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# **5G FWA IN ORKNEY: BUILD AND OPERATION**

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GREG WHITTON, CLOUDNET**

# 5G NEW THINKING

# 5GNT: Orcadian Inception

- ✘ DCMS, Cisco, University of Strathclyde
  - ✘ Aims to produce a "toolkit" of how to build rural 5G networks; numerous "testbeds" running for ~6mo
- ✘ CloudNet (local WISP) + Faroes Telecom — testbed
  - ✘ NetEngs experience of previous 4G projects
    - ✘ And some L2 to L3 "growing pains" to resolve
    - ✘ Issues common in organically-grown WISPs

# Vendor Selection

- ✘ **University of Strathclyde** had experience/partners:
  - ✘ **Cisco** — core (...but ended up **Open5GS**)
  - ✘ **Amarisoft** — eNodeB/gNodeB
  - ✘ **AW2S** — radio
  - ✘ **Alpha Wireless** — antenna

# Vendor Selection

- ✘ **CloudNet** had preferences too:
  - ✘ Knows the area and their challenges
  - ✘ Knows their budget
  - ✘ Will be responsible for operations long-term
  - ✘ Supply-chain
  - ✘ Sometimes you have to accept (and work around) sharp edges in the chosen NOS/hardware

# L2 to L3 Migration

- ✘ Architected / HLD in May 2021 (pen and paper!)
- ✘ Low-Level Design in June 2021 (NetBox)
- ✘ Template-automated in July 2021 (Python)
  
- ✘ Full BOM, costed to the patch cable
- ✘ Deadline is October 2021
  - ✘ Feeling pretty pleased with ourselves!

**DELAYS**

# Quadruple-Whammy

- ✘ Pandemic
  - ✘ Almost everything is harder, takes longer
- ✘ Brexit
  - ✘ Customs charges, import duty, returns to supplier
- ✘ Supply Chain
  - ✘ Not having e.g. PSU capacitors affects all vendors
- ✘ Orkney
  - ✘ Turns out that Orkney is Quite Far



**“Space [...] is big. Really big. You just won't believe how vastly hugely mind-bogglingly big it is.”**

*– Douglas Adams, The Hitchhiker's Guide to the Galaxy*

**SCOTLAND**

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# How Far?





**Almost as Northern as Stockholm**



# Not All Choices are Equal

- ✘ Warranty:
  - ✘ Is this hardware made for these environments?
  - ✘ How long would RMA replacement take to arrive?
  - ✘ Self-sparing was essential!



ICELAND

Labrador  
Sea

Thousands of Miles of Sea

UNITED  
KINGDOM

IRELAND

Birmingham

Lon

Celtic  
Sea

Bay of  
Biscay



**ORKNEY: QUITE WET**

**"On Orkney the rain can be vertical.  
Vertical upwards."**

*– Trevor, CloudNet Orkney*

# Typical High Site



# Keeping Dry Inside



**"On Orkney the rain can be vertical.  
Vertical upwards."**

*– Trevor, CloudNet Orkney*



**With  
Added  
Sea Salt**





**ORKNEY: QUITE WINDY**





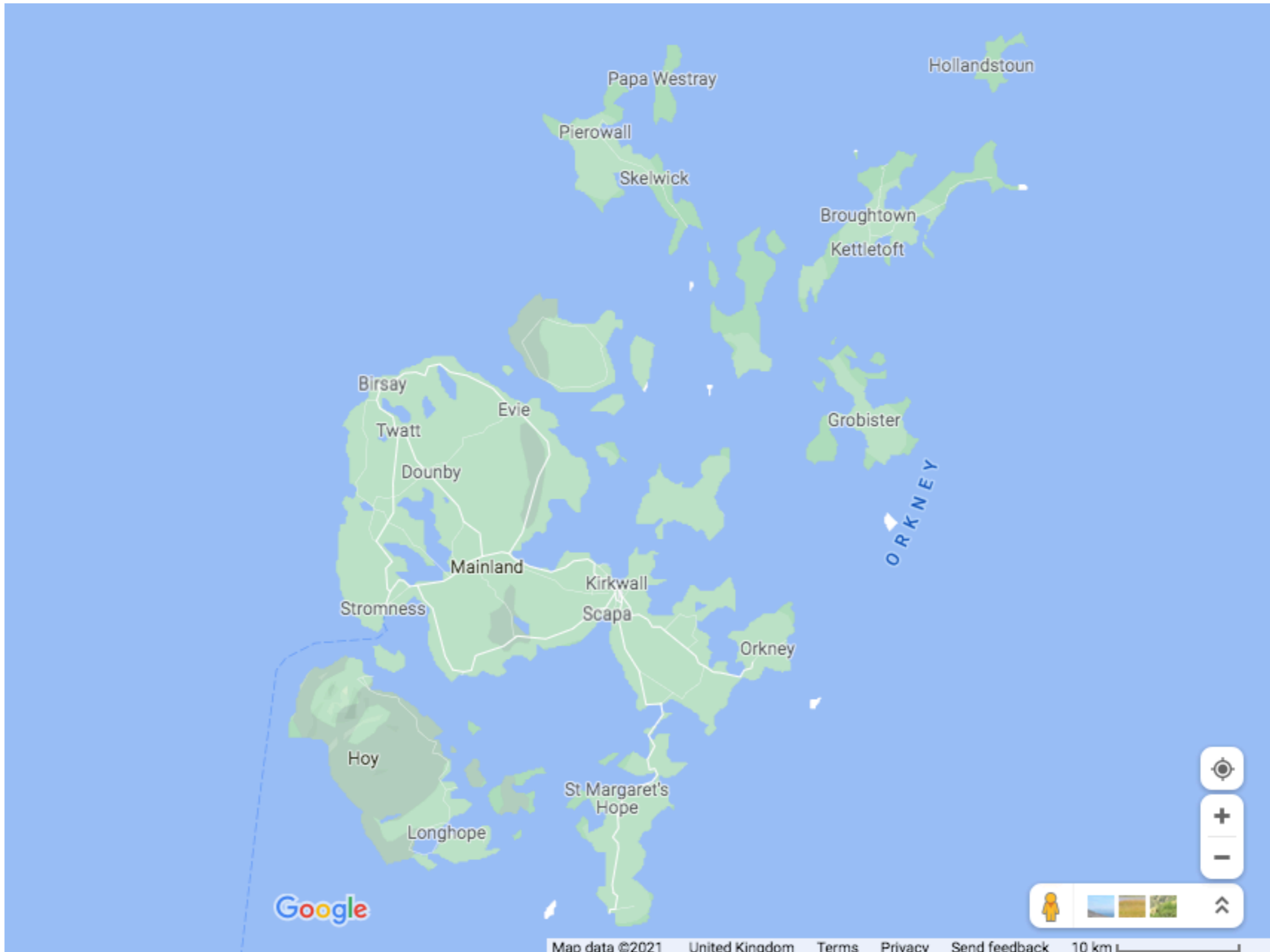
# Changeable Weather

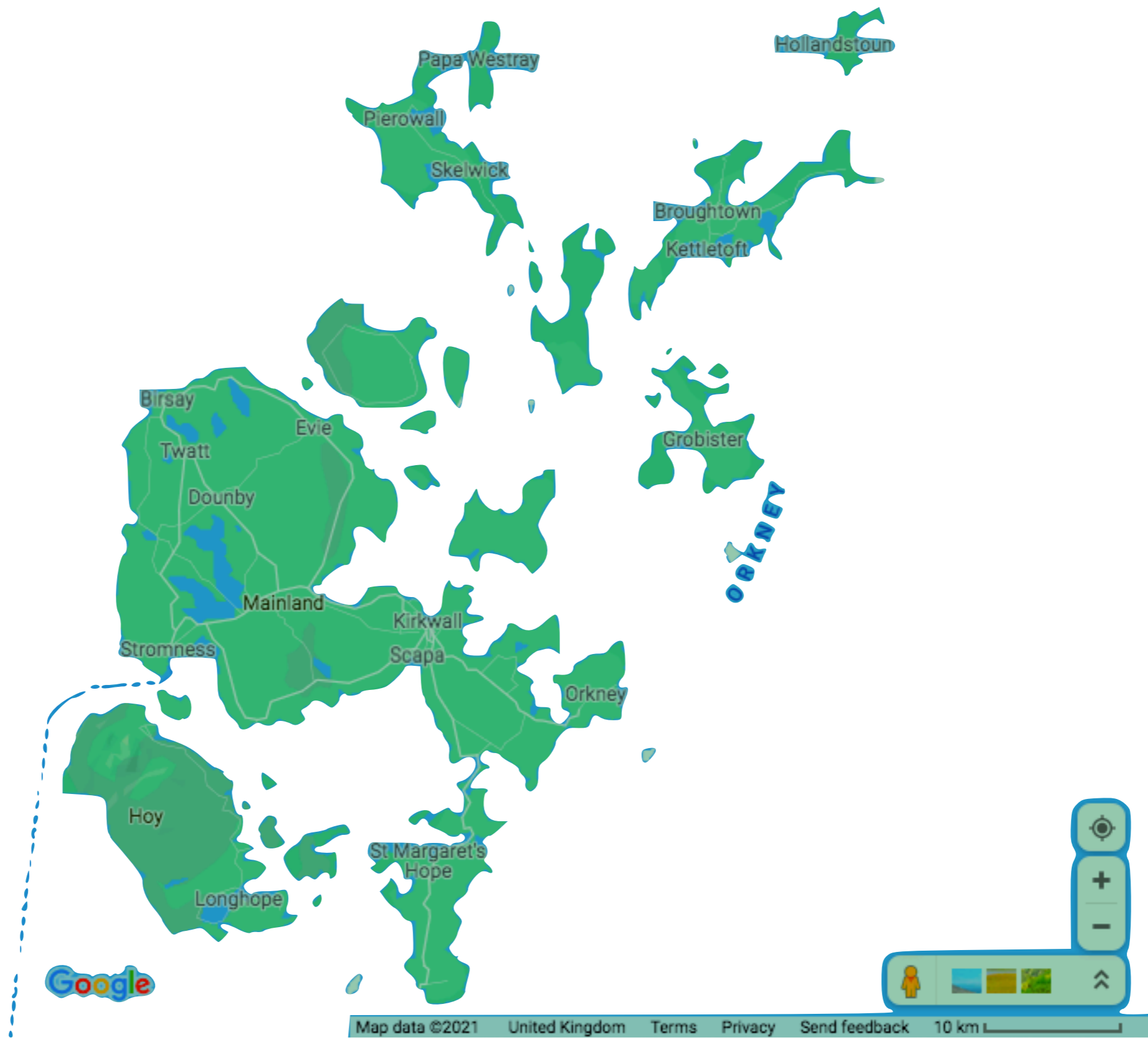


# Will Warranty Cover This?

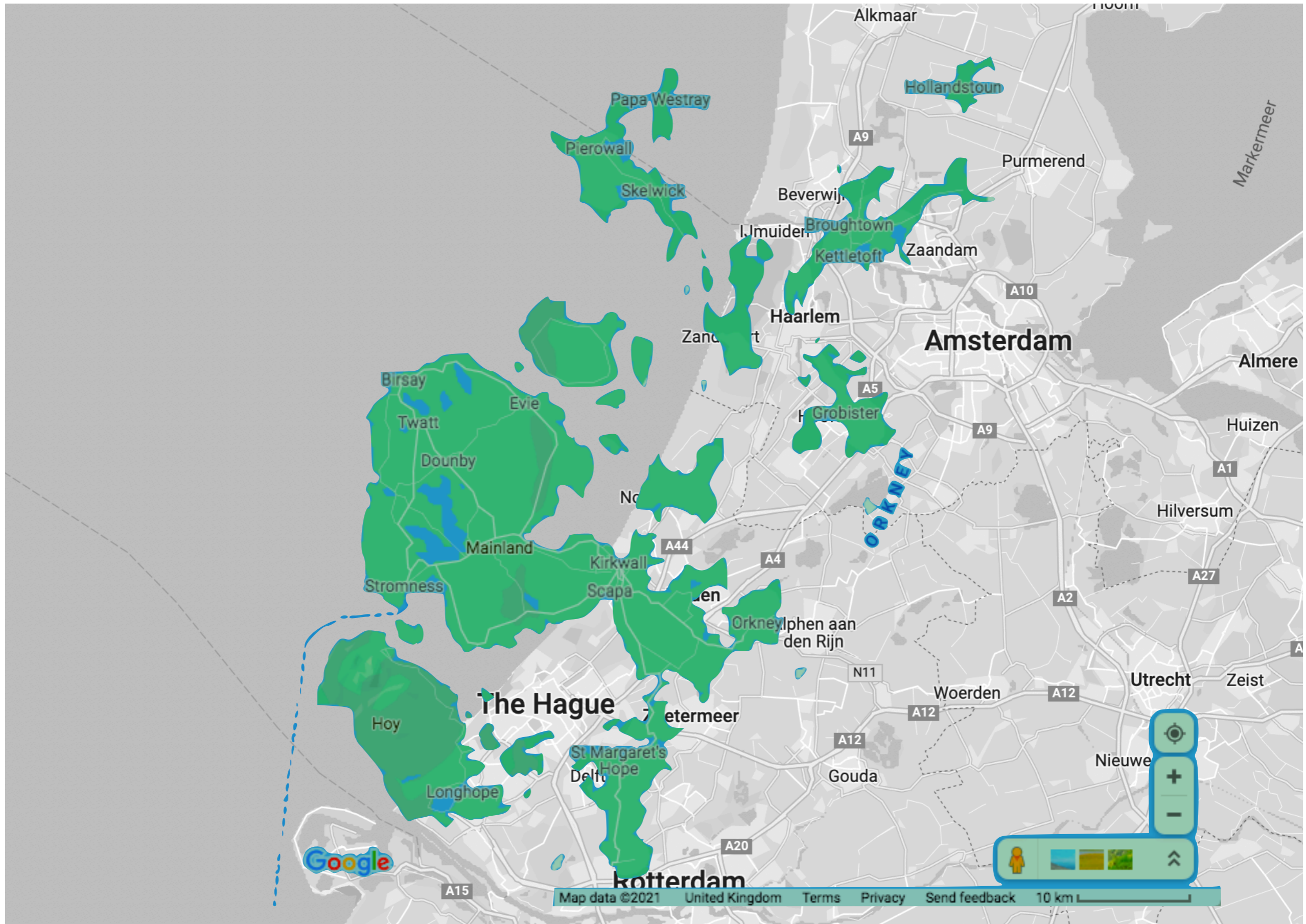


**ORKNEY: QUITE BIG**





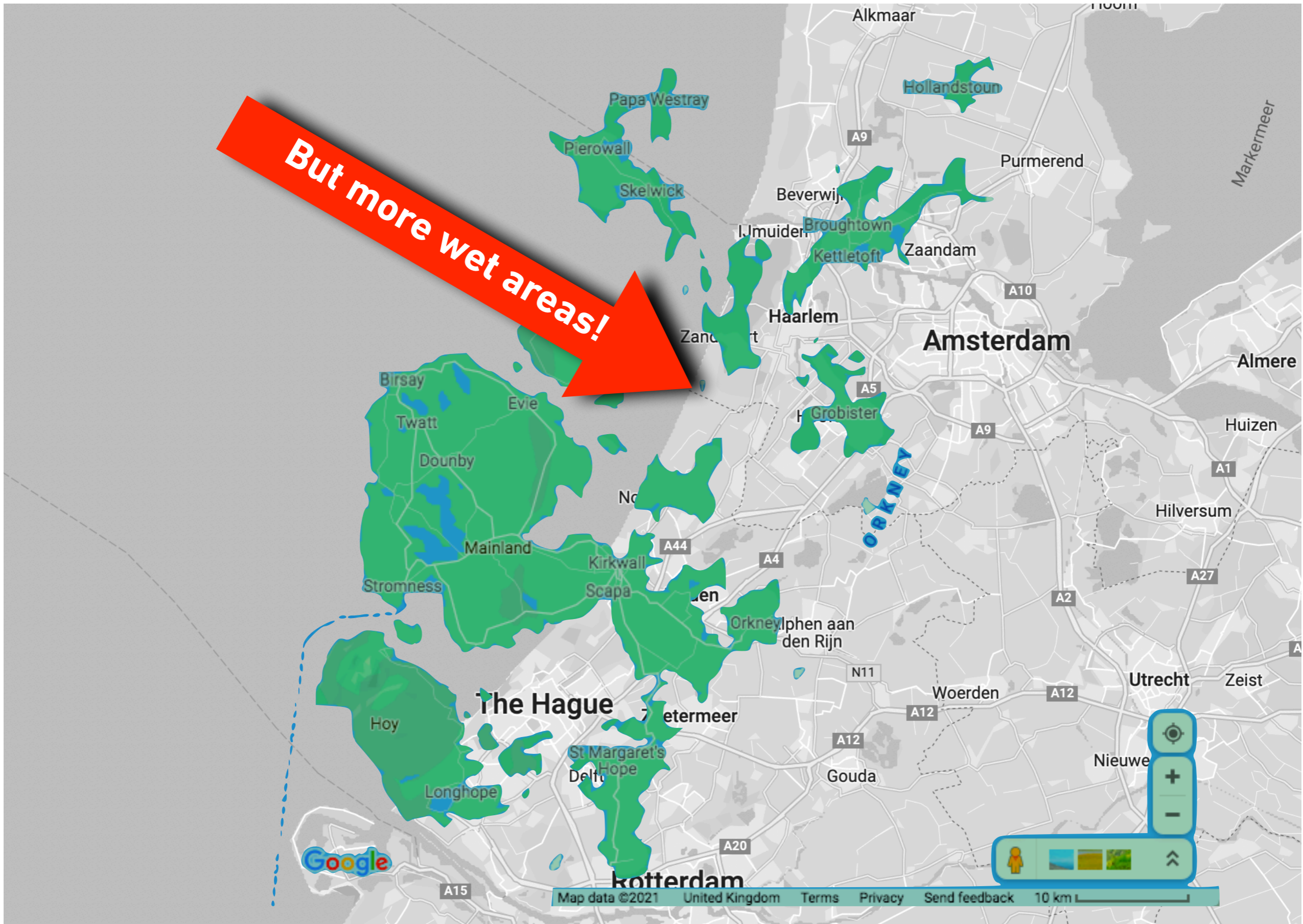
Google



Google

Map data ©2021 United Kingdom Terms Privacy Send feedback 10 km

**But more wet areas!**



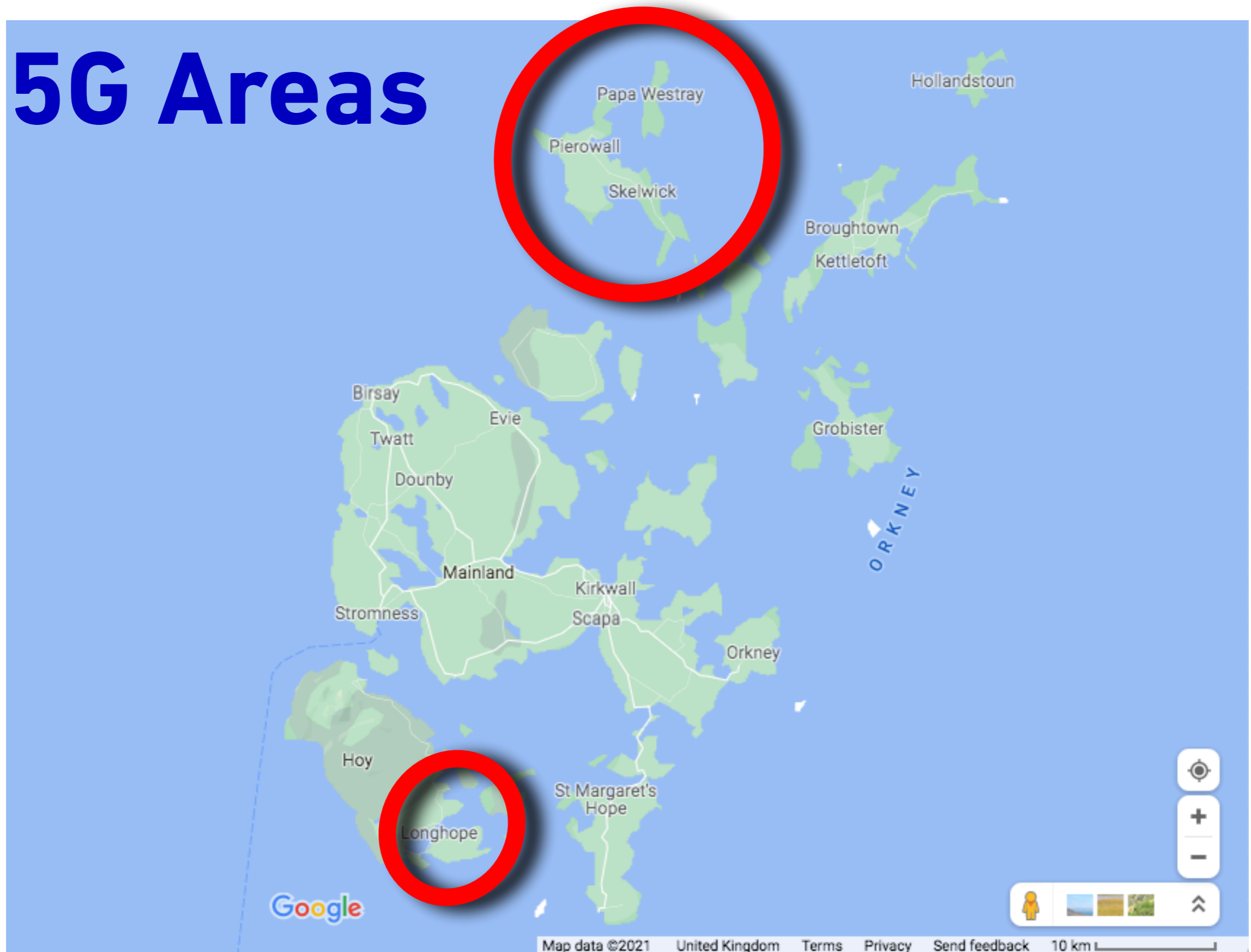


# Fibre 2021

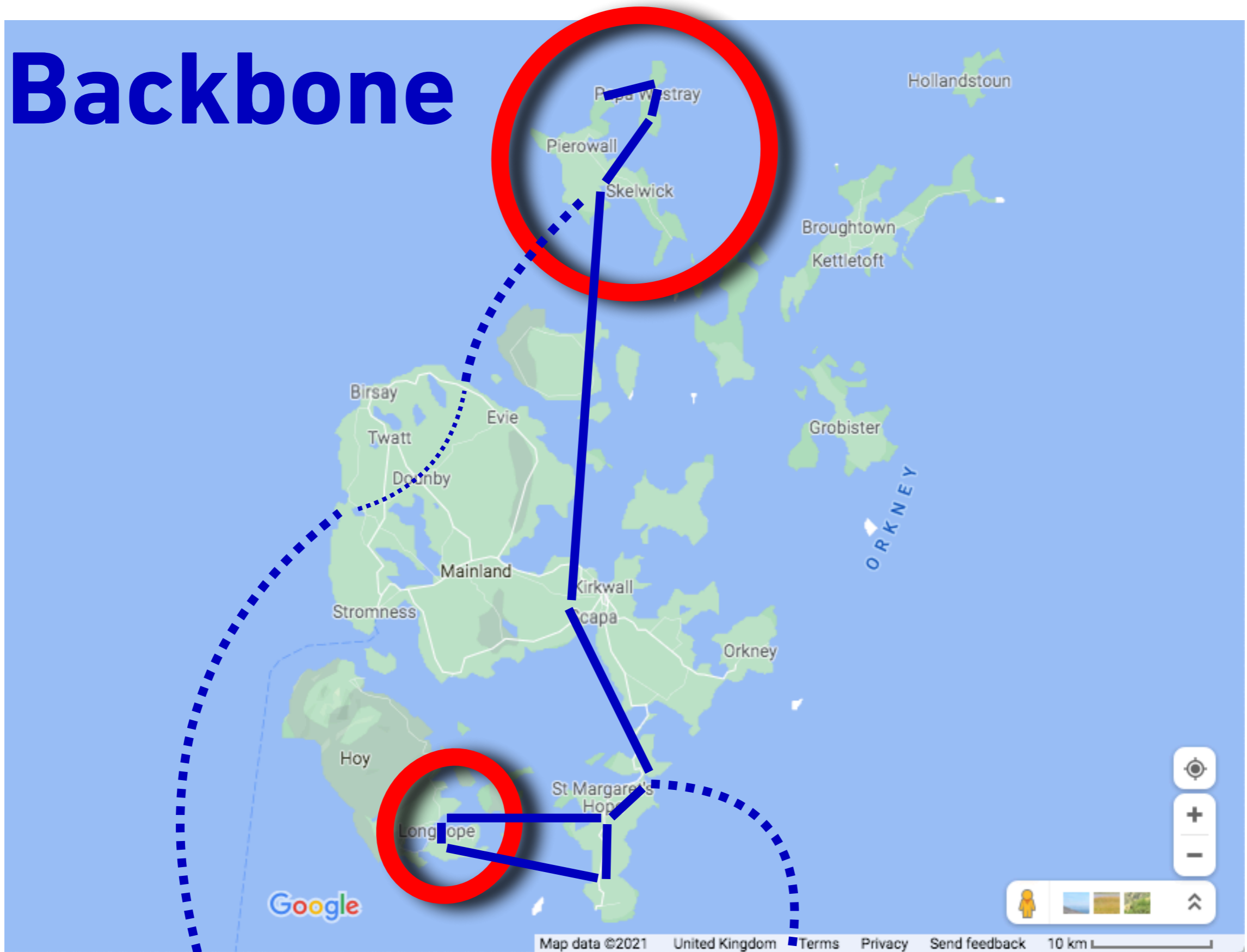




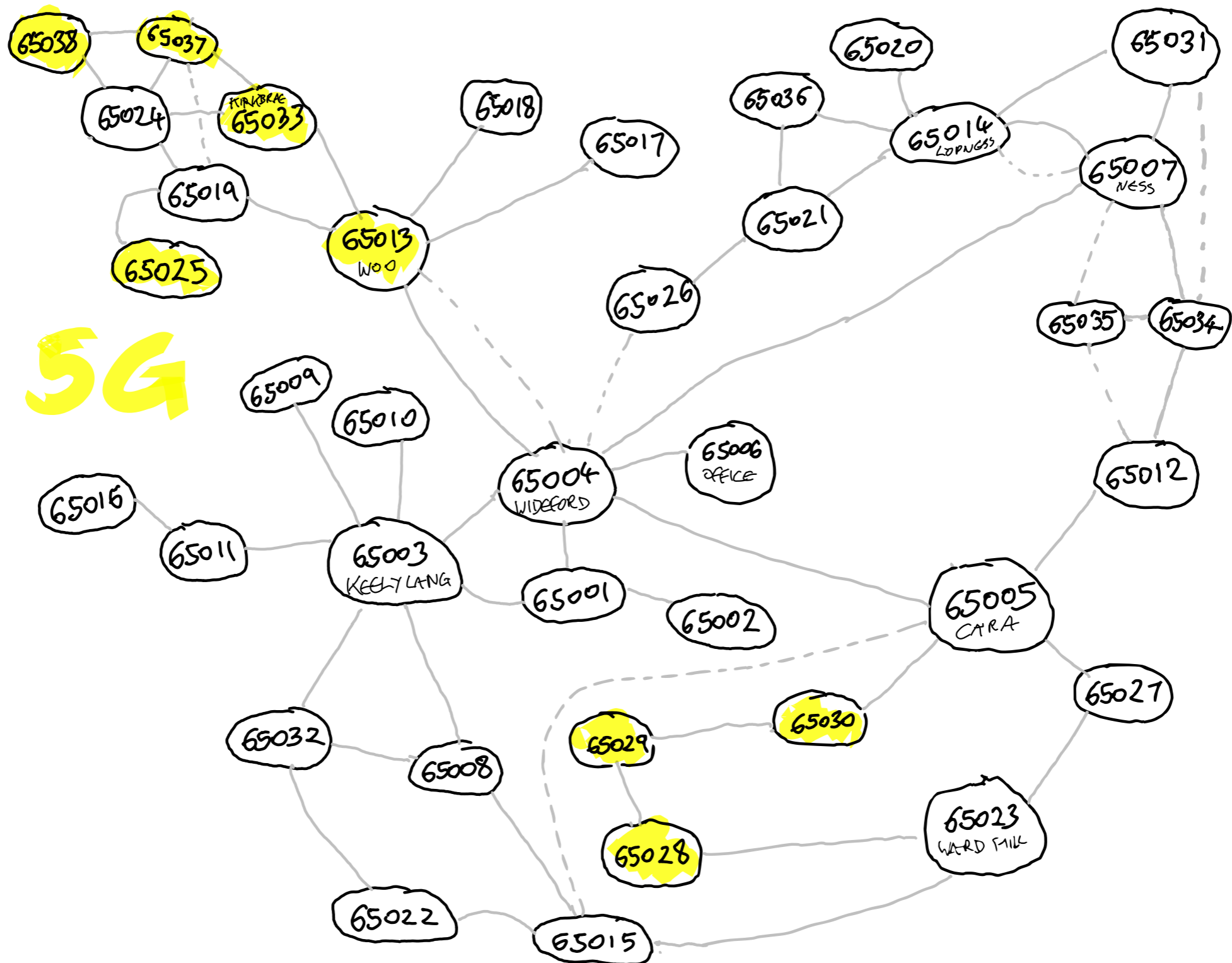
# 5G Areas



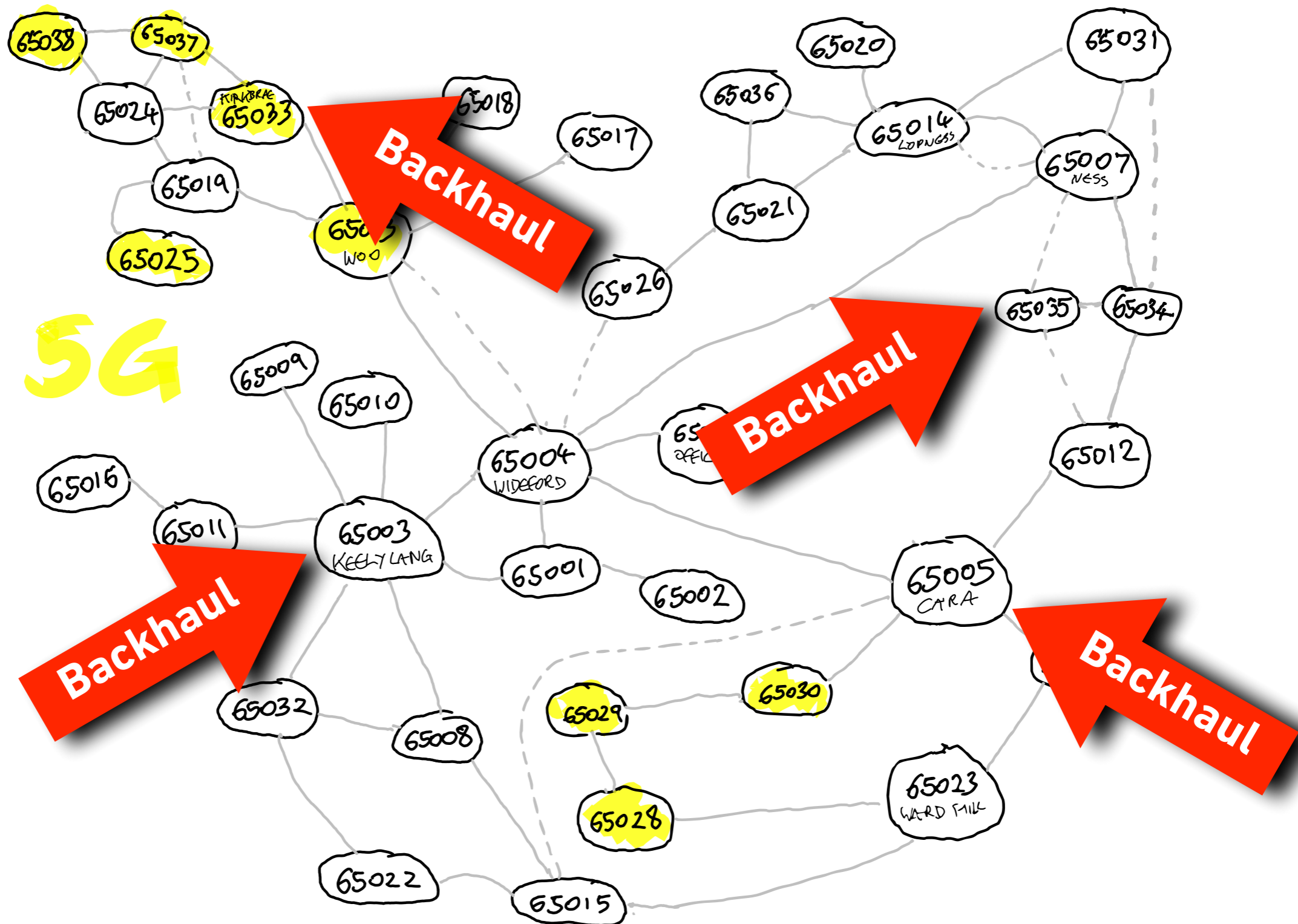
# Backbone

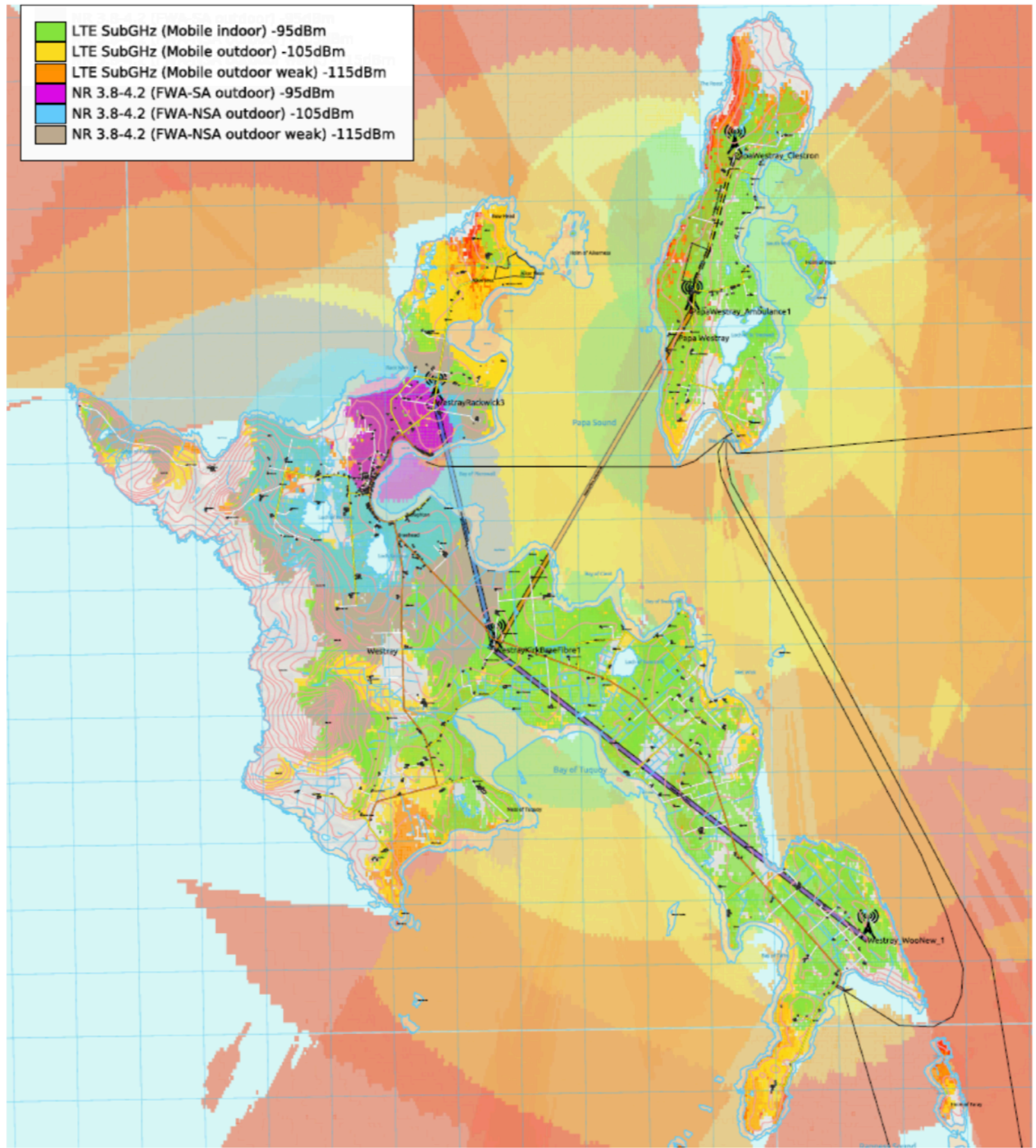


# Architecture



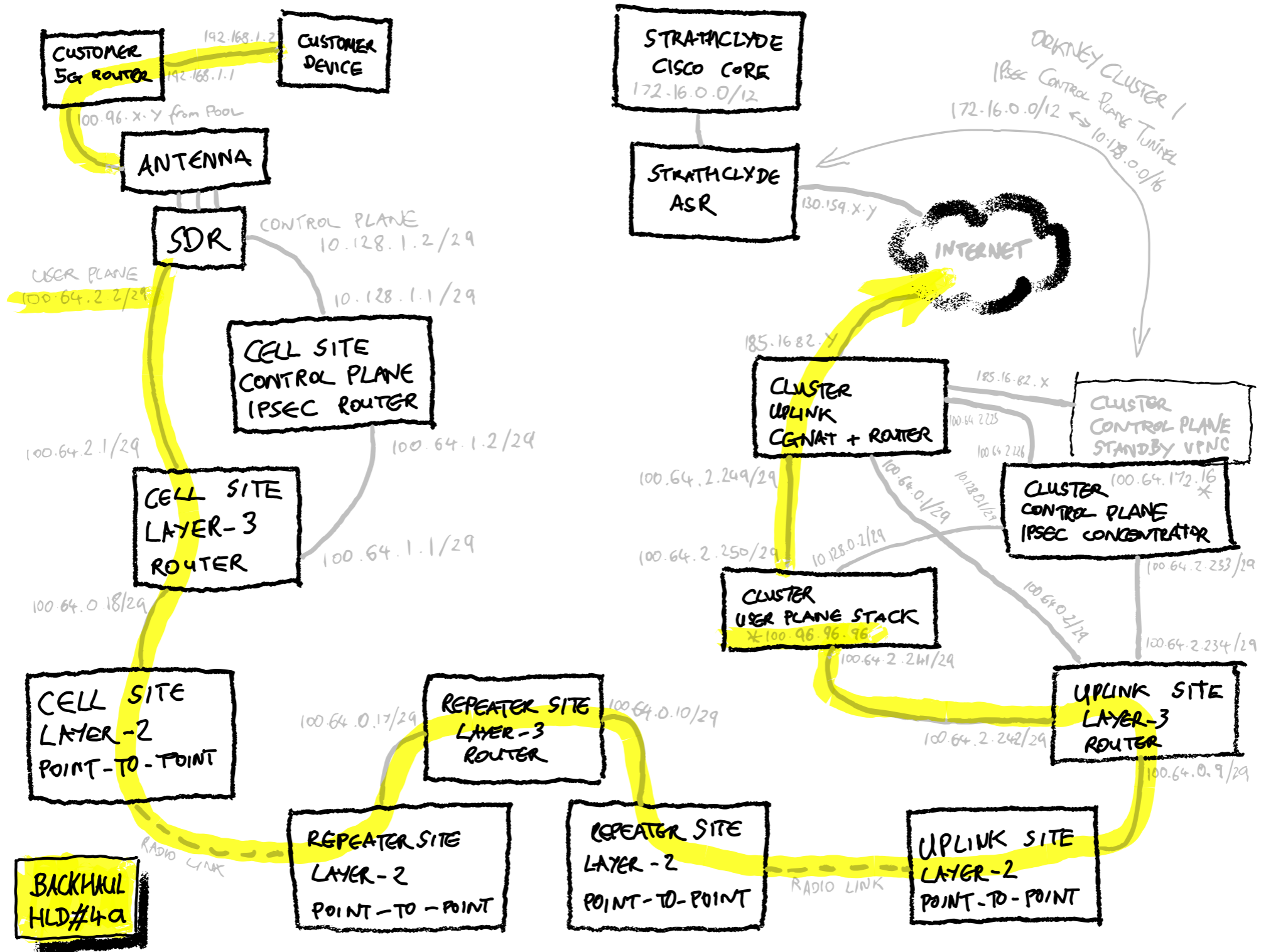
# Fibre Backhaul to Internet





Combined 4G LTE + 5G NR coverage map, showing sites and backhaul links

# Mid-Level Design





# **PLANES, TRAINS, AND AUTOMOBILES**

**PLANES, BOATS,**  
**AND AUTOMOBILES**









# ORKNEY: A TYPICAL DAY

# Grab the Gear (v1)

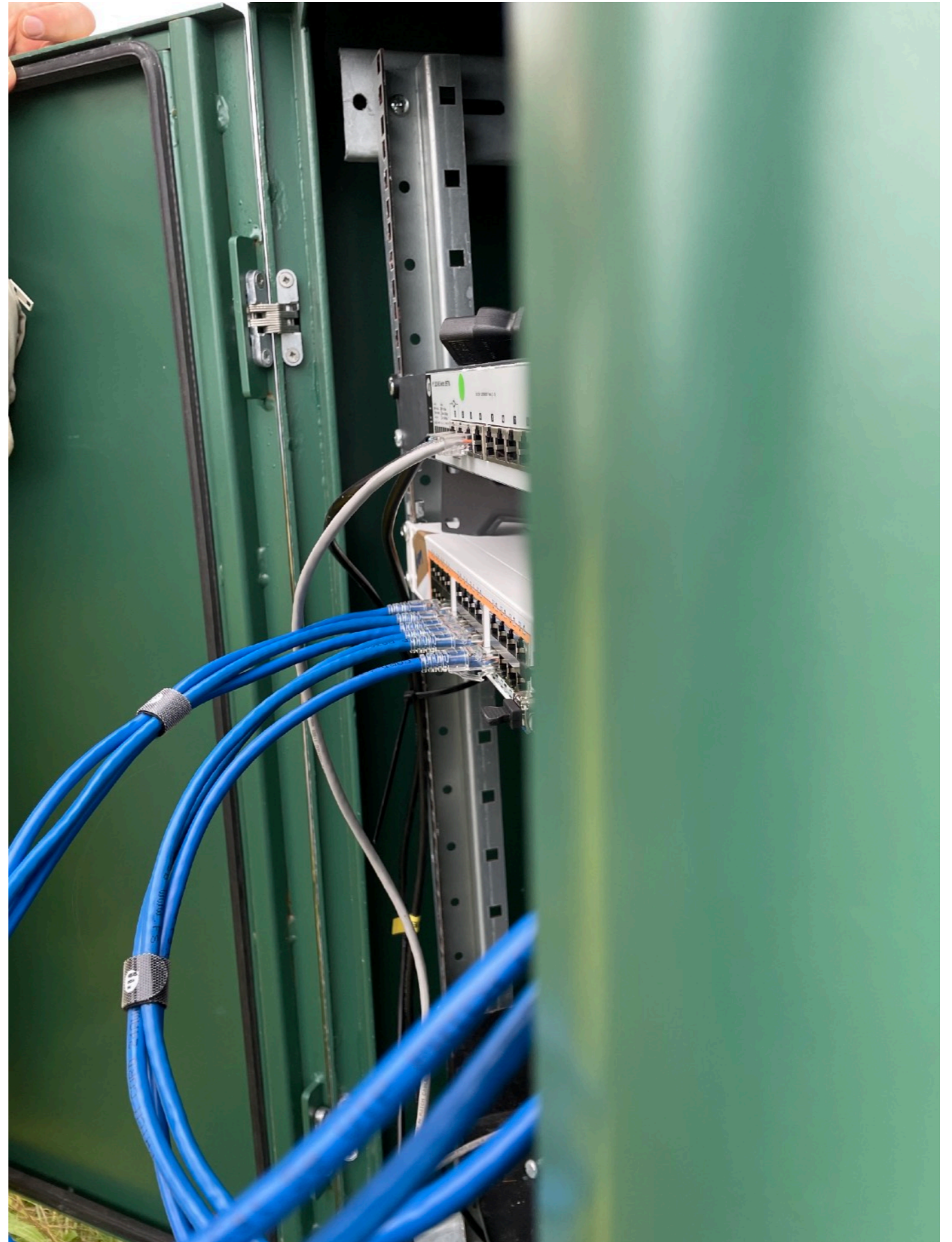




# Get to Site



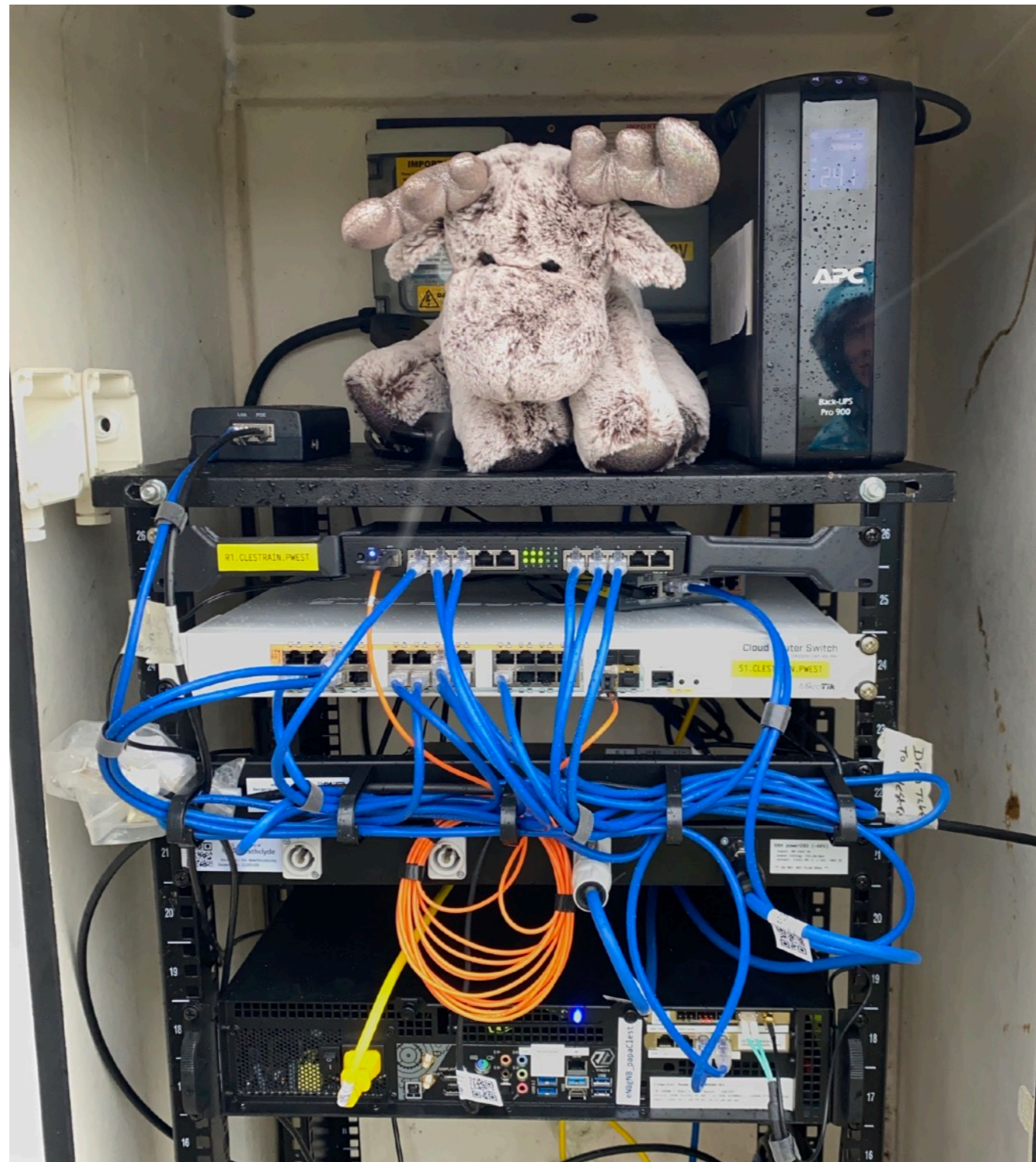
# Swear

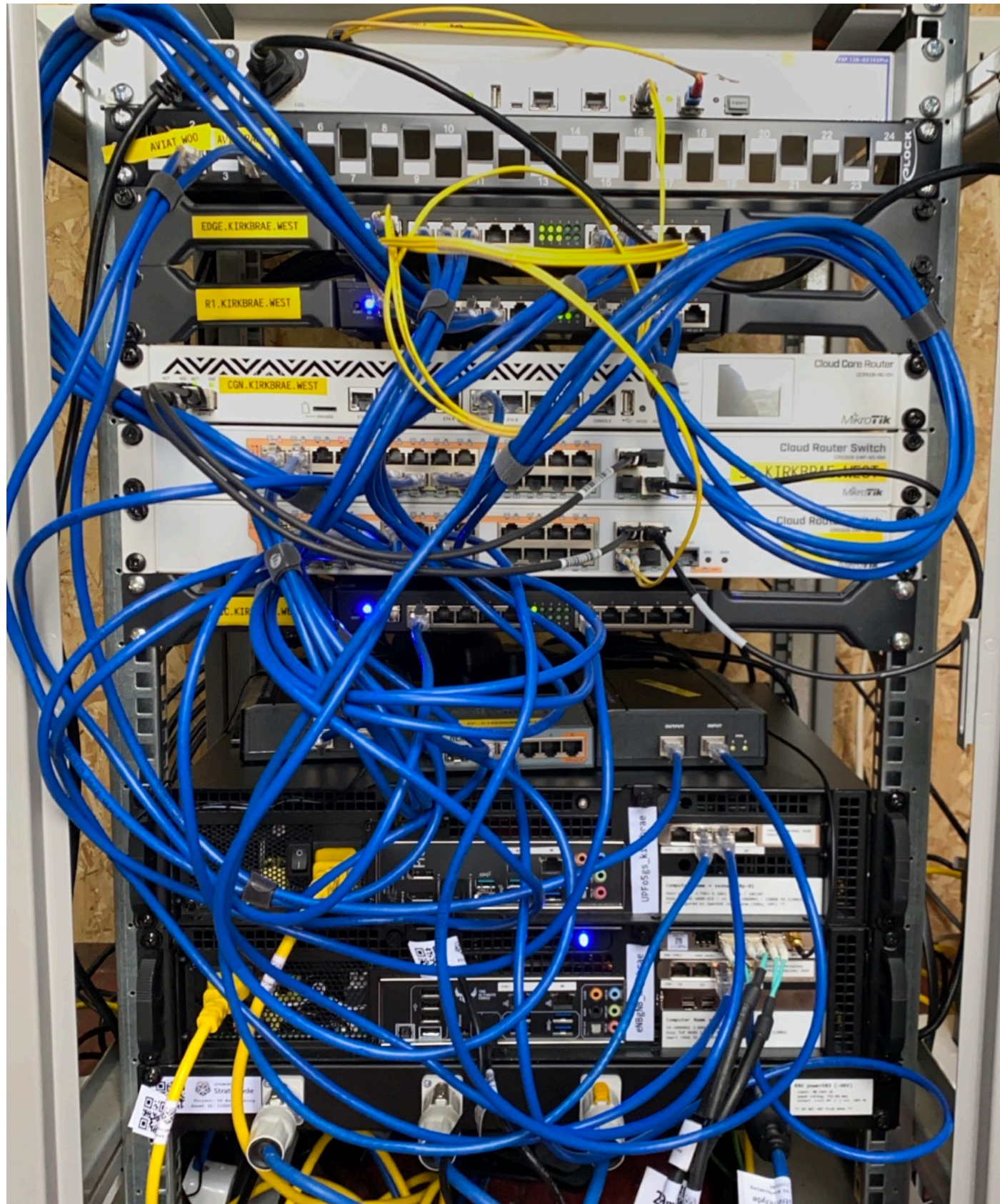


# Grab the Gear v2



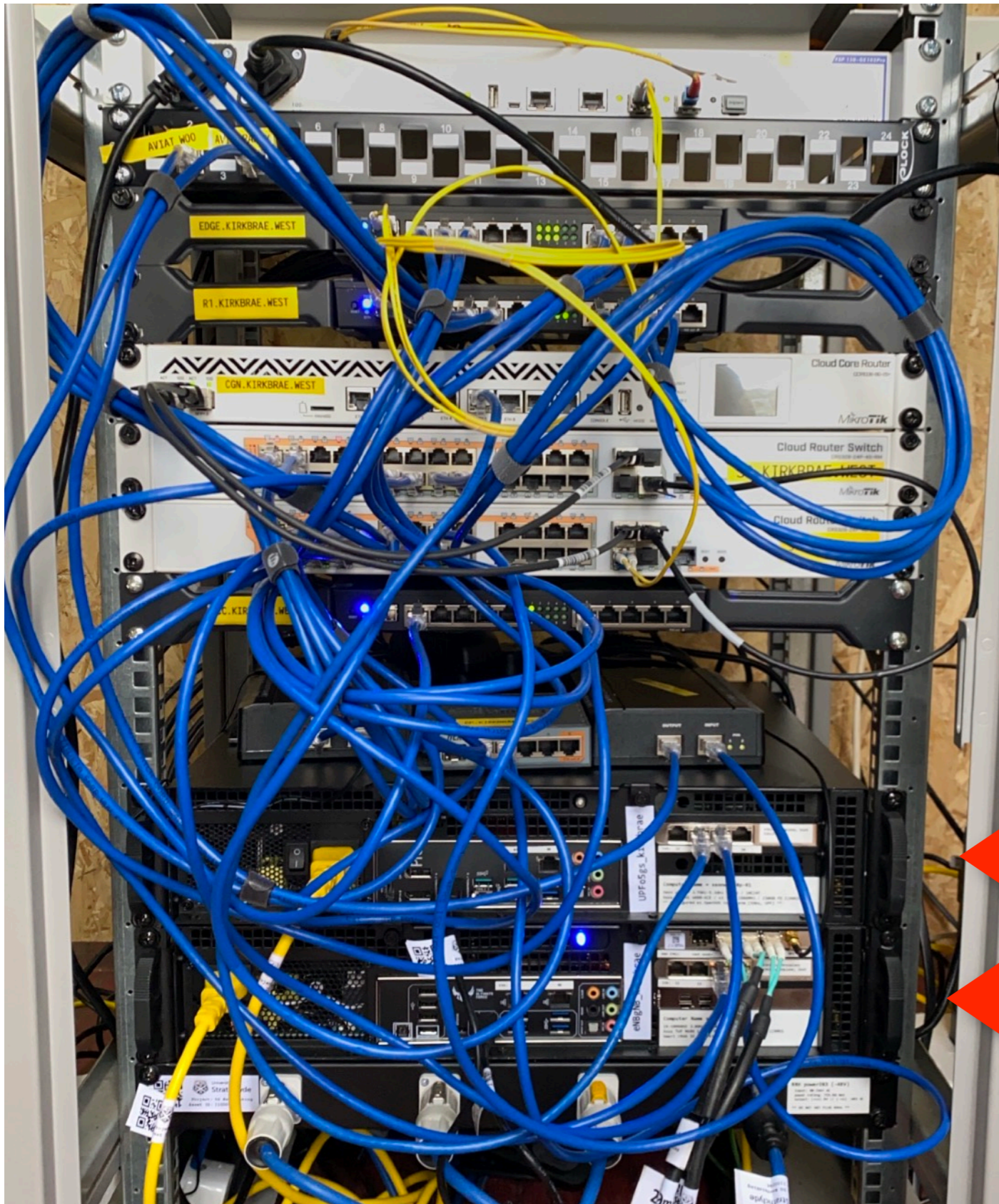
# Connect the Network





# The Most Complicated POP Site

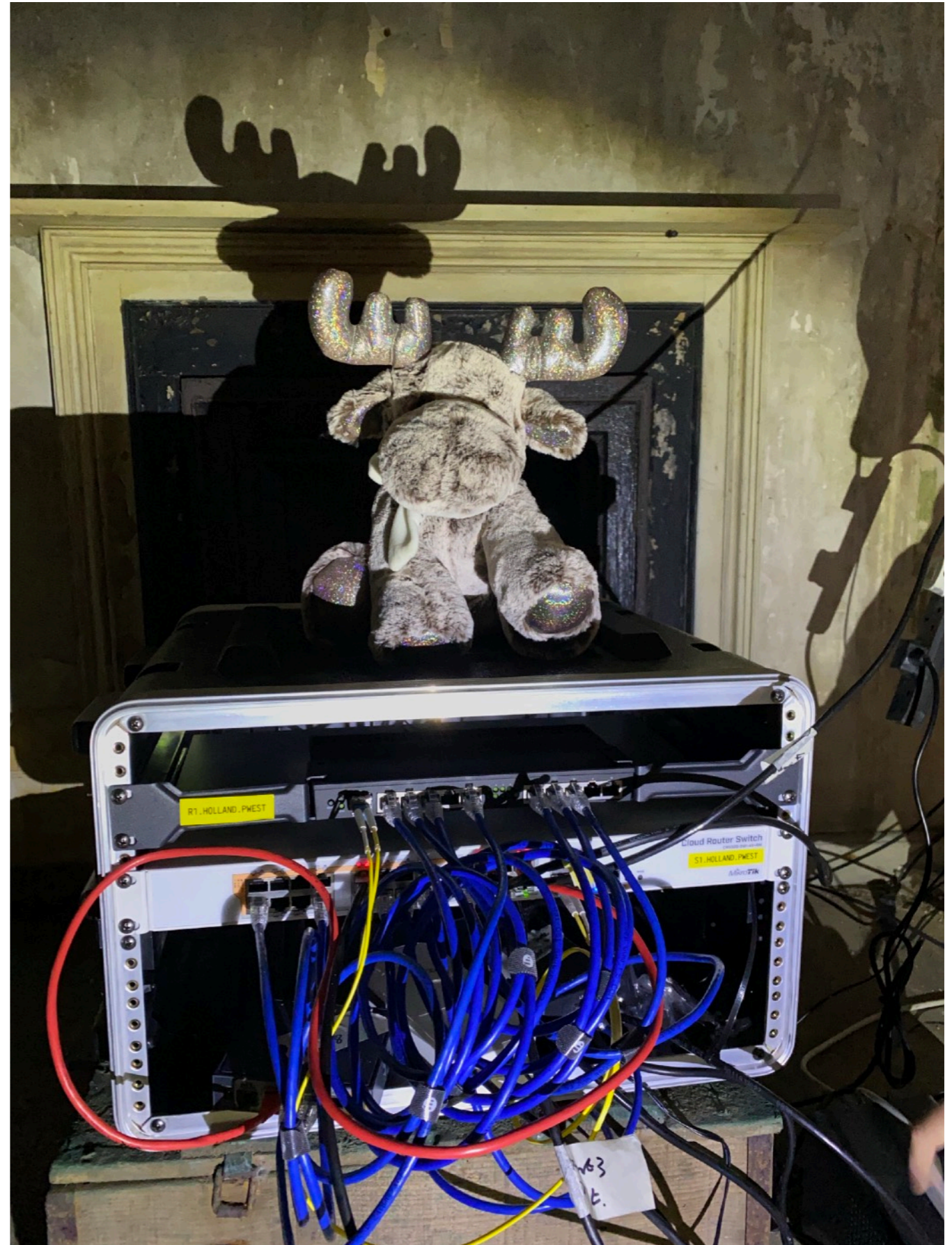
# The Most Complicated POP Site



**5G-User-Plane (UPF)**

**5G-RAN Node (eNB/gNB)**

# Flightcase



# Hoist the Radios!





# Aviat Point-to-Point 11GHz



# Connect the CPRIs



# Make 5G



# Make 5G

**Achievement  
Unlocked:  
DCMS Report  
Moose!**



# Make 5G

- ❌ Apple won't let SIMs connect to non-encrypted networks
- ❌ Non-commercial, testbed, no ciphers, no iPhones/iPads
- ❌ iPhone has a Lightning-to-Ethernet adaptor connected to CPE



# Make 5G

- ❌ Apple won't let SIMs connect to networks
- ❌ Ethernet adapter connected to CPE

**Mobility was not required for FWA use-case**



# Leave Site with Big Smile



# 5G FWA: WORTHWHILE?



# Evolution of the G's

- ✘ 2G: able to make phone-calls
- ✘ 3G: mobile access to Internet
- ✘ 4G: mobile video streaming
- ✘ 5G: "Internet of Things"

— Prof. Andy Sutton, BT EE / University of Salford

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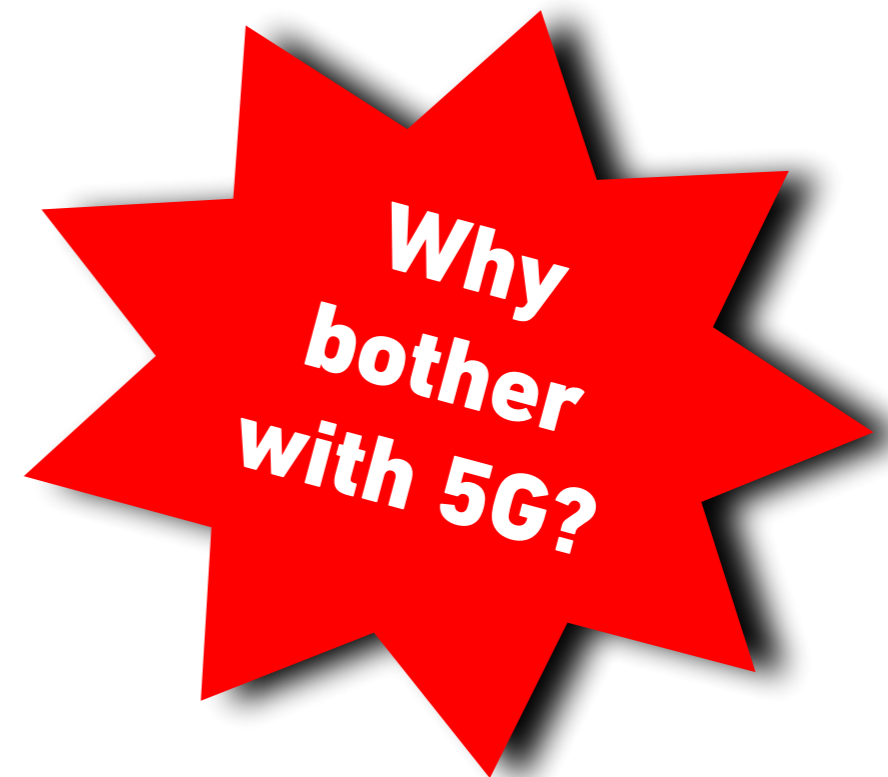
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# Costs of 5G

- ✘ Core (either hosted or self-operated)
- ✘ Increased capex of radios (SDR + BBU)
- ✘ Increased opex of radios (high CPU usage for SDR)
- ✘ Increased cost of CPE compared to 5GHz FWA
- ✘ Spectrum licenses
- ✘ Big Paperwork (GSMA, national regulators, etc)

# Benefits of 5G

- ✘ Mobility (only partially realised in this project)
- ✘ Neutral hosting (revenue share, maybe spectrum)
- ✘ Supports massive number of devices
  - ✘ "Build it and they will come"
- ✘ Fewer vendor interop issues than with 5GHz FWA products...? (e.g. Cambium vs Ubiquiti vs others)
  - ✘ But what channels do your UE devices support?
- ✘ Hype-cycle funding opportunities (until 6G is cool)

# Future of this Project

- ✘ Was initially funded for 6 months, end of March 2022
- ✘ CloudNet continuing to operate, seeking longer-term funding for this 5G trial
- ✘ When you bring  $>1$  Mbit/sec Internet to an area for the first time, users don't immediately have "average utilisation" (no streaming subscriptions)
- ✘ Might transition to "traditional" FWA with 5GHz or light-licensed spectrum instead
- ✘ ...but there are MNOs in discussions, so there is hope!

# The Team



# LET'S DISCUSS 5G LAST MILE

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