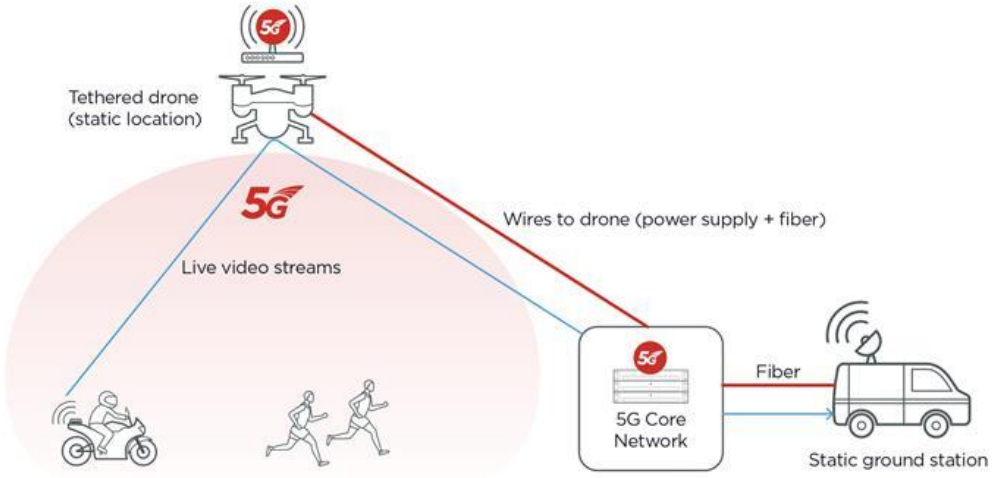
- Wireless connectivity is **essential** but **challenging**
  - Spectrum challenges, interference, congestion, bandwidth
- Wireless connectivity can be **expensive**
  - Dedicated (one-way) point-to-point links/devices
  - Large (moving) coverage areas – lots of equipment, or…
- Wireless connectivity can have **environmental impact**
  - Multiple aircraft airborne for long periods

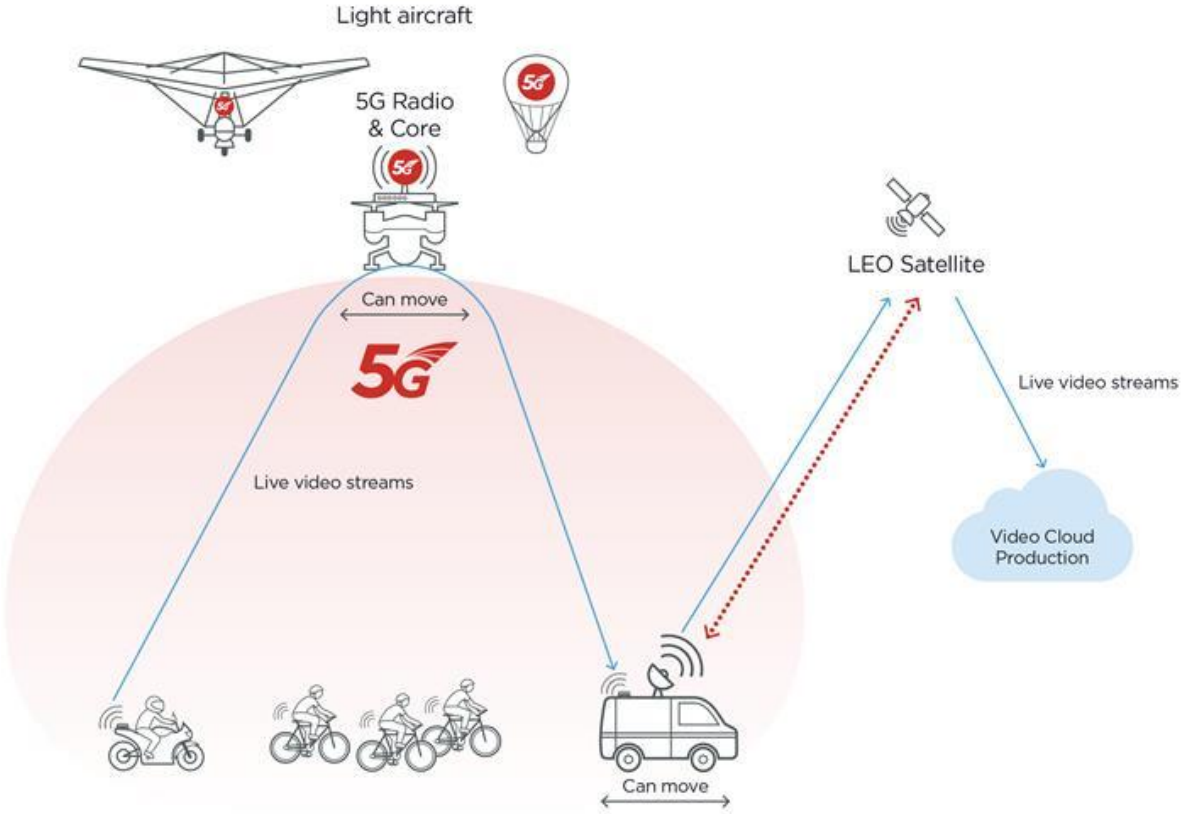
Addressing connectivity creates **opportunities**

Risks and Challenges

- **Spectrum**
  - Spectrum regulation, RF environment, device compatibility
- Working within aircraft **weight restrictions**
  - Deploy tethered or independent network
- Connection (**backhaul**) for control and production feeds
- Suitable **locations** or **events** for approval
- **Availability** of equipment and people (summer holidays!)

Project Approach





Phased approach:

1. Get airborne with a tethered drone and static production
2. Increase complexity and deploy a “mobile” P5G network

#1 RAI – Tethered Drone

Rivoli, Italy

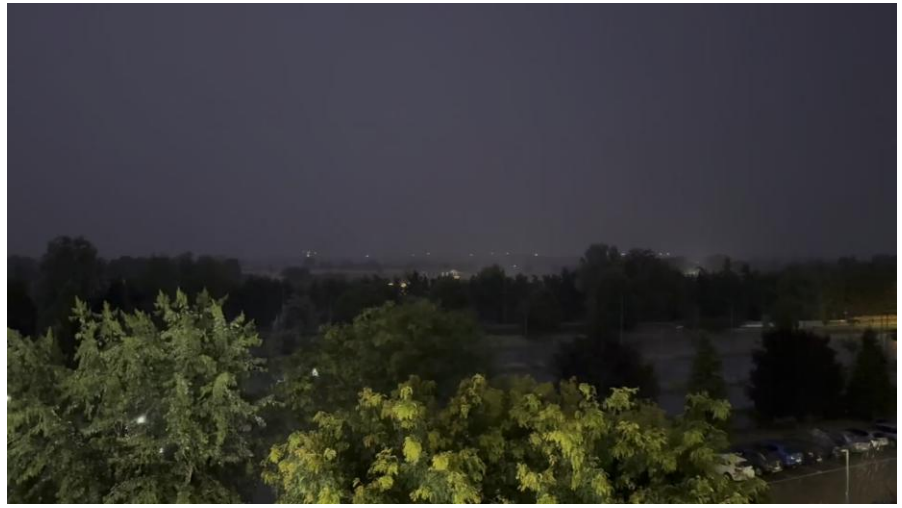
Objectives

Showcase multiple video feeds connected via airborne P5G

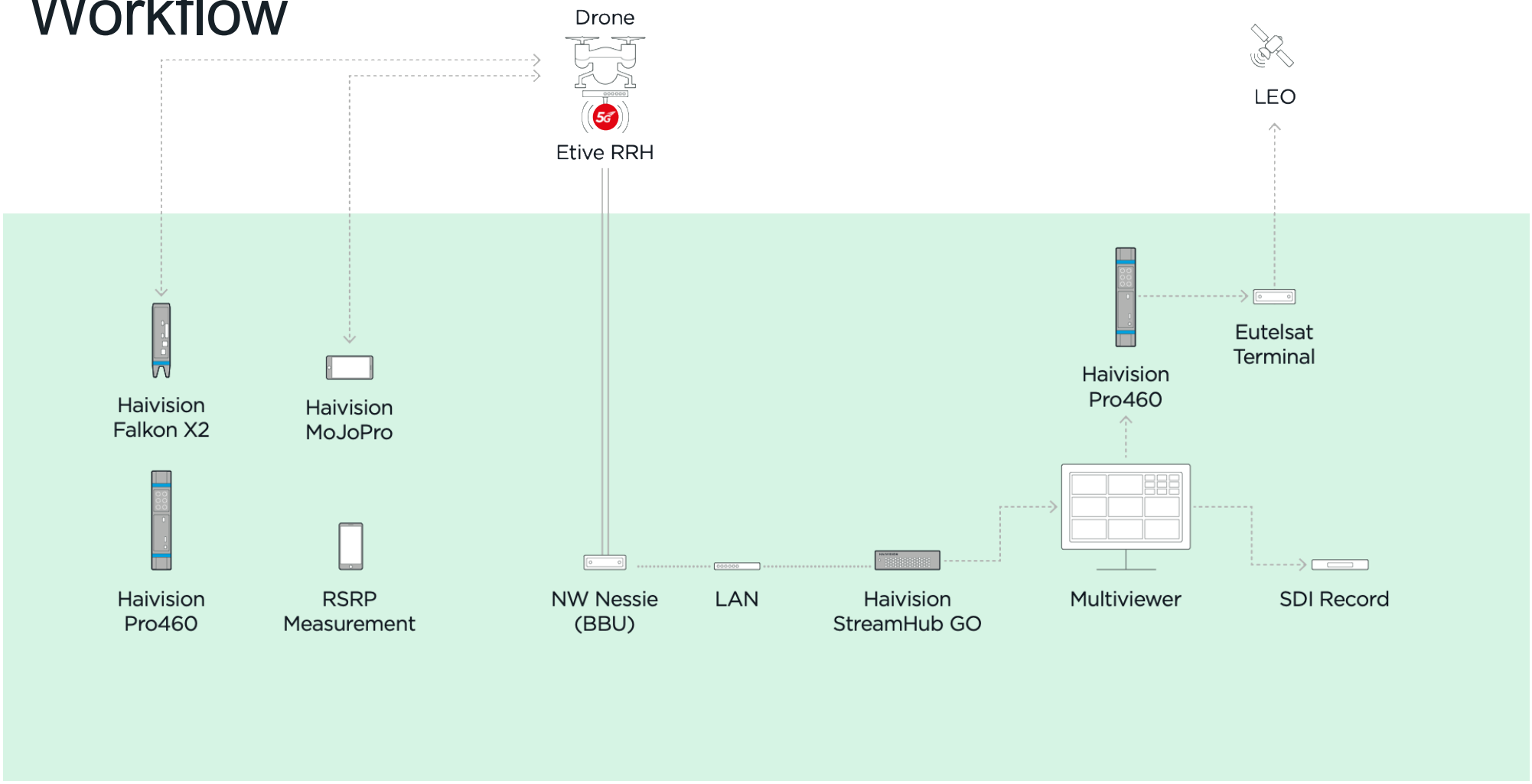
- ✓ Identify suitable location, drone and tether system
- ✓ Approval for **spectrum licence** to fly a private 5G cell
- ✓ Develop prototype low-power **lightweight radio**
- ✓ Mount cell on the drone and remain below take-off weight
- ✓ Test **prototype devices** (Falkon X2 and StreamHub GO)
- ✓ Collect **coverage data** to inform RF simulation methods

Risks and Challenges

- Use of RAI's n77 spectrum for point-to-point links was likely, but needed to be approved by the Ministry for **airborne P5G**
- Losing **weight** – could we get everything below weight limit
- Issues with the **drone** or pilot
- Integrating with the tether system
- Bad **weather** preventing flying



Workflow


Drone
Etive RRH
LEO
Haivision Falkon X2
Haivision MoJoPro
Haivision Pro460
RSRP Measurement
NW Nessie (BBU)
LAN
Haivision StreamHub GO
Haivision Pro460
Eutelsat Terminal
Multiviewer
SDI Record

Come fly with me…

- Fault with tether air module
  - No power over tether!
  - 30 mins just on batteries!
- Used 40 MHz channel centred at 3960 MHz with radio at 45 m
- 4 live video feeds
- RSRP logging using drones
- LEO backhaul to RAI production gallery

Outcome and Learnings

- Low-power P5G from the air provides **excellent coverage**
  - UL > 100 Mbps and DL > 80 Mbps in 40 MHz (prototype)
  - Stable video from mobile handset ~300 m from cell
  - LoS despite ground clutter (tall corn fields)
- Drone platform ideal for “pop-up” coverage
  - Static or steerable network cell(s)
- It may be possible to fly completely **untethered!**
- Next-generation devices have **improved RF performance**

#2 QTV – Henley Music Festival

Henley-on-Thames, UK

Objectives

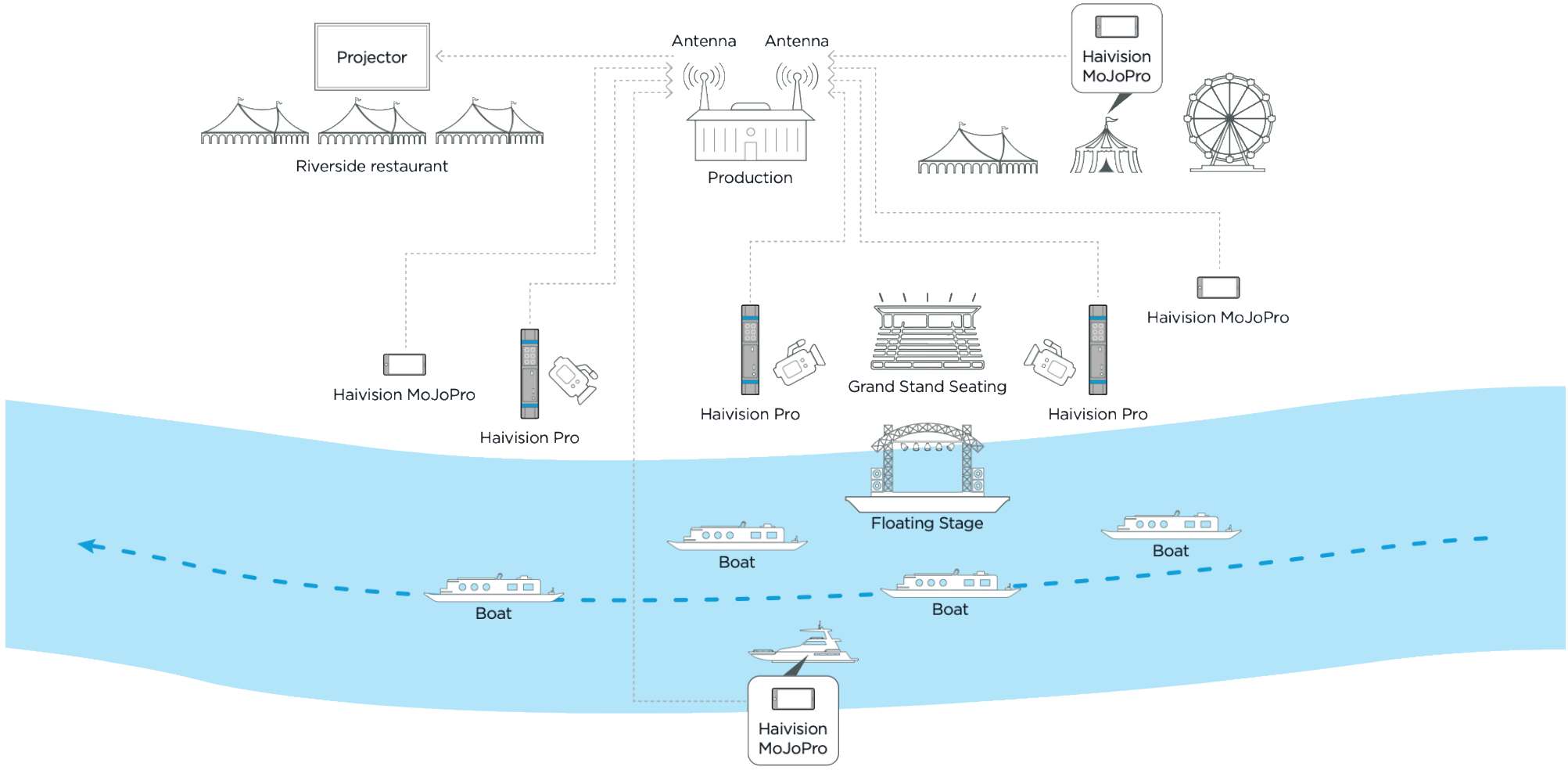
Explore new creative avenues for live production

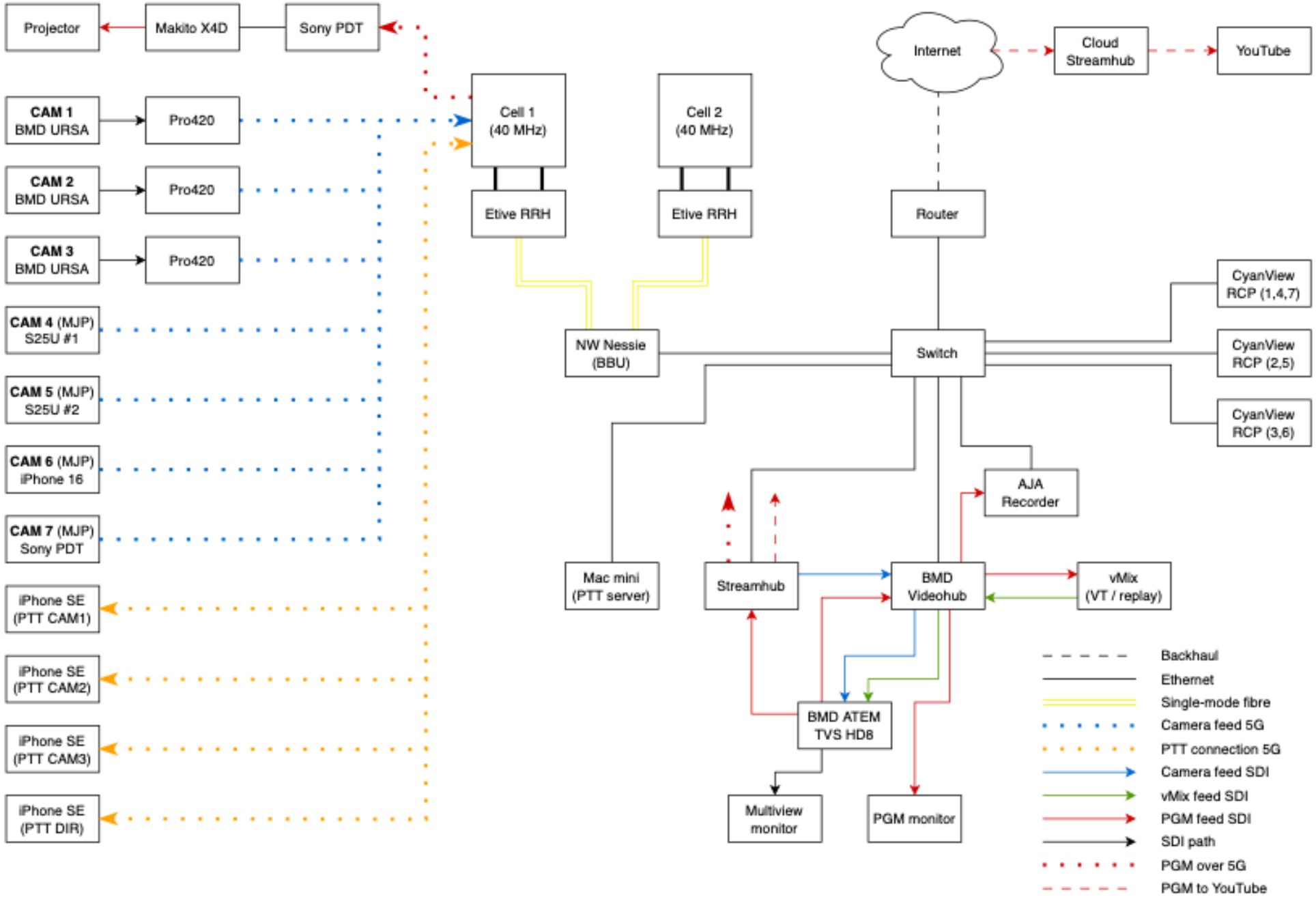
- ✓ Provide widespread uplink **coverage** across the festival site
- ✓ Connect multiple **ULL** wireless broadcast camera feeds
- ✓ Unobtrusive **handset-based** camera feeds
  - Move among the crowds
  - New angles (*e.g.* mounted to boats)
- ✓ Showcase **push-to-talk** intercom and remote **camera control**
- ✓ Local production using **DL to distribute video** on-site

Risks and Challenges

- **Spectrum** – reduced availability due to local ground stations
- Approval from Henley Festival directors
- Equipment availability
- Suitable **projection locations** on-site
- External **backhaul** connectivity for **cloud-based workflows**
- Scotsmen working in black tie in the **35º** heatwave!

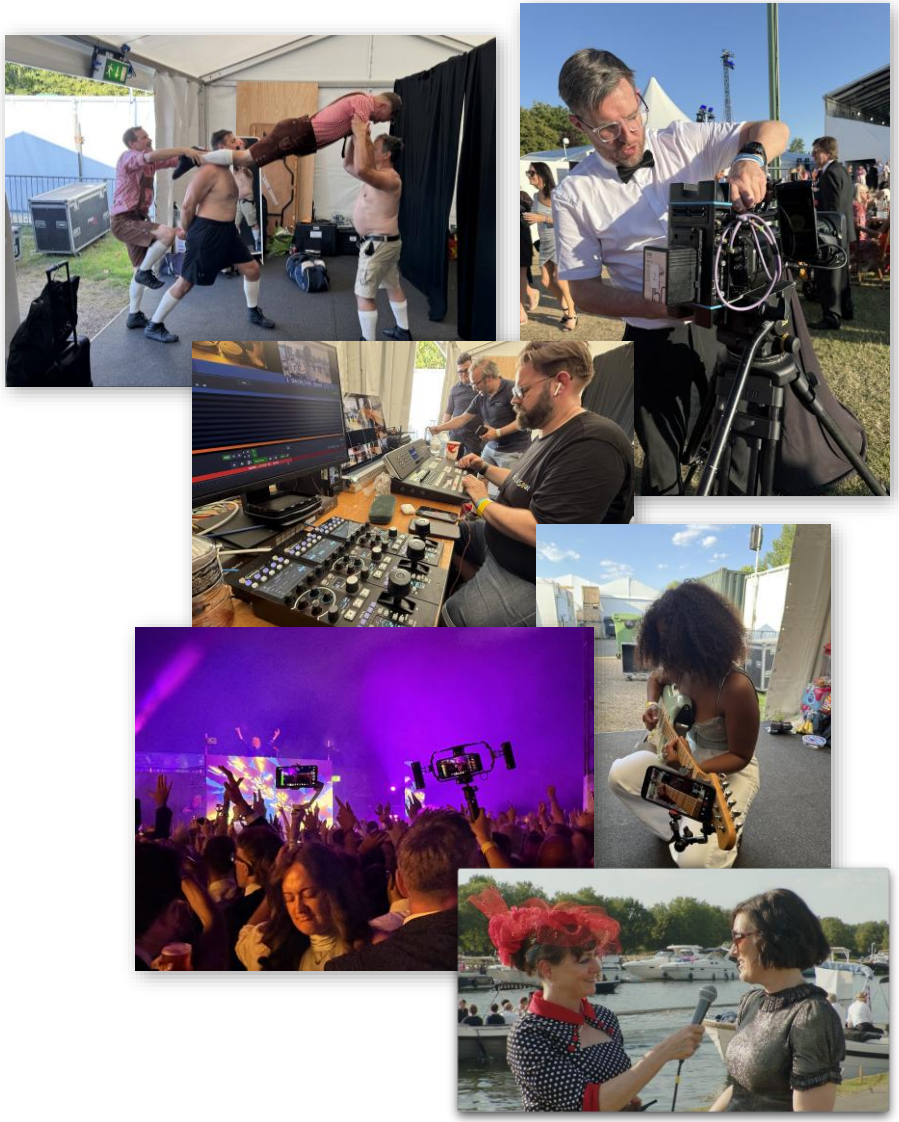
Workflow


Projector
Antenna
Antenna
Haivision MoJoPro
Riverside restaurant
Production
Haivision MoJoPro
Haivision MoJoPro
Haivision Pro
Grand Stand Seating
Haivision Pro
Haivision MoJoPro
Haivision Pro
Floating Stage
Boat
Boat
Boat
Boat
Haivision MoJoPro


Projector
Makito X4D
Sony PDT
CAM 1 BMD URSA
Pro420
CAM 2 BMD URSA
Pro420
CAM 3 BMD URSA
Pro420
CAM 4 (MJP) S25U #1
CAM 5 (MJP) S25U #2
CAM 6 (MJP) iPhone 16
CAM 7 (MJP) Sony PDT
iPhone SE (PTT CAM1)
iPhone SE (PTT CAM2)
iPhone SE (PTT CAM3)
iPhone SE (PTT DIR)
Cell 1 (40 MHz)
Cell 2 (40 MHz)
Etive RRH
Etive RRH
NW Nessie (BBU)
Internet
Cloud Streamhub
YouTube
Router
Switch
CyanView RCP (1,4,7)
CyanView RCP (2,5)
CyanView RCP (3,6)
AJA Recorder
Mac mini (PTT server)
Streamhub
BMD Videohub
vMix (VT / replay)
BMD ATEM TVS HD8
Multiview monitor
PGM monitor
Backhaul
Ethernet
Single-mode fibre
Camera feed 5G
PTT connection 5G
Camera feed SDI
vMix feed SDI
PGM feed SDI
SDI path
PGM over 5G
PGM to YouTube

Party on, Wayne…

- Used two adjacent 40 MHz cells
- 3x ULL broadcast camera feeds
- 3x handset-based camera rigs
- 1x handset mounted on a boat
- PGM projected live in restaurant
- Full camera control of all cameras
- Push-to-talk intercom



Outcome and Learnings

- Unlikely to replace cabled cameras on stage
- Handset-based camera rigs a **gamechanger** for production
  - Small, light, go anywhere
  - Capture genuine atmosphere with natural reactions
- Camera control **essential** for smartphone camera sources
- **Stacked use cases** valuable for live broadcast production
- Huge **opportunity** for P5G to transform festival production
- DL viable option to **distribute feeds** (even with UL bias)

#3 France TV – Ultralight Aircraft

Bretagne Classic

Brittany, France

Objectives

Wireless connectivity using P5G network from an aircraft

- ✓ Identify suitable **aircraft** and experienced **pilot**
- ✓ **Modifications** to airframe for P5G and transcode hardware
- ✓ Develop and test **prototype** radio and video hardware
- ✓ Develop **innovative** video and audio **workflows**
- ✓ Explore different **backhaul** routes off the aircraft
- ✓ **Spectrum** licence and **approval to fly** a 5G baseband unit

Risks and Challenges

- **Spectrum** – regulators really **not keen** on flying 5G cells!
- Finding suitable **aircraft** and **pilot** with correct registration, who would also let us modify their personal plane
- **Integrating** and powering network and transcode hardware
- Poor radio links due to **distance** and **limited TX power**
- **Weather** for all travel to Italy/France and during the event
- Permission to **join the event** production team on-site

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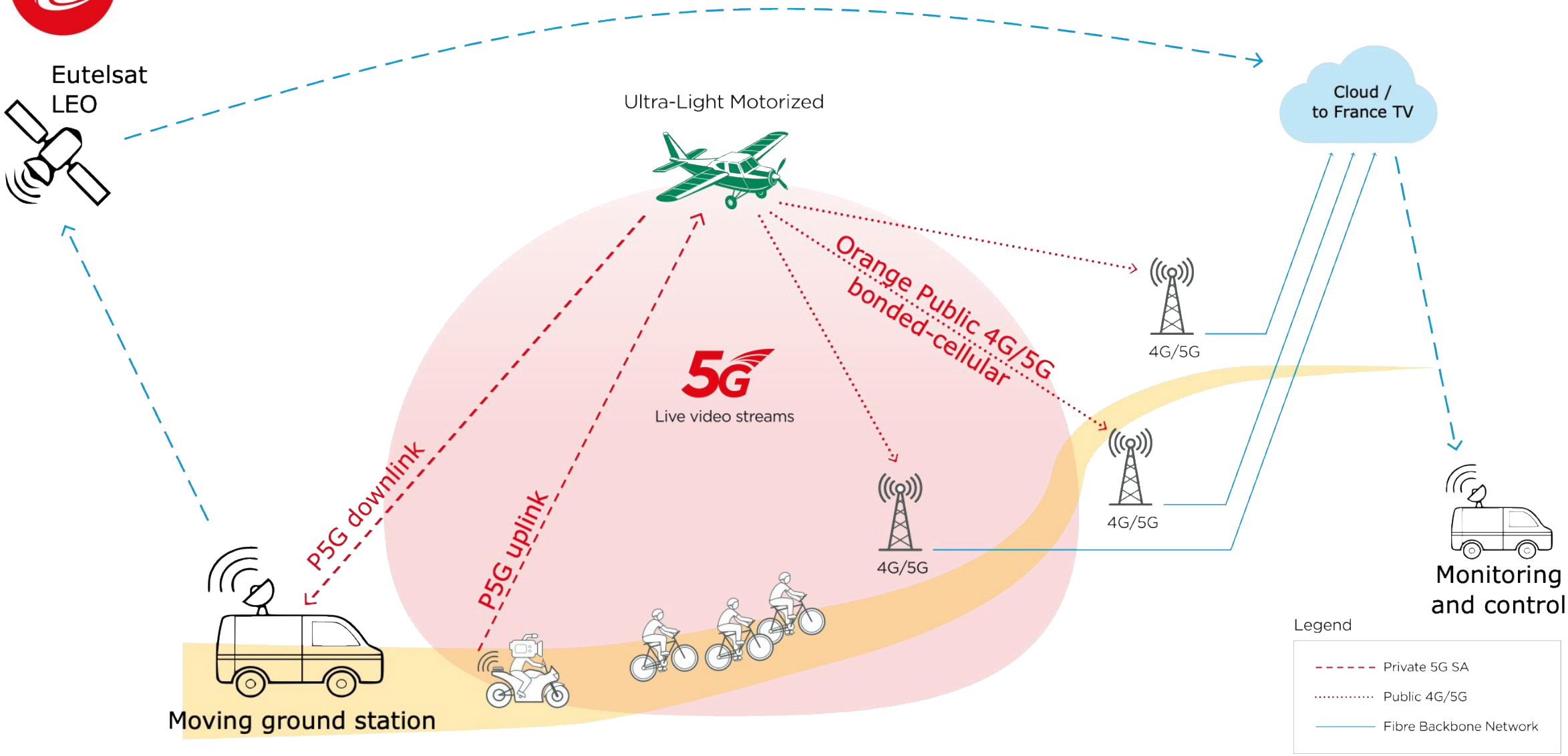
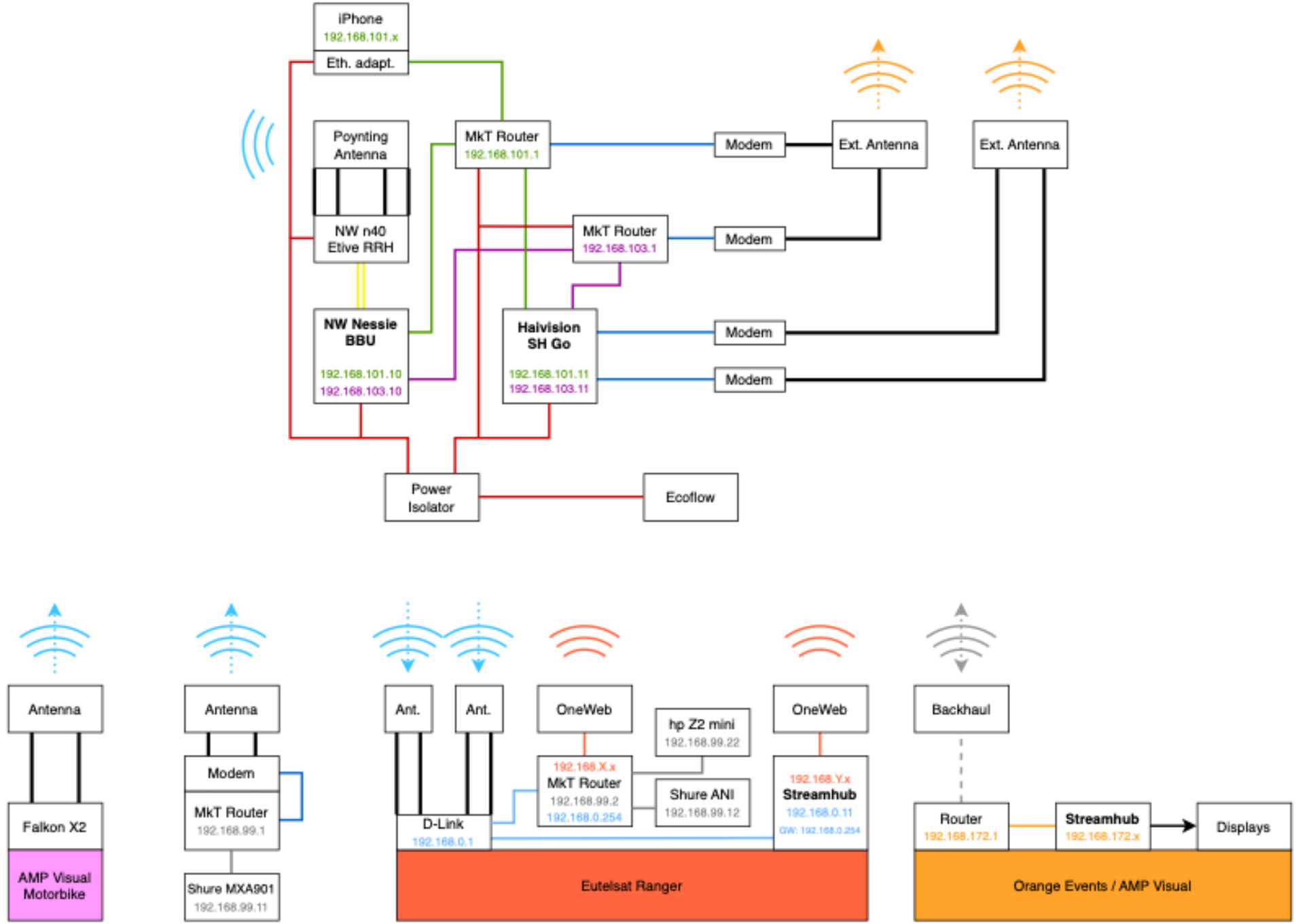
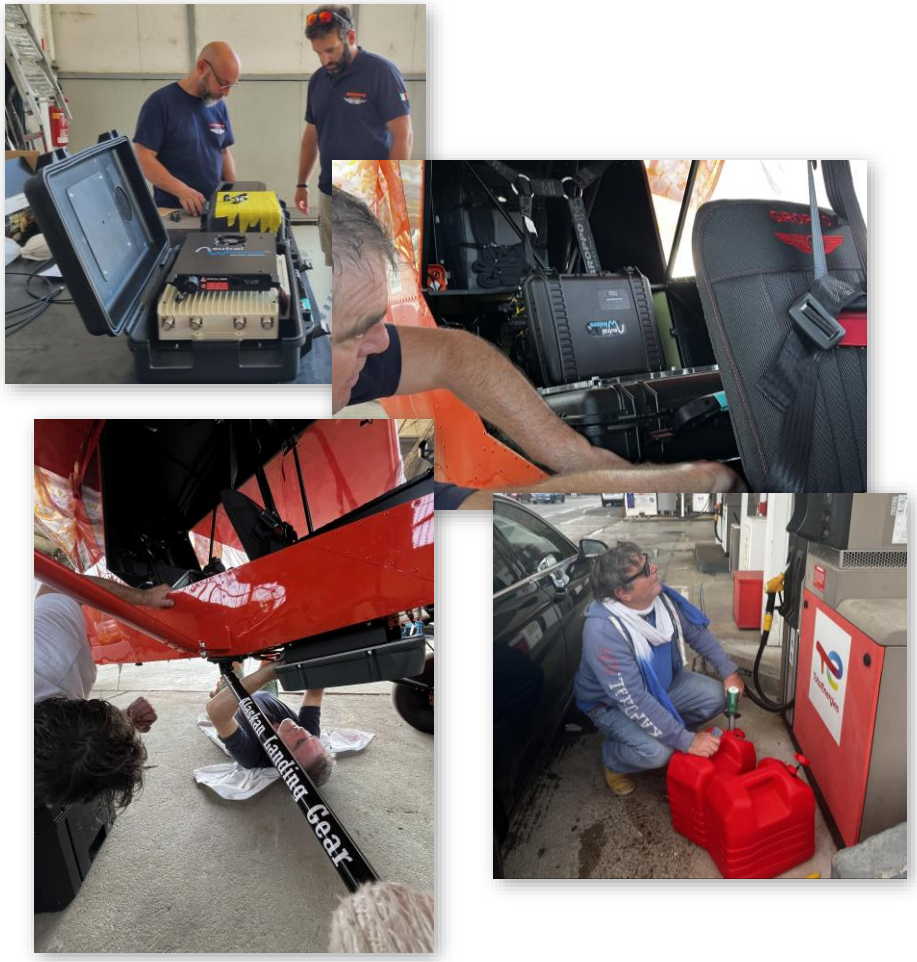



iPhone
192.168.101.x
Eth. adapt.
Poynting Antenna
NW n40 Etive RRH
MkT Router
192.168.101.1
MkT Router
192.168.103.1
Modem
Modem
Modem
Modem
Ext. Antenna
Ext. Antenna
NW Nessie BBU
192.168.101.10
192.168.103.10
Haivision SH Go
192.168.101.11
192.168.103.11
Power Isolator
Ecoflow
Antenna
Falkon X2
AMP Visual Motorbike
Antenna
Modem
MkT Router
192.168.99.1
Shure MXA901
192.168.99.11
Ant.
Ant.
D-Link
192.168.0.1
OneWeb
192.168.X.x
MkT Router
192.168.99.2
192.168.0.254
hp Z2 mini
192.168.99.22
Shure ANI
192.168.99.12
OneWeb
192.168.Y.x
Streamhub
192.168.0.11
GW: 192.168.0.254
Eutelsat Ranger
Backhaul
Router
192.168.172.1
Streamhub
192.168.172.x
Displays
Orange Events / AMP Visual

Take Your Marks…



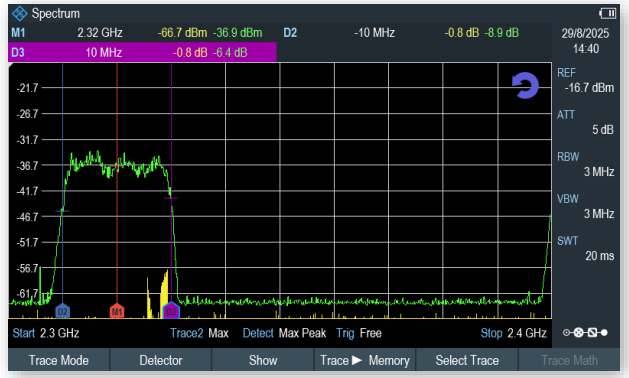
- Multiple trips to Italy, working with **Groppo** engineers to modify the aircraft and manufacture custom parts
- Negotiating **spectrum** with ARCEP and the Ministry of Armed Forces
- Coordinating flight plans and camera motorbikes with **AMP Visual TV**
- Transporting everything and everybody to Brittany

Get Set…

- Final set up and integration in Pontivy
- Spectrum licence landed 18:30 on Thursday 28th August
- Testing video and audio with airborne P5G around airstrip
- Flight plan coordination
- Integration with AMP Visual TV COFDM camera motorbikes
- Deployment of equipment for race day

GO?

- **Pre-flight** testing at Pontivy successful
- **Poor uplink connectivity** observed over Plouay (low UL MCS and negative PUSCH SNR)
- Spectrum analyser showed our licensed channel was **being used**
- Band had also been licensed for **COFDM camera links** on the motorbikes
- Managed a few clips, but not from motorbike



Groppo → **Eutelsat MDF** → **Cloud**

Outcome and Learnings

- Successfully integrated entire system in **less than 35 kg**
- Showcased **multiple** video and audio **streams** via aircraft
- P5G DL + LEO and public bonded-cellular **backhaul worked**
- Licensed low power **transmit 25 dBm** (0.3 W) was usable with aircraft 1000–1500 ft and 1.5 km radius
  - Limited by UE uplink power (usually <23 dBm)
  - Would like to test higher transmit power
- Important to have **clean spectrum** allocation

Action Replay

Post-match Analysis

Project Overview

- Hugely **ambitious** and **innovative** project
- Strong **collaboration** and positive **can-do** attitude
- Delivered three **industry-leading POCs**
- **Novel workflows** to adapt to deployment configuration
- Demonstrated how airborne P5G could **transform** production
- Showcased **stacked use cases**
- Engaged with **regulators** – potentially **influence policy**

Key Learnings — The Good

- **It works!** Even at low transmit power, P5G can be used to transport live video and audio to an **airborne** cell
- Network **downlink** can be used to distribute local content, or as a backhaul solution from an isolated cell
- P5G can simultaneously support **stacked use cases** delivering auxiliary services essential to live production and events (intercom, camera control, medical, PoS…) [These could be achieved with airborne network, too!]

Key Learnings — What Could be Improved?

- Spectrum regulation is **challenging** for airborne 5G networks
- **Clean spectrum** is essential
- Work closer with production companies
- Would like to **integrate LEO** connectivity directly on aircraft
- Allow more time (or add more hours in a day!)
- Don’t rely on engineers to capture BTS video footage!

Impact

- Opportunity to reduce cost and improve **sustainability**
- Groppo ULM typically consumes 15 l/h (gasoline) at 100 km/h (a **fraction** ~2.5% of **fuel consumption** of current solutions)
- Reduced cabled infrastructure (less haulage, less travel)
- New storytelling and remote workflows support both audience and employee **accessibility**, **inclusivity** and **diversity**
- Influence spectrum **regulation and policy** (spectrum sharing)
- Medical data provided to teams could potentially **save lives**


LAND | SEA | AIR