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Private Network Opportunities in Australia

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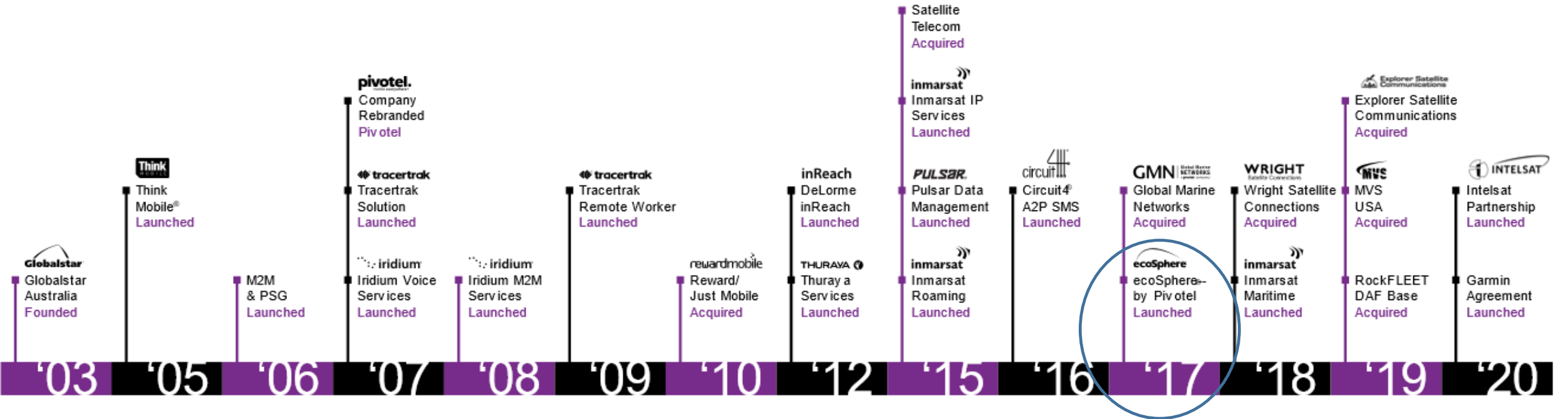
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Pivotal Mobile Pty Limited

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Company History



Pivotel's Australian Network



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Pivotel Office Locations

- Head office in Queensland
- 60+ Queensland based staff
- 130+ staff and 13 offices across Australia, New Zealand, America and Indonesia



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Pivotal Infrastructure

Pivotal's satellite gateway site at Dubbo, NSW hosts a number of satellite network gateways and associated services for a number of partners.



Pivotel Services

- Terrestrial MVNO (Think Mobile, Reward)
- Satellite Services (Irdium, Thuraya, Inmarsat, Intelsat, OneWeb, O3B, Starlink)
- ecoSphere network (terrestrial)
 - LTE/5G
 - IoT
 - FWA
 - Solar autonomy for rural/remote use cases
 - Backhaul
- Applications
 - Tracertrack: a powerful exception management system for worker safety, personnel and asset tracking, and fixed asset management

The Communications Challenge

67% OF AUSTRALIA'S LAND MASS DOES NOT HAVE MOBILE PHONE COVERAGE

- Only 33% of Australia has cellular coverage
- This leaves 5.23 million km² unconnected
- Emergency situations can also see mobile infrastructure disabled due to network congestion or physical damage



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Private Network Opportunities in Australia

- Pivotal forecasts rapid proliferation of private networks in the following main sectors:
 - Fixed Wireless Services to rural and remote communities (eMBB)
 - Mining
 - Agriculture
 - Oil & Gas
 - Automation
 - Transport
 - Public Safety
 - Smart City
 - Aviation
 - Maritime
 - Defence
- Architecture of each private (or mixed public/private) network depends upon each use case:
 - On-premise Cloud
 - Far Edge Cloud
 - Metro Edge Cloud
 - Centralised Cloud
- Pivotal offers bespoke architecture taking into account: latency, reliability, security and capacity requirements; driven by customer application.
- Pivotal has already deployed Central, Far Edge and On-premise Clouds in Australia.



Spectrum Scene

Spectrum	Mode	Apparatus or Area Wide Licence (Enabler for Private Networks)
700 MHz	FDD	No
850 MHz	FDD	No
900 MHz	FDD	No
1800 MHz	FDD	Remote region only, max 10 MHz channel per operator
1900 MHz	TDD	Outside Metro, max 20 MHz channel per operator
2100 MHz	FDD	Outside Metro, 10 MHz channel per operator
2300 MHz	TDD	No
2600 MHz	FDD	No
3400 - 3475 MHz	TDD	Restricted power licenses would be allowed in main cities
3750-3800 MHz	TDD	Some regional areas
3800 - 3950 MHz	TDD	National Allocation
3400-3950 MHz	TDD	Remote Australia Only
mmWave 26/27 GHz	TDD	Regional/Remote Areas, where not fully allocated

Pending release.

Pivotel Deployed Use Cases

- **Far Edge cloud enabled LTE** networks in Australian Green (Wheat) Belt regions
 - Wickepin, Western Australia
 - Mount Barker, Western Australia
 - Main use case is FWA for farm homesteads and latency insensitive IoT.
 - 2.1 GHz FDD spectrum
- **On-Premise Edge enabled private LTE** network at a large Bauxite mine embedded in dense Jarrah forest
 - main use case is Fleet Management System (FMS) in conjunction with sensor data collection and analysis
 - to increase productivity, efficiency and safety.
 - 700 MHz FDD spectrum
- **Central Cloud enabled Air to Ground Base Stations (Trial Network)**
 - main use case is to provide connectivity to Aviation layer (emergency helicopters for fire fighting and ambulance, streaming data for passengers in commercial aircrafts)
 - Band65 (2.17 GHz FDD Spectrum)

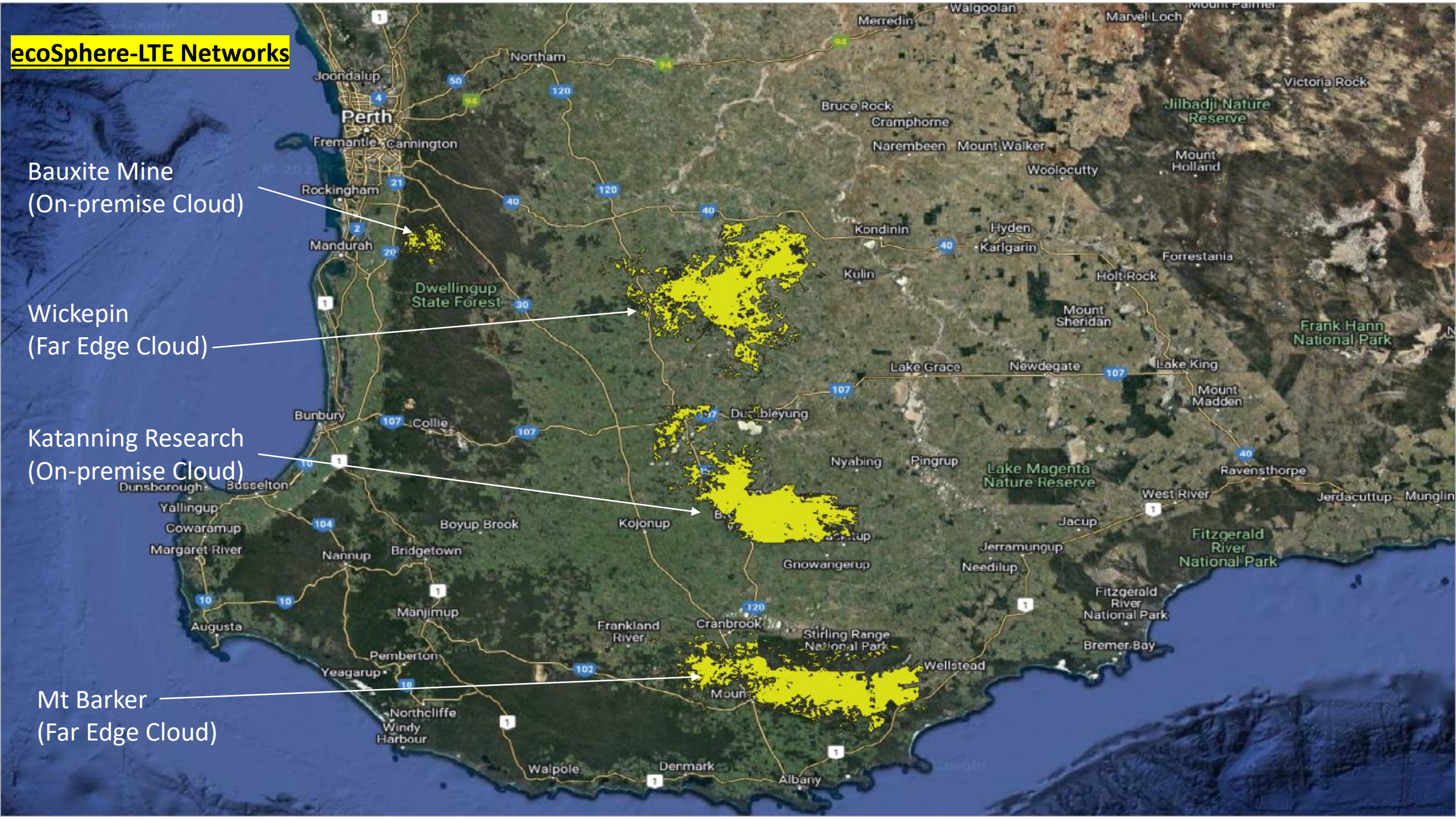
ecoSphere-LTE Networks

Bauxite Mine
(On-premise Cloud)

Wickepin
(Far Edge Cloud)

Katanning Research
(On-premise Cloud)

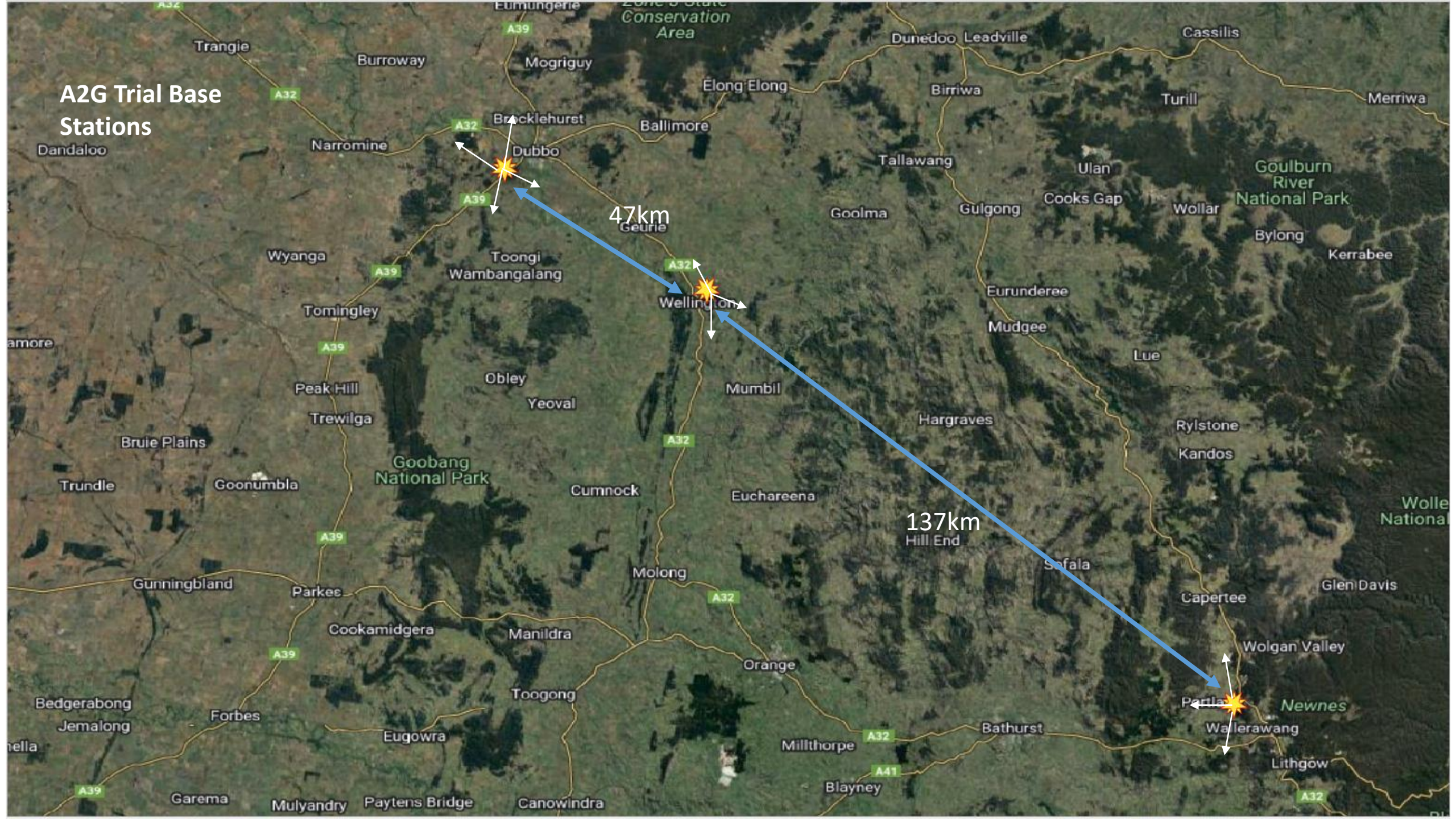
Mt Barker
(Far Edge Cloud)

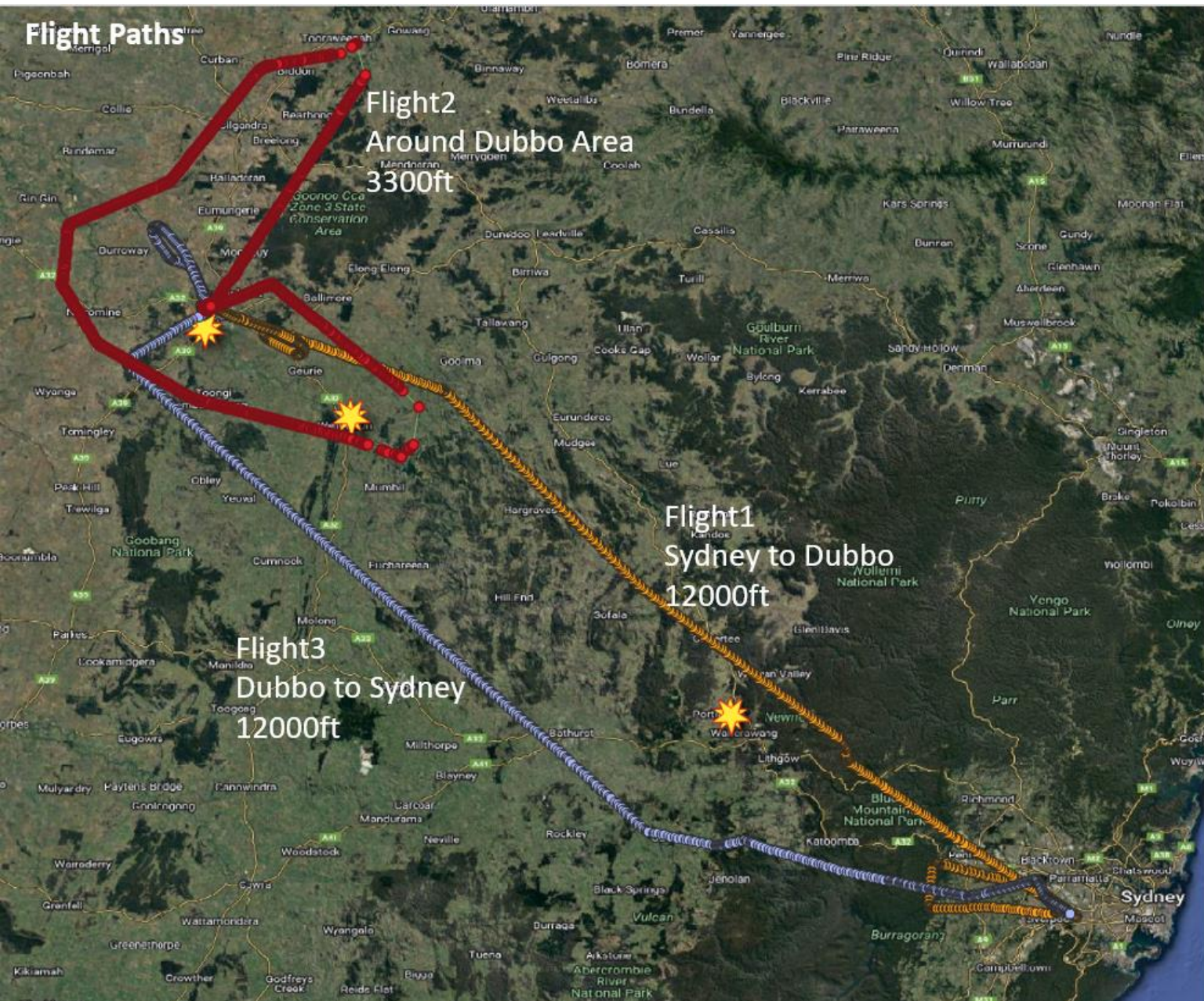


Air to Ground

- In Australia, Band-65 (upper 2.1 GHz spectrum) is being planned to allow Complimentary Ground Component (CGC) for providing Direct Air to Ground Communication (DA2GC). The spectrum is not yet released
- Pivotel and SkyFive joint A2G Trial was enabled by a scientific licence granted by ACMA
- Three base stations were installed using Nokia Equipment
- **Athonet provided Centralised 4G Core on VM**
- Many insights were gained from the trial on the following aspects:
 - Optimum placement of base stations
 - Site acquisition challenges (e.g., collocating on electrical substation in remote areas)
 - Backhaul challenges in remote areas (because A2G base stations are spaced far apart)
 - Lab verification approach
 - Device selection (On-board aircraft equipment)
 - Regulatory constraints
 - Field performance results: Throughput vs Aircraft Altitude. **Download speed circa 100 Mbps was achieved with RTT of circa 30ms during charter test flights.**
 - Deployment costs
 - Unforeseen weather-related issues during deployment and flight tests.
- **Athonet Core has worked wonderfully and not a single issue was found in regard to interoperability with Nokia RAN.**

A2G Trial Base Stations





Summary

- Private networks in Australia are expected to proliferate to enable Industry 4.0 revolution and close the Digital Divide.
- Australian local regulatory body ACMA has planned release of C-band spectrum especially 3.8-4.0 GHz to enable 5G use cases.
- The ecosystem is evolving rapidly and needs to support a diverse range of use cases and deployment constraints.
- Distributed cloud architectures are seen essential to support diverse use cases (application requirements).
- The solutions need to be scalable and cost-effective for business viability.

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