AusNOG

New ways of deploying Disaster recovery networks

Simon Lardner – Head of Wireless

Format for the presentation….

- How disasters/incidents can impact communications
- Common solutions & their limitations
- RF propagation theory 101
- A home video
- Discussion around a (part) solution
- Questions

Typical disasters & impacts

- Disasters:
  - Fire & Floods
  - Cyclones
  - War / disturbances
- Results in:
  - Loss of life
  - Loss of infrastructure
  - Loss of transport – roads, bridges, etc
  - Terrestrial communications fail:
    - Transmission destroyed
    - Mains power loss
    - Towers & sites destroyed
    - Network load

The problem

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Typical issues with a disaster response…….

- Lots of challenges!
- Managing a triage response – who, what & how to prioritise ?
- Logistics – How, what & when ?
- Getting communications – both within disaster zone and to/from external world:
  - First responders
  - Local community

The Aim

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Fundamental challenges of traditional consumer networks in disaster recovery

- Deterministic traffic vs Non-Deterministic traffic
- Cost verses benefit
- Which then implies:

How to get ‘the network’ to where it’s required ?

- Given challenges of:
  - Loss of infrastructure
  - Limited logistics

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Typical communication responses – mobile networks

- Trailers with base station – 'Cell on Wheels' (COW)

Limitations:

- Difficult to rapidly deploy due to size/weight (logistics)
- Small coverage area (due to height of antenna)

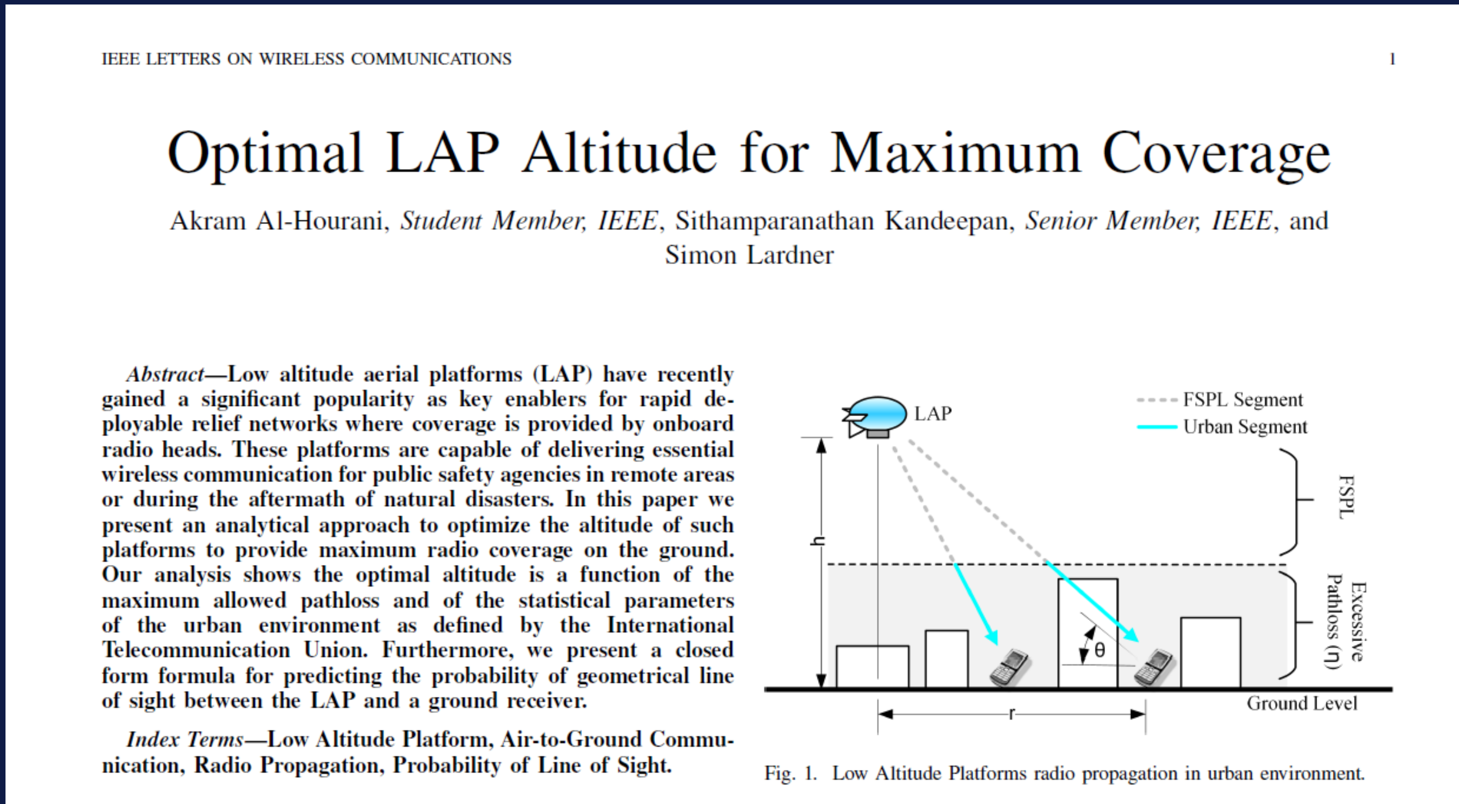
Crash course in the physics of wireless

- Radio waves (more or less) want to travel in straight lines
- Objects in the way of the radio waves stop them (to varying degree)

Crash course in the physics of wireless

- Radio waves (more or less) want to travel in straight lines
- Objects in the way of the radio waves stop them (to varying degree)
- Thus – the higher you have one of the parties the better

Source Research Paper



Optimal LAP Altitude for Maximum Coverage

Akram Al-Hourani, *Student Member, IEEE*, Sithamparanathan Kandeepan, *Senior Member, IEEE*, and Simon Lardner

***Abstract*—Low altitude aerial platforms (LAP) have recently gained a significant popularity as key enablers for rapid deployable relief networks where coverage is provided by onboard radio heads. These platforms are capable of delivering essential wireless communication for public safety agencies in remote areas or during the aftermath of natural disasters. In this paper we present an analytical approach to optimize the altitude of such platforms to provide maximum radio coverage on the ground. Our analysis shows the optimal altitude is a function of the maximum allowed pathloss and of the statistical parameters of the urban environment as defined by the International Telecommunication Union. Furthermore, we present a closed form formula for predicting the probability of geometrical line of sight between the LAP and a ground receiver.**

***Index Terms*—Low Altitude Platform, Air-to-Ground Communication, Radio Propagation, Probability of Line of Sight.**

Fig. 1. Low Altitude Platforms radio propagation in urban environment.

- Published in 2014
- Cited 2694 times

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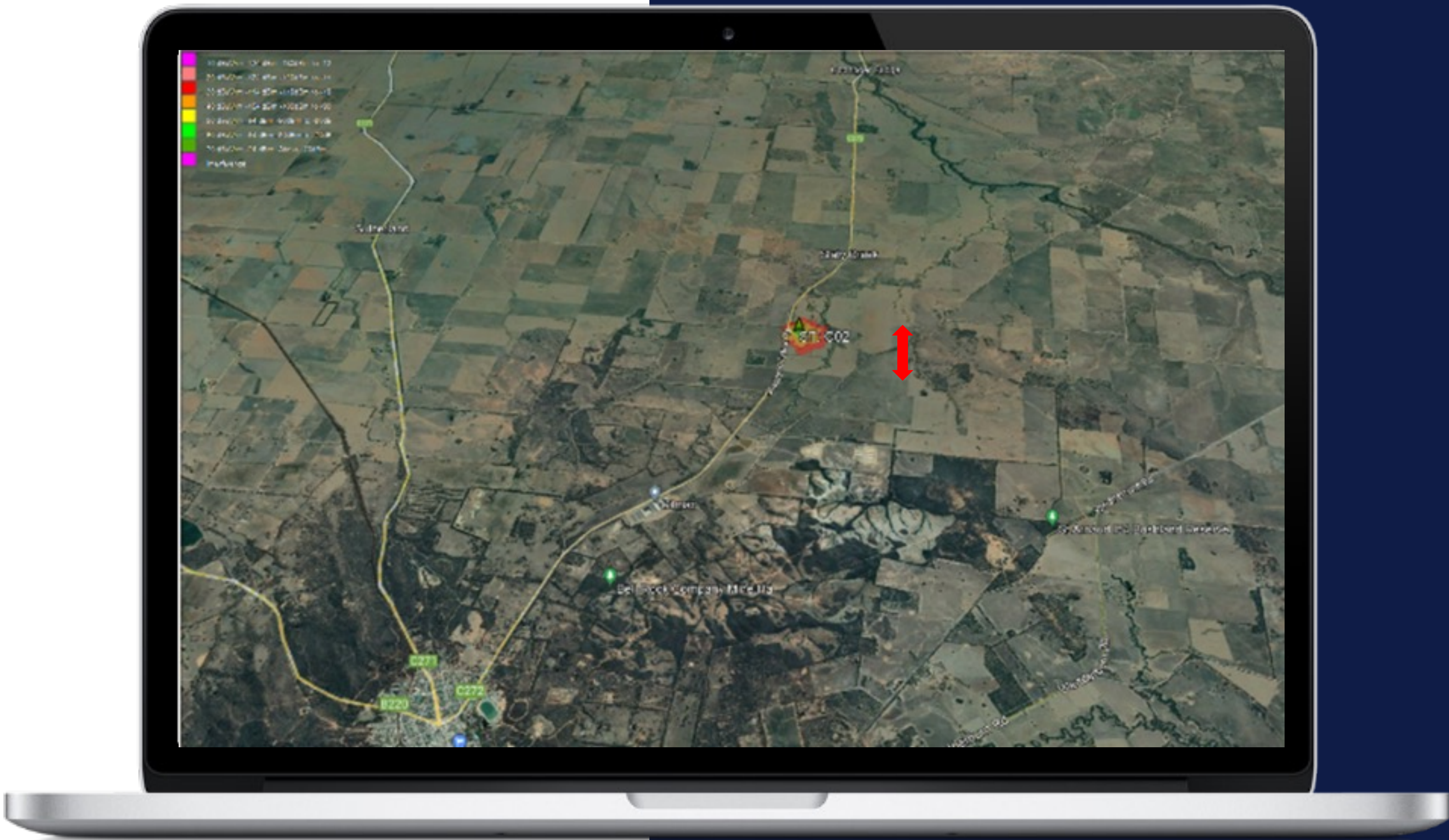
Real example – Drone eNodeB



Antenna height – 5m

- 5w 2T2R eNodeB, 2100 MHz
- Victorian undulating farmland
- **Coverage width ≈500m**

Real example – Drone eNodeB

Antenna height – 20m

- 5w 2T2R eNodeB, 2100 MHz
- Victorian undulating farmland
- **Coverage width 4km**

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Real example – Drone eNodeB

Antenna height – 100m

- 5w 2T2R eNodeB, , 2100 MHz
- Victorian undulating farmland
- **Coverage width ≈8km**

Desired ‘Rapid Deployment’ characteristics

- Lightweight – ‘hand carried’ in light vehicle/plane
- Quick to deploy (a few hours) after an incident
- Integrates if required with traditional mobile networks
- Maximises coverage area – high antenna ≈ 100m
- Brings own power & backhaul


Rapid Deployment Drone Solution

Video – some explanation

- Very much a 3 min ‘home video’
- Was literally shot in my family ‘back yard’
- Was our first trial of the solution (2 years ago)
- The Company “Challenge Networks” is now part of Vocus
- Working with Melbourne Drone manufacturer XM2
- We were trying to impress Starlink

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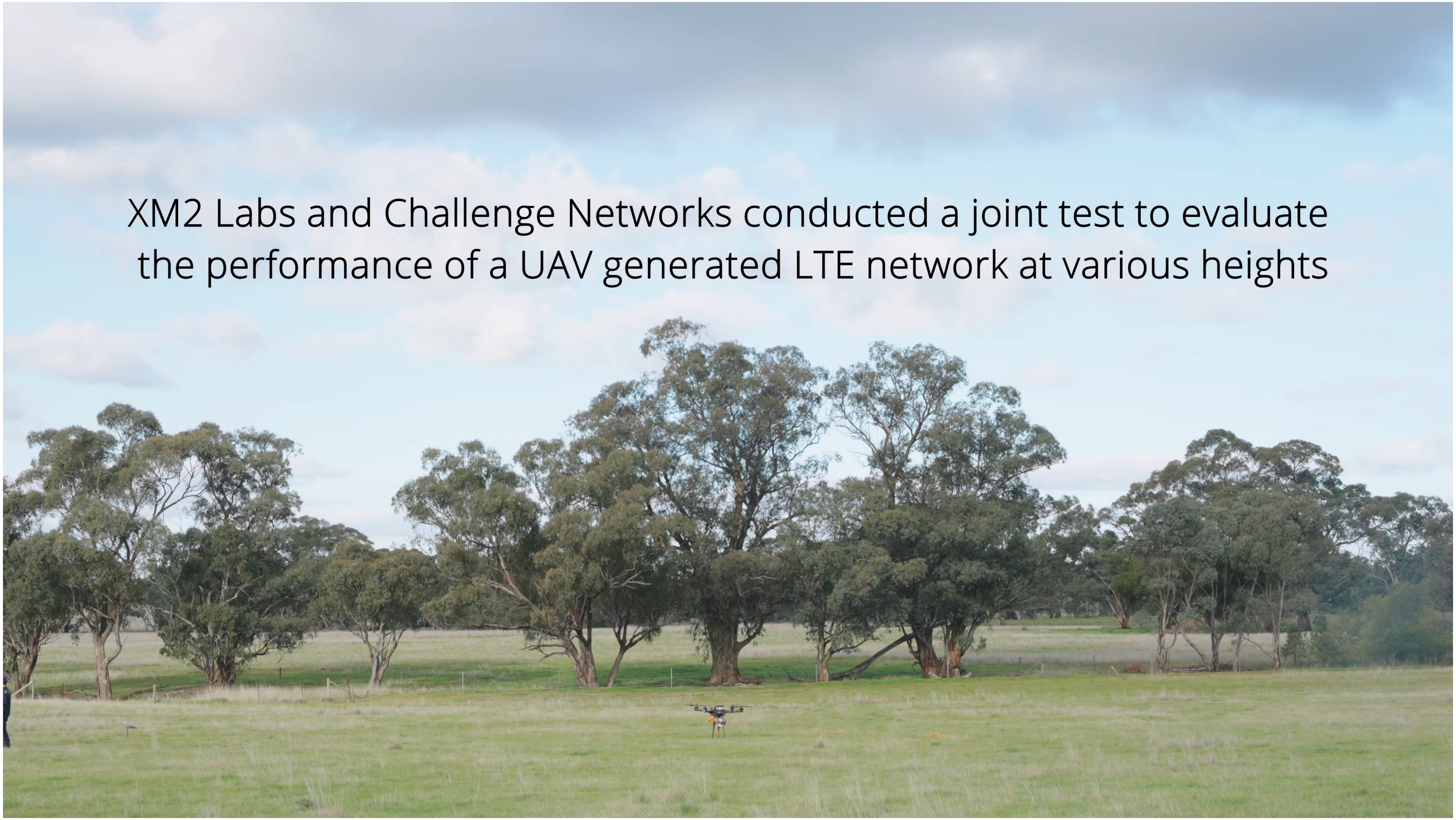
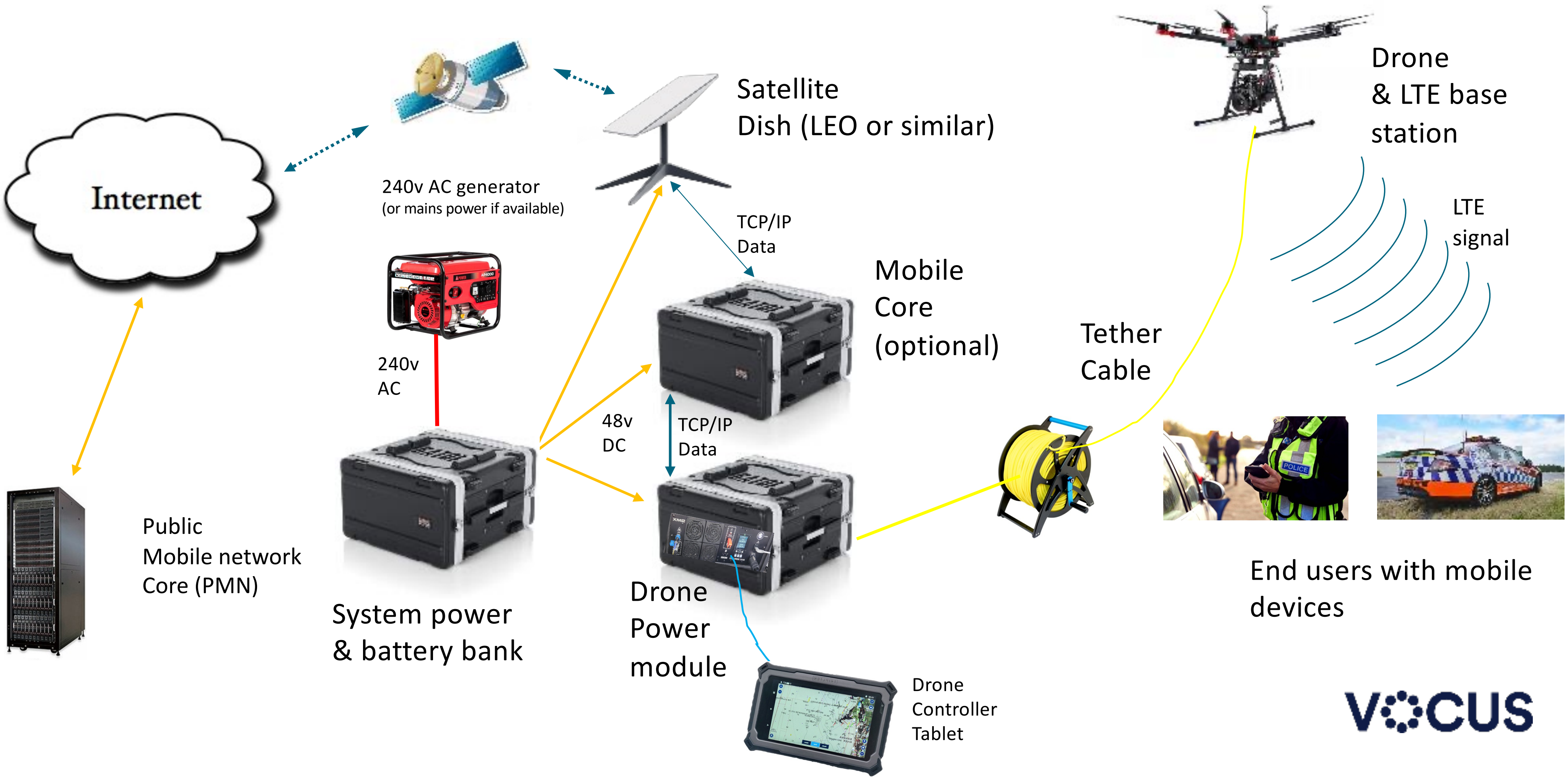

XM2 Labs and Challenge Networks conducted a joint test to evaluate the performance of a UAV generated LTE network at various heights

Drone, power, core, backhaul & Public networks (PMN)



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Final solution

Drone

Drone – packed up

Starlink Case

Drone Power Module

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So what is the innovation ?
Bringing together several components…

- High payload capacity drones -> Lift more than ever before ≈15 kg
- Light weight power converters -> enables tethered drones & payload ≈ 4kva
- Lighter mobile base stations -> enables drones to lift them
- Small & cost-effective mobile networks -> enables 'in a box' deployment
- Rapid deployment / high bandwidth backhaul (LEO) -> instant backhaul
- Results in:
  - Small/light -> Carried on plane / light vehicle (4-5 x 20kg boxes)
  - Antenna height (≈100m) -> Larger coverage (8-50km)
- Finally:
  - Better communications in difficult environments

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Limitations of solution (nothing is perfect!)

- Not for long term deployment (timeframe is days not weeks)
- Limited by weather conditions (especially high wind)
- Availability of spectrum that is dynamically usable

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The future & parting words

- Will be part of a portfolio of solution(s) for telecommunications DR response

- Only salespeople have the ‘perfect solution’ – the rest of the world relies on physics and economics.

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Thanks & Questions?

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