Beyond the City

5G UK RuralFirst

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Presentation Overview

- **5G RuralFirst Partners**
- **5G RuralFirst Use Cases Overview**
  - Orkney Islands, Somerset & Shropshire
- **Infrastructure**
  - 1Gbps Dedicated Fibre & Digital Power
- **Shropshire Test Bed**
  - UAV Precision Agriculture
- **Somerset Test Bed**
  - Connected Cows Use Case
- **Self Contained 5G Network**

- **Paraguay IoT Demonstration Farm**
- **Closing Remarks**

Partners

CISCO

University of Strathclyde Engineering

afimilk
Vital know-how in every drop

AGRIEPICENTRE
Engineering • Precision • Innovation

BBC

BROADWAYPARTNERS

BT

CENSIS

CloudNet
IT-Solutions Ltd

DATAVITA
Where your data comes to life

Harper Adams University

HERIOT WATT UNIVERSITY

hyperceptions

Kingshay

5G RuralFirst Story

Identify new market, technology, and applications opportunities

Create rural test-beds and trials for 5G mobile connectivity

Co-innovation project
- Cisco, University of Strathclyde, UK Government
- Partner consortium

5G RuralFirst Sites

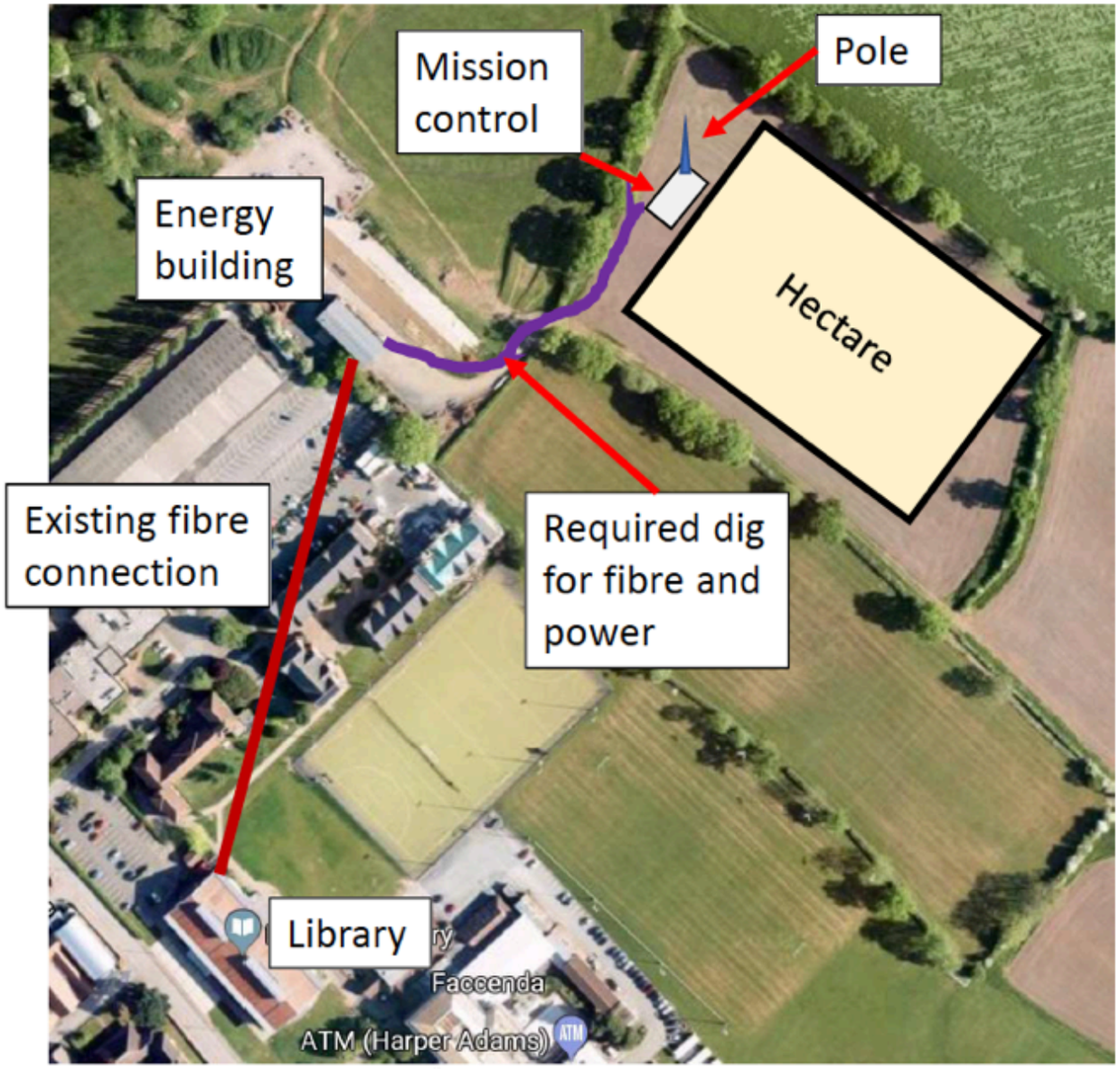
Wind Farm Sensors
Community EMBB
Salmon Farms
Legionella Sensors
FWA - Homes
- Transport Terminals
- Healthcare
Low Cost RAN
5G Shore to Ship
Connected Buses
AR Tourism App
Li-Fi Backhaul

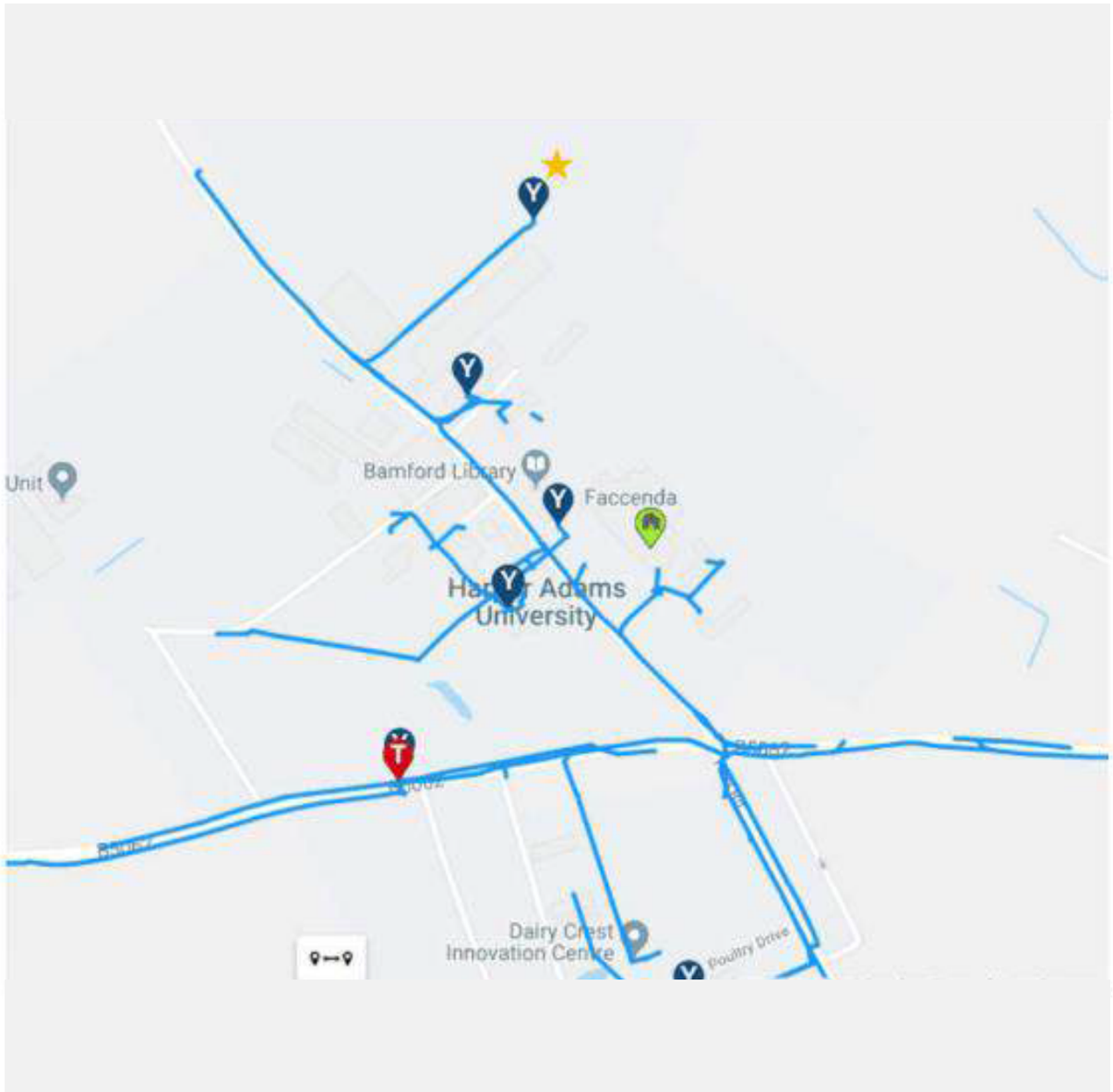
Data Vita DC

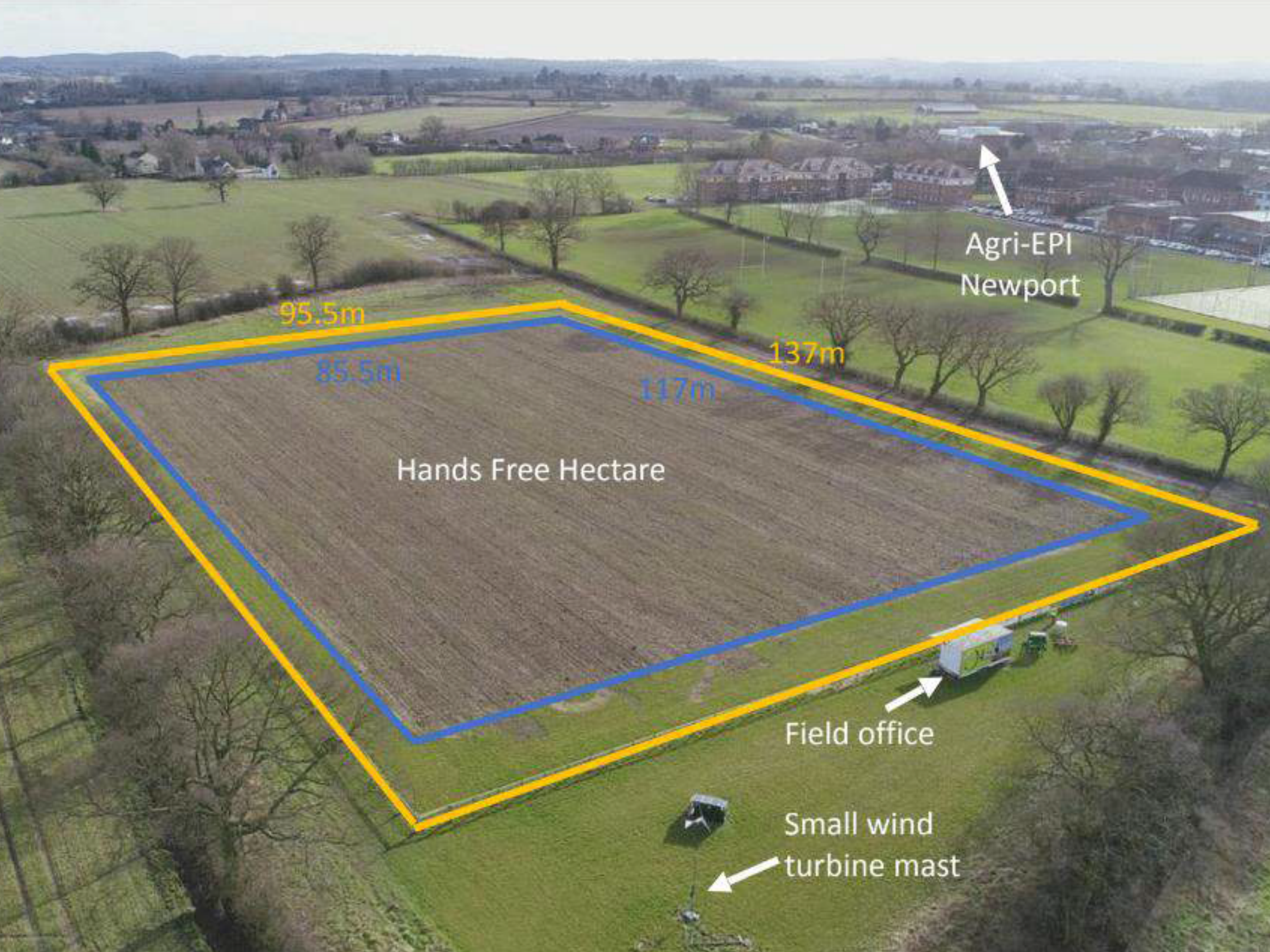
Autonomous Drones
Soil Analysis

Connected Cows
AR Vet

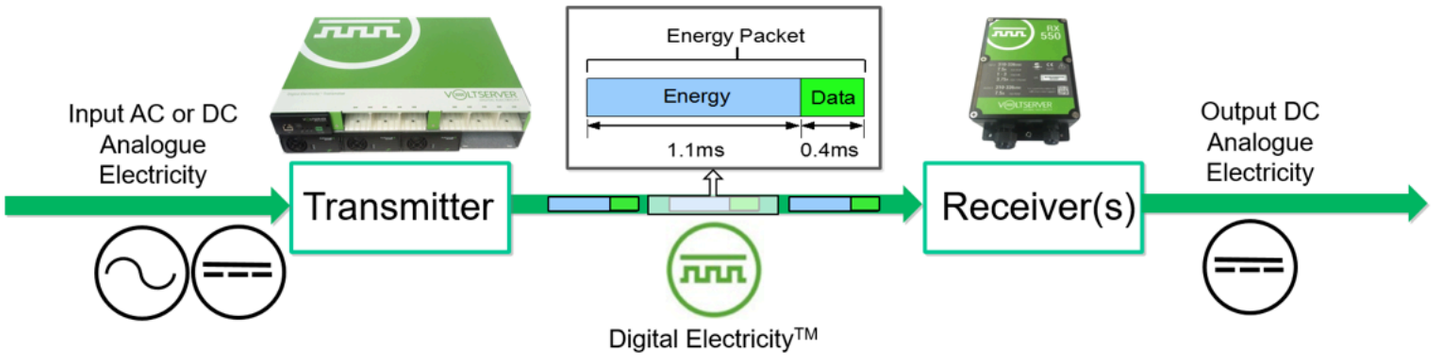
Shropshire - Infrastructure






Agri-EPI
Newport
95.5m
85.5ml
137m
117m
Hands Free Hectare
Field office
Small wind
turbine mast


HandsFree
Hectare



VoltServer Digital Electricity:

- Safe power distribution
- Standard communication cablling
- Packet Energy Transfer (PET).

Up to 2 km
>96% efficiency

VOLTSERVER
DIGITAL ELECTRICITY™

Not secure | 192.168.1.106

VOLTSERVER DIGITAL ELECTRICITY™ — Local Management Console

Status | Settings | About

Device name: **VS-2198**

Last screen refresh: **28/11/2018, 13:35:39**

System Status

TX CARD SUMMARY	1 2 3		
OUTPUT	68 W	VOLTAGE CURRENT	340 V 0.2 A
MGT TEMP	29 °C	BACKPLANE	20 °C
MGT STATUS	OK	POWER MODULES	OK

Hardware Info

CHASSIS ID	1200000368	
MGT SERIAL NO.	4200100051	
MGT MAC	00:80:A3:B9:BF:0F	
MGT VERSION	FW HW GATEWAY	1.3.2 2.0.0 1.1.0

Transmitter Cards

SLOT	STATUS MODE	POWER	VOLTAGE CURRENT	TEMP	SERIAL NO.	VERSION	ACTIONS
1	OK Source Enabled	0 W	336 V 0.0 A	29 °C	3200001766	FW 2.2.0 HW 2.0.0	OUTPUT OFF ON LIVE ID OFF ON
2	OK Source Enabled	34 W	337 V 0.1 A	31 °C	3200001776	FW 2.2.0 HW 2.0.0	OUTPUT OFF ON LIVE ID OFF ON
3	OK Source Enabled	34 W	336 V 0.1 A	29 °C	3200001777	FW 2.2.0 HW 2.0.0	OUTPUT OFF ON LIVE ID OFF ON

Power Modules

SERIAL NO.	STATUS ALARMS	VOLTAGE CURRENT	TEMP
163071009682AC	Normal	234 VIN 337 VOUT 0.0 A	28 °C
163071009651AC	Normal	229 VIN 338 VOUT 0.3 A	28 °C

VoltServer Inc. - Digital Electricity

HandsFree
Hectare

Drone operation in progress
This area is completely
off limits

If access is required contact
07854651907 Jonathan Gill

COSTA

YOUR LIFE

700 MHz and 3.5 GHZ radios

UAV Precision Agriculture

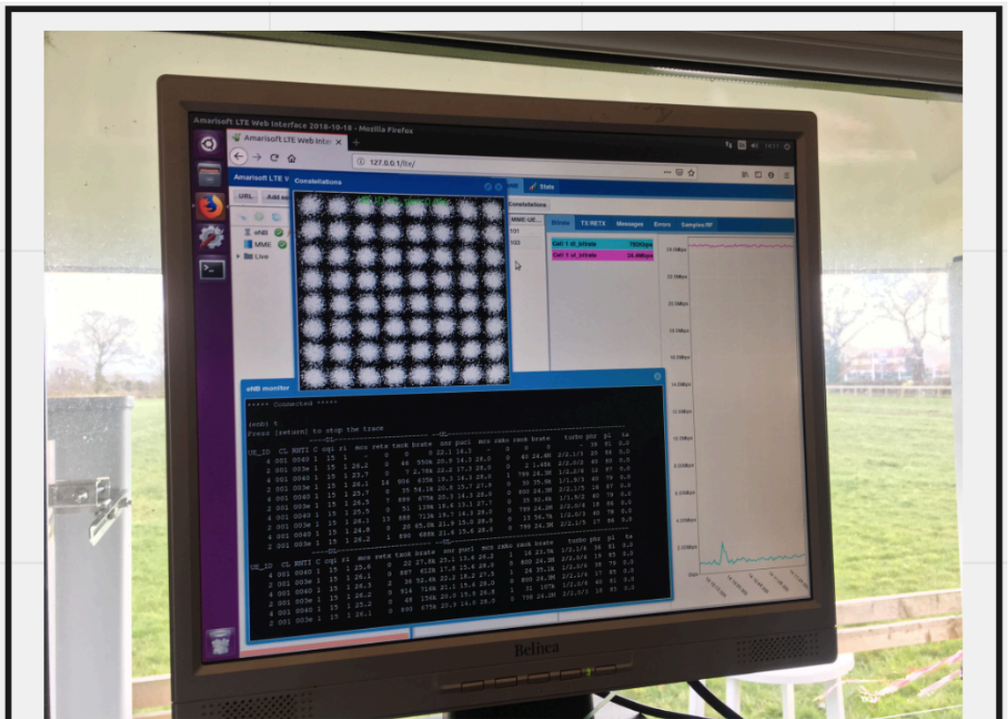
1 - Drone integrated with modem

2 - UE configured to Band 42 (700MHz)

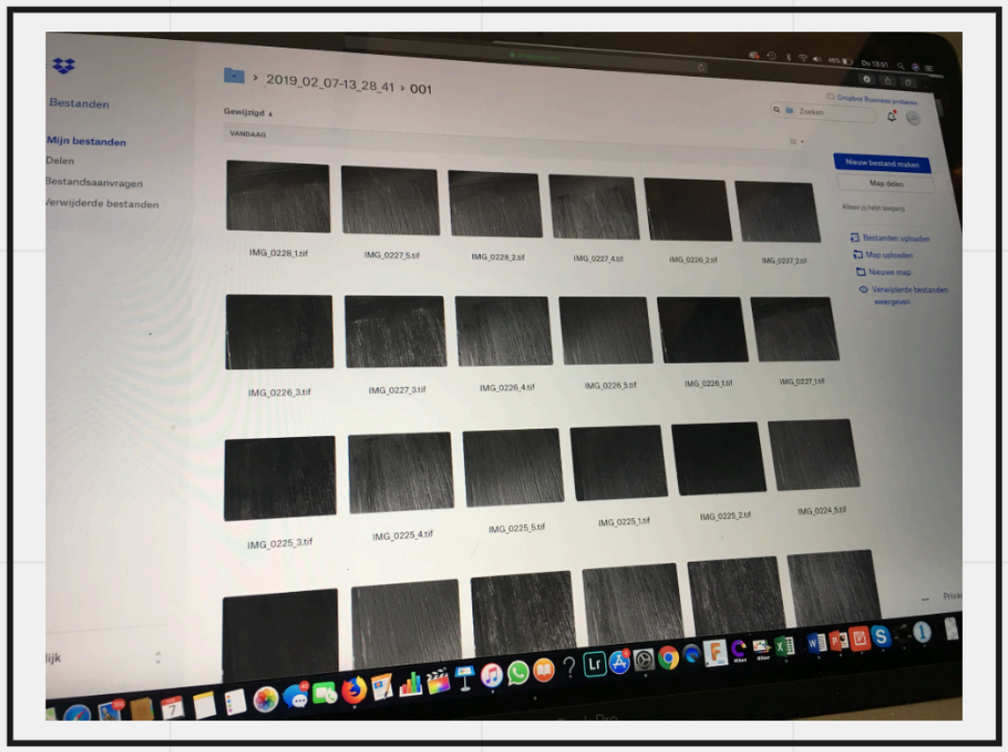
3 - Precision Flight outlines flight

4 - Drone flies autonomously across the field

5 - Network monitored while drone offloads images



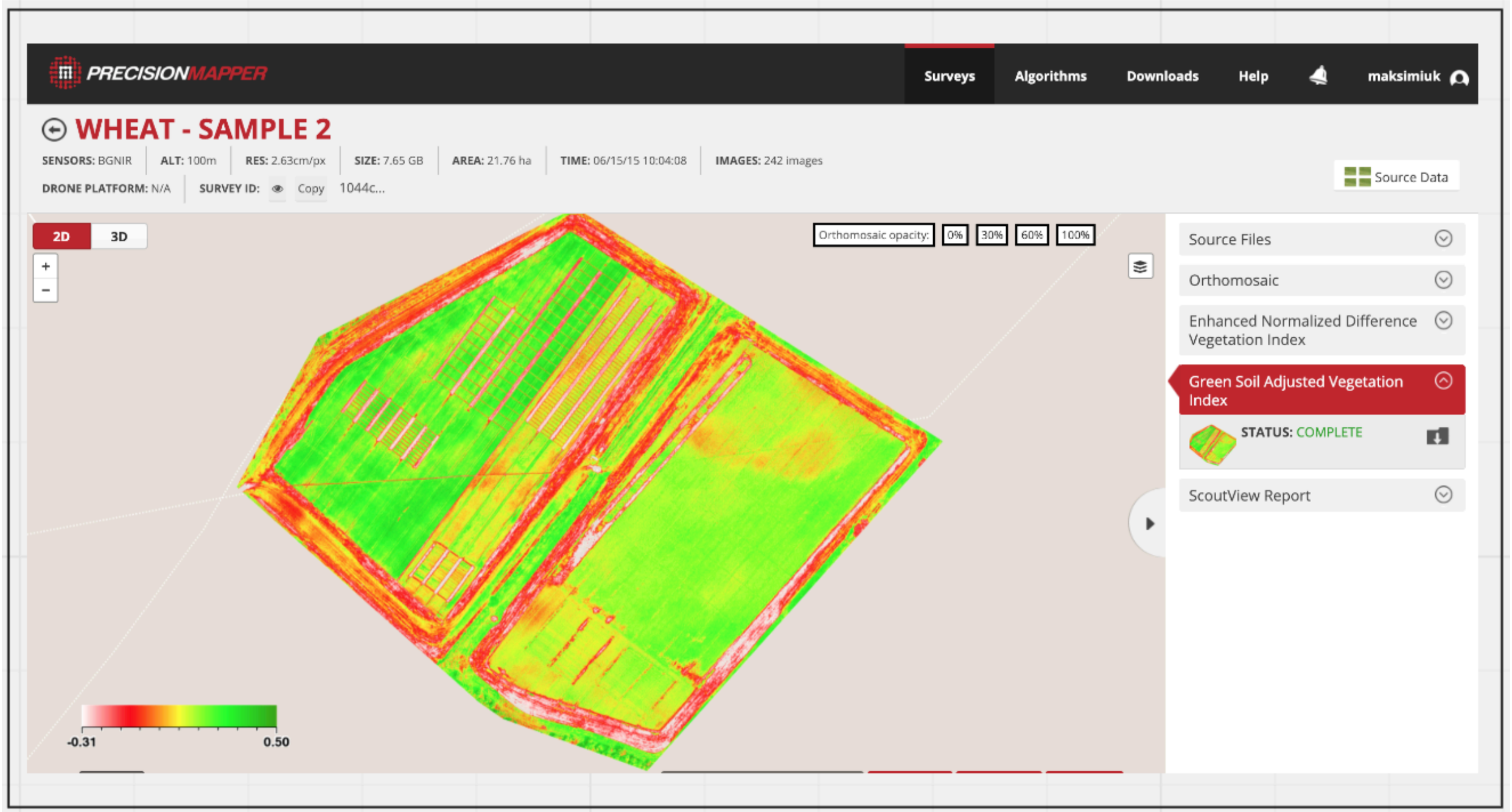
7 - Images offloaded to Dropbox in real-time



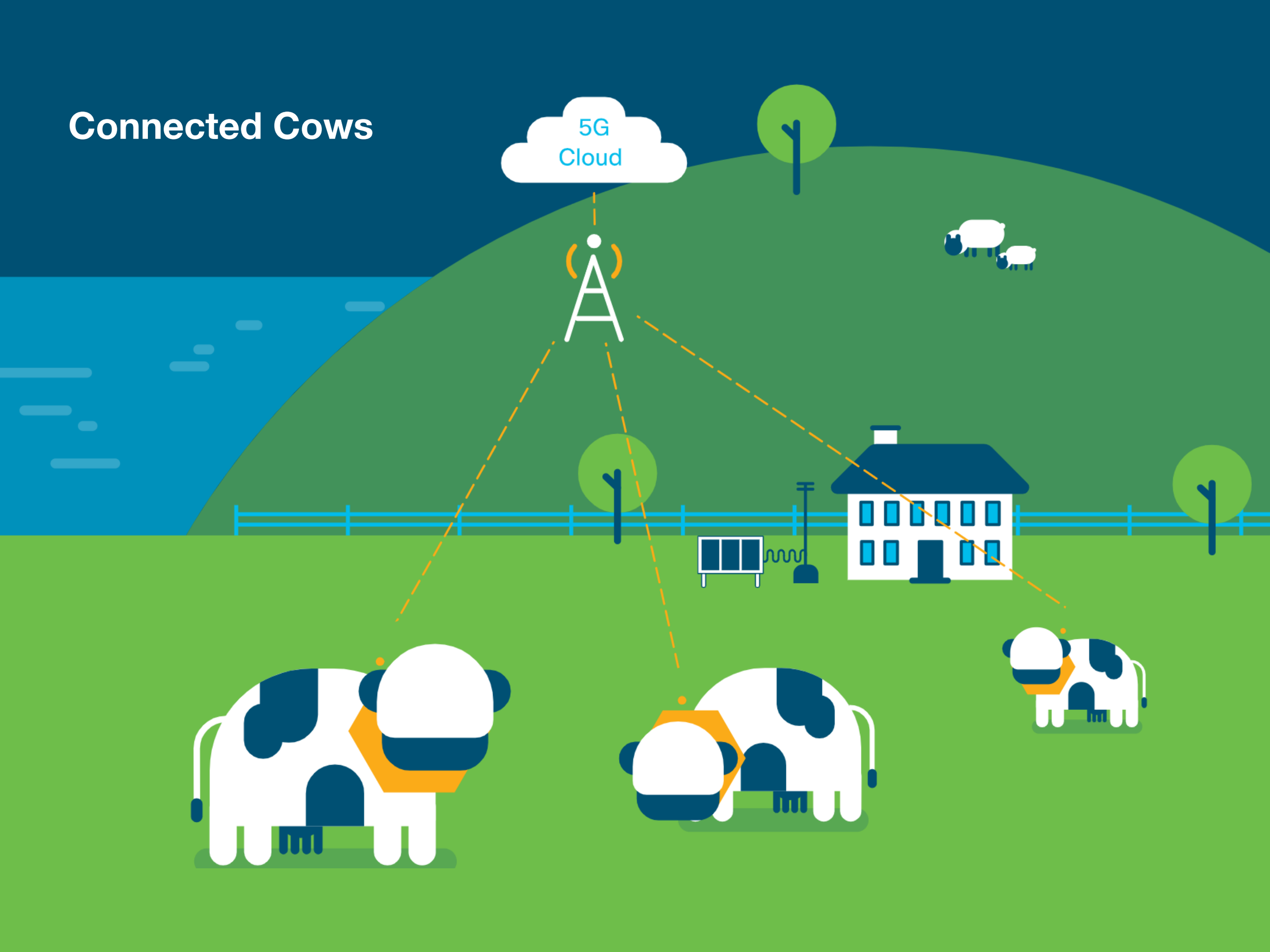
8 - Dropbox automatically sends raw images to platform for stitching and algorithm processing

SURVEY	SENSOR	LOCATION	ALGORITHMS	DATE
 **Wheat - Sample 2** 242 images 7.65 GB	BGNIR	Leicestershire, United Kingdom		06 / 15 / 15 10: 04

9 - Farmer can analyse results in the field



Connected Cows




afimilk
SHR.116.530
3
6

Afimilk
mySilent Herdsman

MENU

Estrus Alerts | Health Alerts

Filters | All Cows

- 10 — 23 days ago - 19:20
- 27 — 23 days ago - 15:47
- 124 — 23 days ago - 10:13
- 14 — 23 days ago - 05:17
- 175 — 24 days ago - 18:11
- 341 — 23 days ago - 21:00
- 75 — 24 days ago - 22:00
- 34 — 24 days ago - 22:00
- 365 — 23 days ago - 10:00
- 359 — 25 days ago - 01:00
- 15
- 100

Online data synchronization 22 days ago

Collar data received 22 days ago

5 Estrus alerts	3 Health alerts
1 Eating alerts	1 Rumination alerts
1 Repeatedly cycling	1 Not cycling
4 PD check	10 Due on heat

Reports	5 January 2019
2 base stations on farm	25 cows on farm
No license installed	320 collars on farm
Logged in as demo@cisco.com	22 collars on cows

Afimilk
mySilent Herdsman

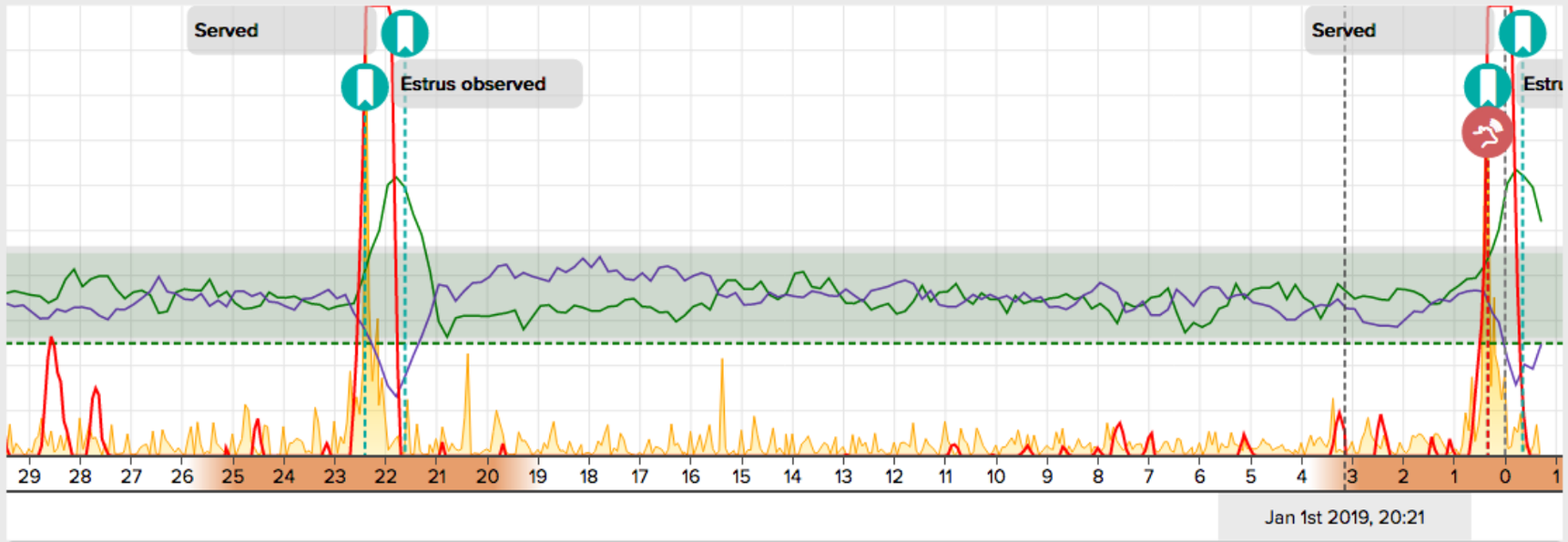
MENU

Estrus Alerts | Health Alerts

Filters | All Cows

- **10** — a day ago - 19:20
- **27** — a day ago - 15:47
- **124** — a day ago - 10:13
- **14** — a day ago - 05:17
- **175** — 2 days ago - 18:11

Cow ID: 27



Estrus detected
Yesterday at 15:47

Serve | Dismiss

History | Information

Event	Detail	Date	Days ago	
Served	aventador	05 Jan, 2019 - 08:12	Today	Edit
Estrus observed	Estrus detection	04 Jan, 2019 - 15:47	Yesterday	Edit
Served	beef	14 Dec, 2018 - 09:05	22 days ago	Edit
Estrus observed	Estrus detection	13 Dec, 2018 - 14:14	23 days ago	Edit

Why 5G?

- Afimilk cow collars use Zigbee connectivity
- Existing setup requires a local PC server to offload data
- The PC server installation requires an Afimilk expert technician to install and costs £5,000
- The collars need low latency (less than 35ms) to talk directly to the cloud and maintain 7 year battery life
- Test bed is trialling 700MHz frequency
- Achieving less than 35ms latency eliminates PC server from setup.
- This creates a “plug and play” solution and opens new markets through distribution (such as Service Providers)
- New business models can be explored (CapEx vs subscription based models)

Self Contained 5G Network

- Conventional mobile networks require backhaul to operate.
- Where this isn't an option, it is still possible to deploy a local network where everything is on-site (similar to “Private LTE”)
- Removing the dependency on backhaul means that a farm can be operational, even with low-capacity or poor-quality backhaul.
- Insights and key information can be transferred when backhaul is available, while still fully operational on a private "LAN".

Neutral Wireless

Paraguay

Showcase of the Agri-Tech Satellite Demonstration Farm

Department for International Trade

INNOVATION IS GREAT

BRITAIN & NORTHERN IRELAND

Prioritising Challenges

- In-calf rate (currently very low)
- Pregnancy losses between scanning and birth
- Long period to first pregnancy
- Finishing stock take 900 days to reach slaughter weight
- Calves lost at birth

- Nutrition
- Genetics

POC Design

Pen A

Regular Diet

Pen B

Maxammon Diet

Some Facts

	Current	Potential
Number of cows	14500	14500
Scanning percentage	**0.78**	**0.83**
Calf losses (scan to wean)	**0.12**	**0.1**
Replacements	**0.17**	**0.14**
Carcase value $/kg CWT	$3.10	$3.10
Cost $/kg CWT	$1.60	$1.60
Average Heifer CWT	190	210
Average Steer CWT	250	260
Death rate post wean pa	0.03	0.03
Days to finish	900	850

What Does it Mean Commercially?

	Current	Potential		
Percentage calves weaned	0.69	0.75		
Total income	$5,175,847	$6,372,141		
Total cost of production	$2,671,405	$3,288,847		
Gross Profit	**$2,504,442**	**$3,083,294**	**$578,852**	**0.23**
GP/cow	**$173**	**$213**		

Beef Monitors Installation

- Site prepared - ground flattened for cattle weighing crates.
- Trench excavated - water pipe extended
- Electronic readers configured and installed.
- Pen size reduced in pen A and B to fit 50 animals each.
- Safety fencing installed around beef monitors to prevent chewing of cabling.

Nearest source of power.

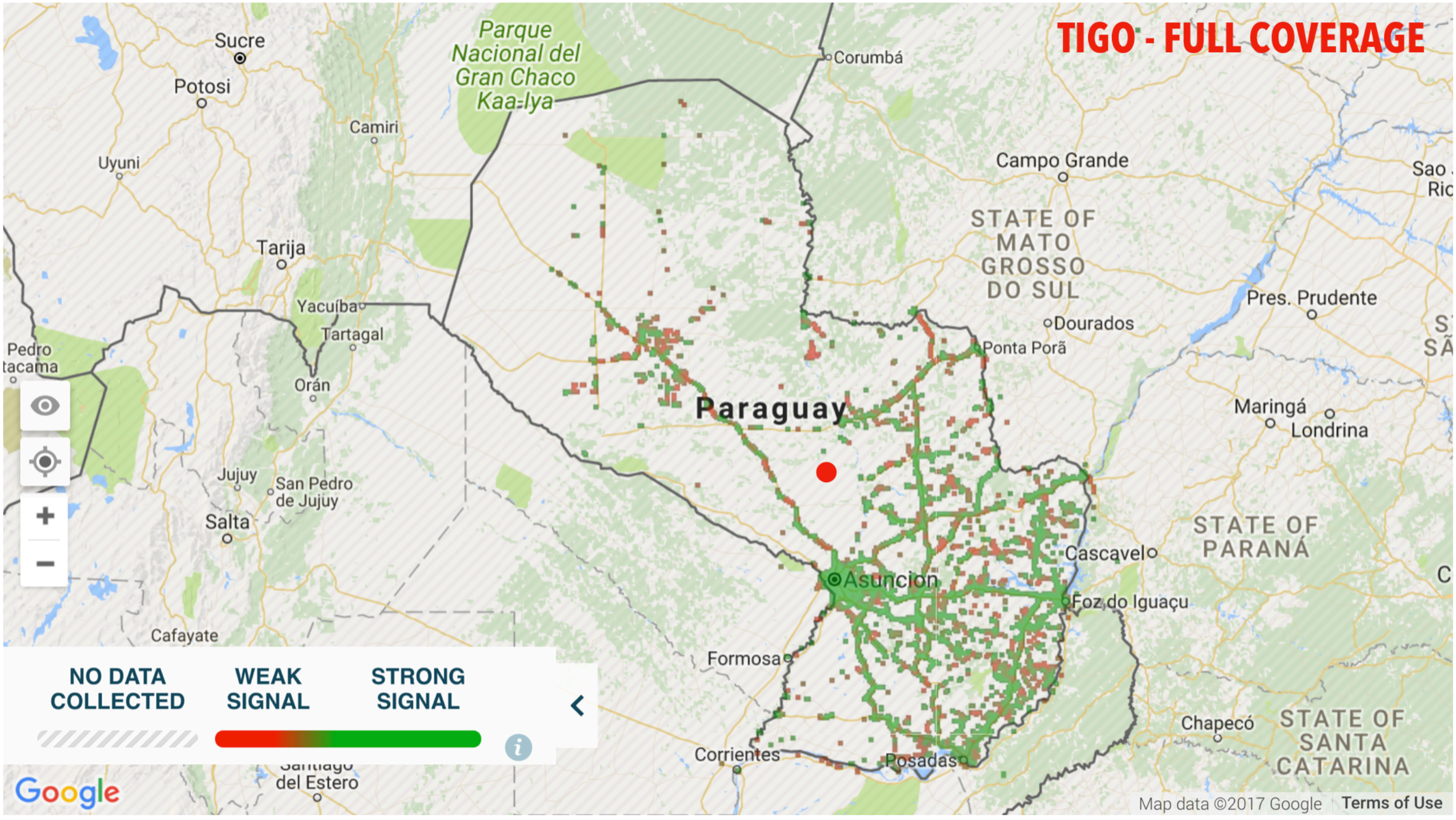
- 2x 75M Trenches dug between comms cabinet and pens for CAT5 and power cabling.

- 1x 35M Trench dug between comms cabinet and Iridium satellite dish.

POC Challenges

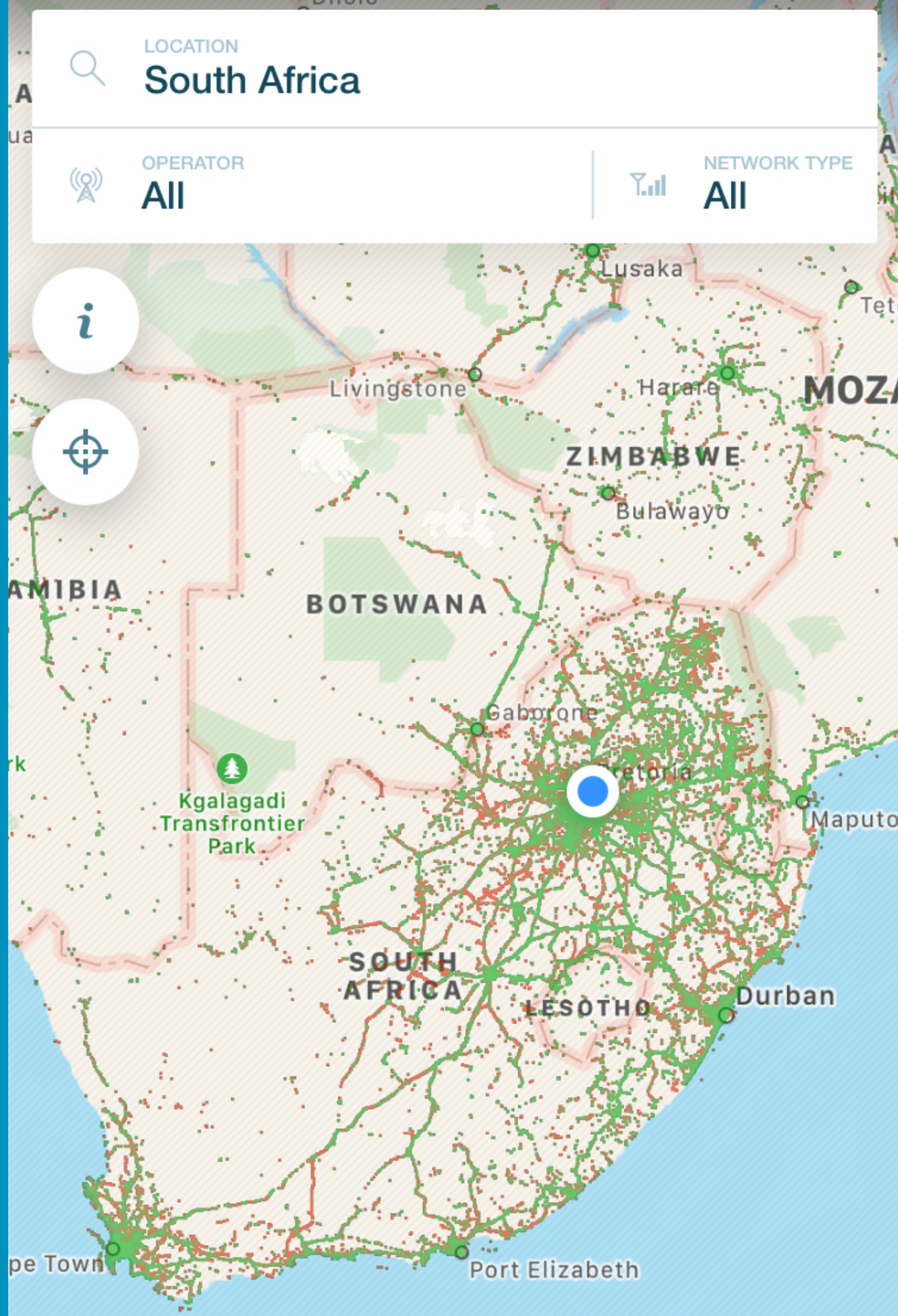
- Shipping over 2,000 kilograms of goods (beef monitors, feed, satellite equipment)
- Challenging customs clearance process in Asuncion
- Pilot site located 400 kilometers from Asuncion
- Lack of road infrastructure
- Lack of baseline connectivity (3G or 4G)
- Lack of reliable power (regular power cuts)
- No local qualified engineers able to work at height
- Lack of trenching equipment

Paraguay - 2G/3G/4G Coverage Map

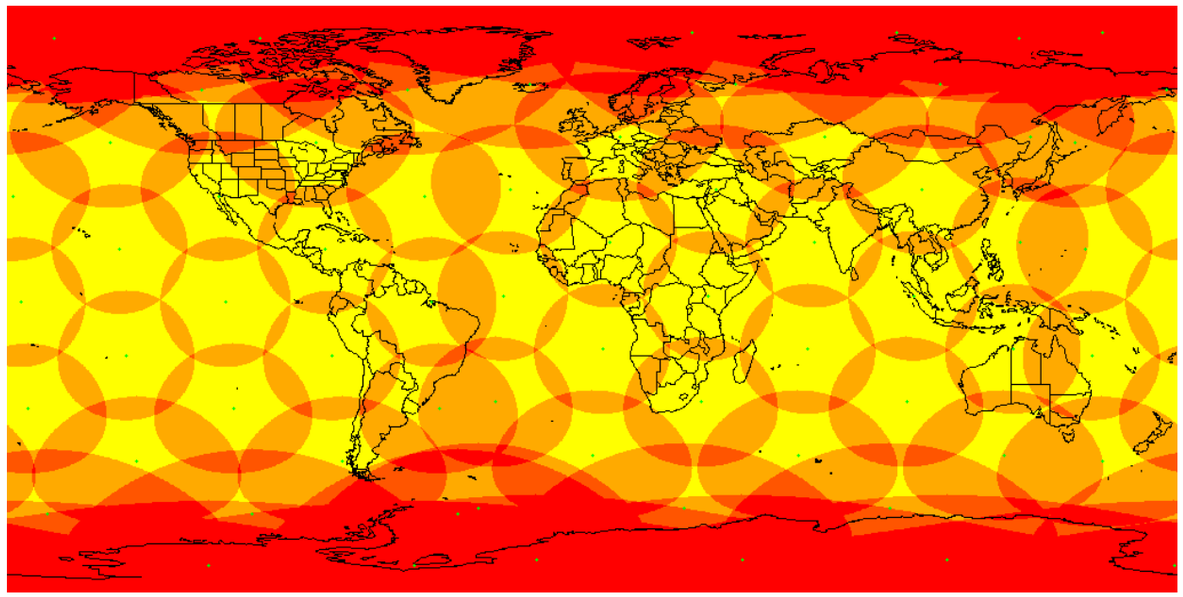


South Africa Coverage Map

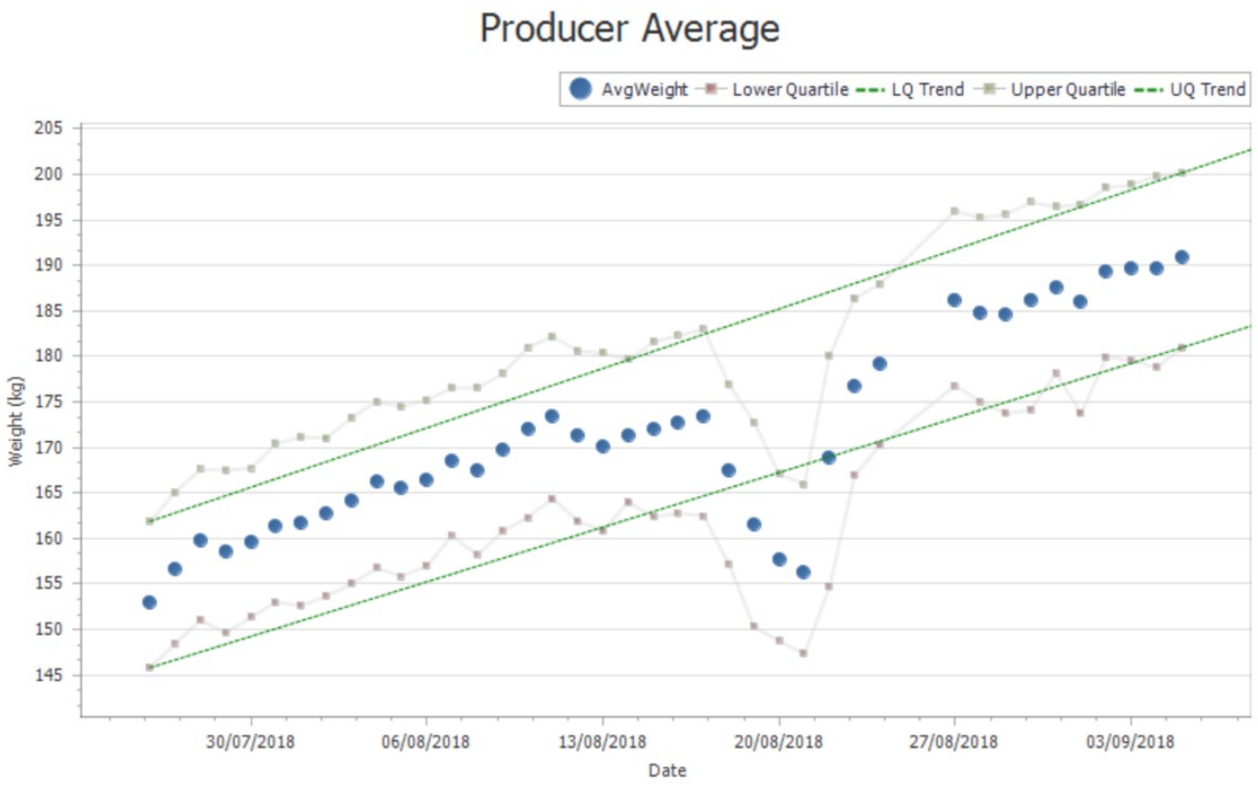
For comparison….



Iridium Land Pilot Satellite Installation



Results



Improved cattle weight readings from 3x a year to daily Average Weight Gains.

Closing Remarks

- Just because you can deploy a technology, it doesn’t mean you should.

- Always validate assumptions by running a cost benefit analysis.

- IoT deployments exist in an ecosystem. Avoid partners who are only interested in being a supplier. Successful deployments require close collaboration.

- Success breeds success. Maximise low hanging fruit and deliver the Minimum Viable Product (MVP) first.