



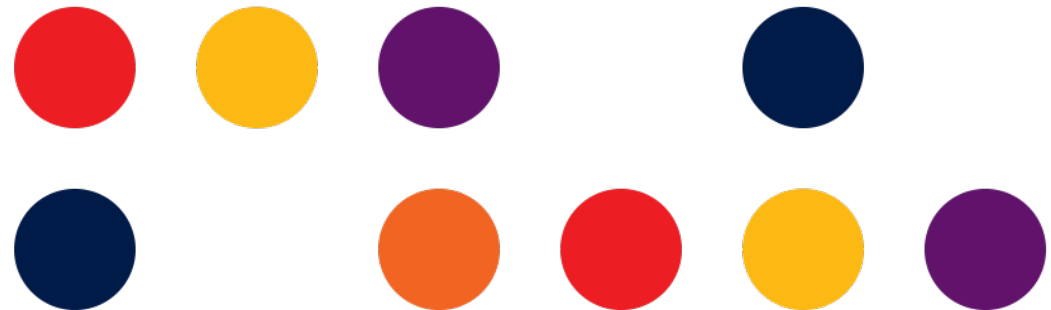
TPG Telecom's technical analysis of Australia's Fastest 5G Network Rollout

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TPG Telecom

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TPG Telecom's 5G Journey: From Necessity to Innovation

01

Where we started:
Our 5G Journey

02

Overcoming
Challenges:
Rebuilding a
mobile network

03

Leading with
Innovation:
Fast-track rollout
and network
reach

04

Where we stand
today:
Bold, Adaptive,
and Innovative

TPG telecom's focus has been on building a cutting-edge 5G network to offer superior network experience



Image source: Nokia



Faster data transfer rates



Diverse use cases for network users



Enhanced security and encryption



Higher IoT device density



Cloud native network architecture

Pre 2018

- Australian Government blocks High Risk Vendors (HRVs) from Australia's 5G rollout (2018)
- Vodafone and TPG Telecom announce merger (2018) complete their merger (2020)
- TPG purchase C-Band spectrum and start planning 5G network (2019)
- Iphone 12 5G Capable – launch on Telstra (2020)

- Single RAN (3G and 4G) and Tx vendor across our network (Huawei)
- Joint Venture (eJV) with Optus only allowing 3G+4G site upgrades
- No 5G Spectrum assets
- Competition beginning their 5G journeys

2018-2020

2021

- Following the HRV ban, TPG developed a standalone, 5G-native network using alternative suppliers

2022

- TPG expanded its 5G network to cover the top 10 most-populated cities in Australia.
- Formed new partnerships for network sharing joint ventures

- TPG continues to expand its 5G, aiming to reach more sub-urban and regional areas.
- Signed a Regional network sharing deal with Optus to more than double its coverage
- 5G Advanced use cases are coming

2024 and beyond

TPG Telecom's 5G Journey: From Necessity to Innovation

A dark blue, semi-transparent rectangular block with a background image of a city skyline at night. The number '01' is prominently displayed in white. Below it, the text 'Where we started: Our 5G Journey' is written in white.

01

Where we started:
Our 5G Journey

A solid orange rectangular block. The number '02' is prominently displayed in white. Below it, the text 'Overcoming Challenges: Rebuilding a mobile network' is written in white.

02

Overcoming
Challenges:
Rebuilding a
mobile network

A dark blue, semi-transparent rectangular block with a background image of a city skyline at night. The number '03' is prominently displayed in white. Below it, the text 'Leading with Innovation: Fast-track rollout and network reach' is written in white.

03

Leading with
Innovation:
Fast-track rollout
and network
reach

A dark blue, semi-transparent rectangular block with a background image of a city skyline at night. The number '04' is prominently displayed in white. Below it, the text 'Where we stand today: Bold, Adaptive, and Innovative' is written in white.

04

Where we stand
today:
Bold, Adaptive,
and Innovative

HRVs ban was a **significant hurdle**, but TPG adapted by innovations and partnerships to expedite rollout and coverage



Due to National security concerns, HRVs were banned in Australia (2018)

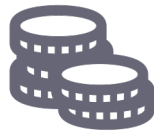


- TPG Telecom (then Vodafone) relied heavily on an HRV for its existing 3G, and 4G network
- The ban meant that TPG had to reconsider its entire 5G strategy

This change has a notable impact on TPG Telecom's 5G rollout in Australia



Delayed Rollout: The need to replace HRV's equipment and find new suppliers slowed down TPG Telecom's 5G rollout. Other MNO's did not have this scale of issue



Additional Costs: The ban required Vodafone to strip out HRV's equipment from its existing 4G network, which was a costly process



Strategic Adjustment: TPG had to find alternative suppliers for 5G which was a complex transition to integrate new equipment while ensuring operating existing network

In response, TPG Telecom had to make significant changes to its strategy



Roll-out Innovation: Preassembled, tested radio equipment delivered as a single assembly to sites to **fast track 5G rollout**

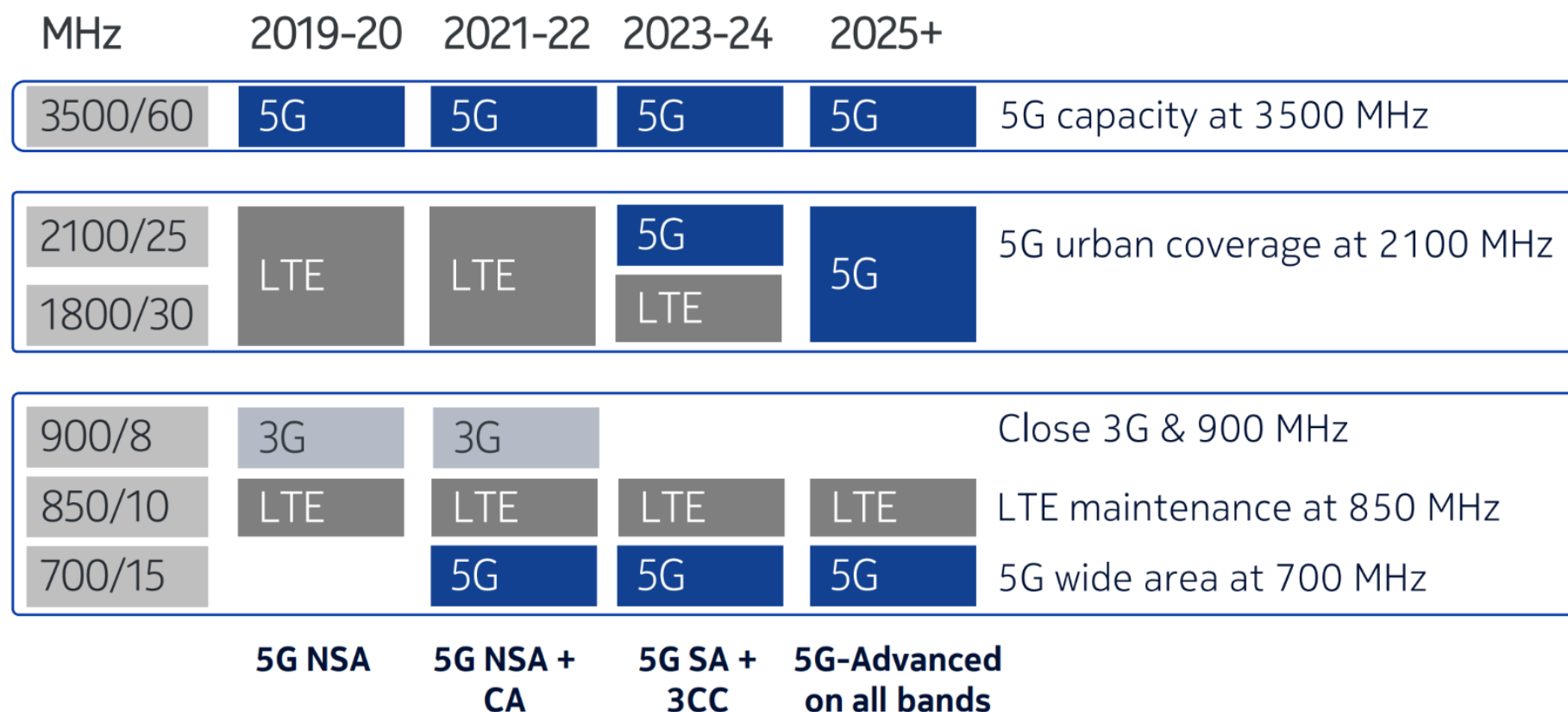


New Partnerships: Collaborations with Nokia, Ericsson helped **modernize TPG's infrastructure**; and with Optus for our eJV and recently Regional MOCN deal to **extend coverage**

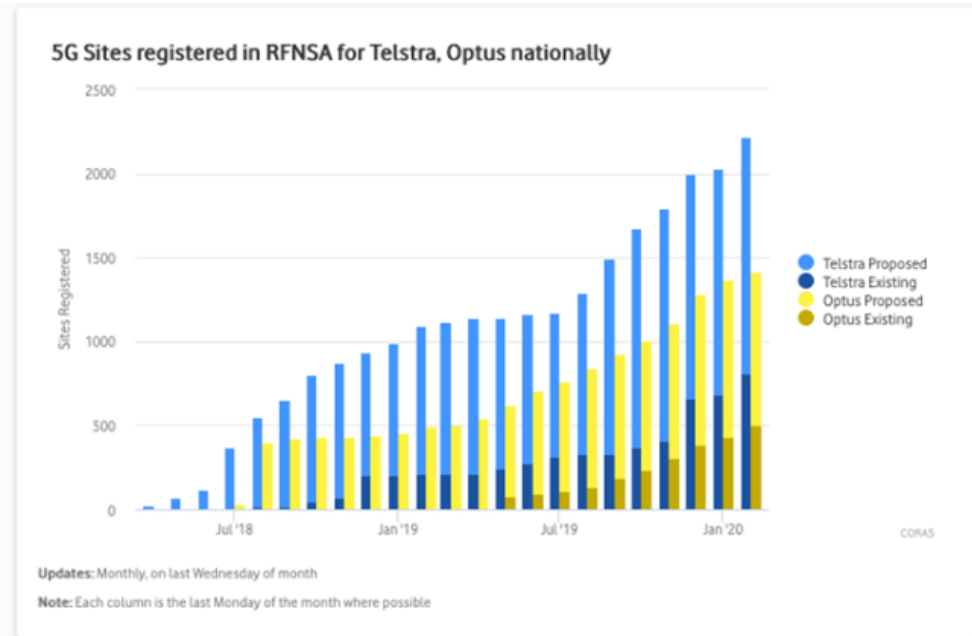
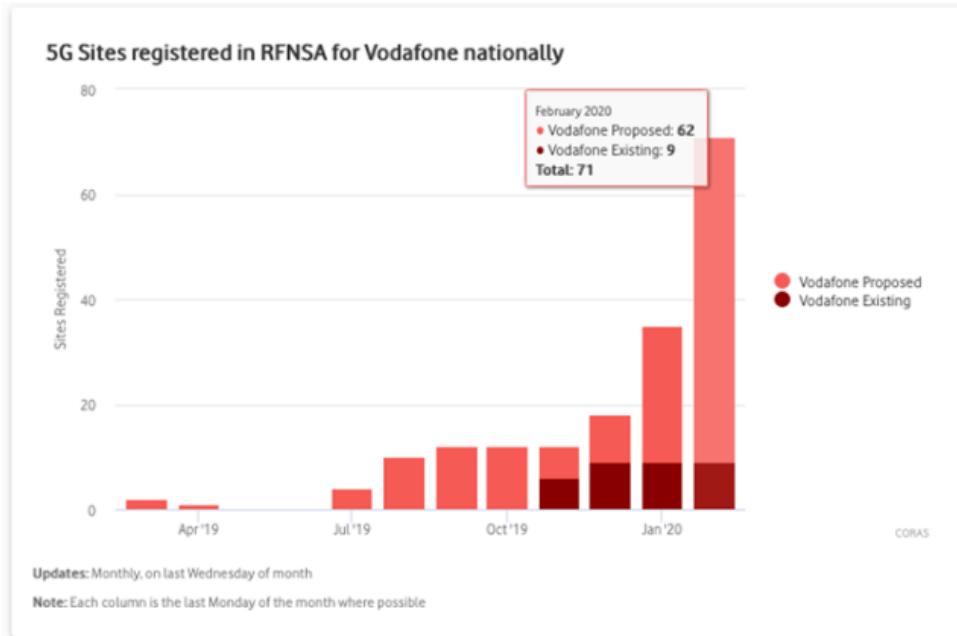


5G Stand Alone: TPG with Nokia, launched the world's first live 5G standalone network on the 700MHz band, enabling wide coverage and deep indoor penetration

TPG needed to acquire key spectrum assets and strategically planned their use

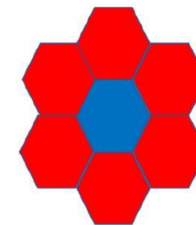


The Competition and the Coverage Gap: Comparing NSA and SA Handover Points in 5G Networks

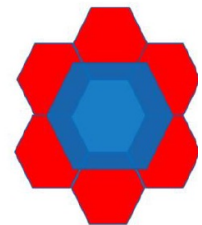


A. In NSA, the inter-cell HO (Handover) point unavoidably occurs at the 4G Radio cell boundary, typically at the midpoint between two eNBs. This then drops the 5G radio bearer. **The issue is accentuated when you have a pepper-potted RAN footprint between high-risk vendor and Nokia (5G RAN vendor)**

B. In SA, the inter-cell HO point occurs at the 5G Radio cell boundary; this can be far beyond the midpoint to the nearest eNB rather than the nearest gNB. The effective 5G cell area is greatly increased in the early years of rollout before converging at 100% once the last site is swapped from the legacy RAN vendor.

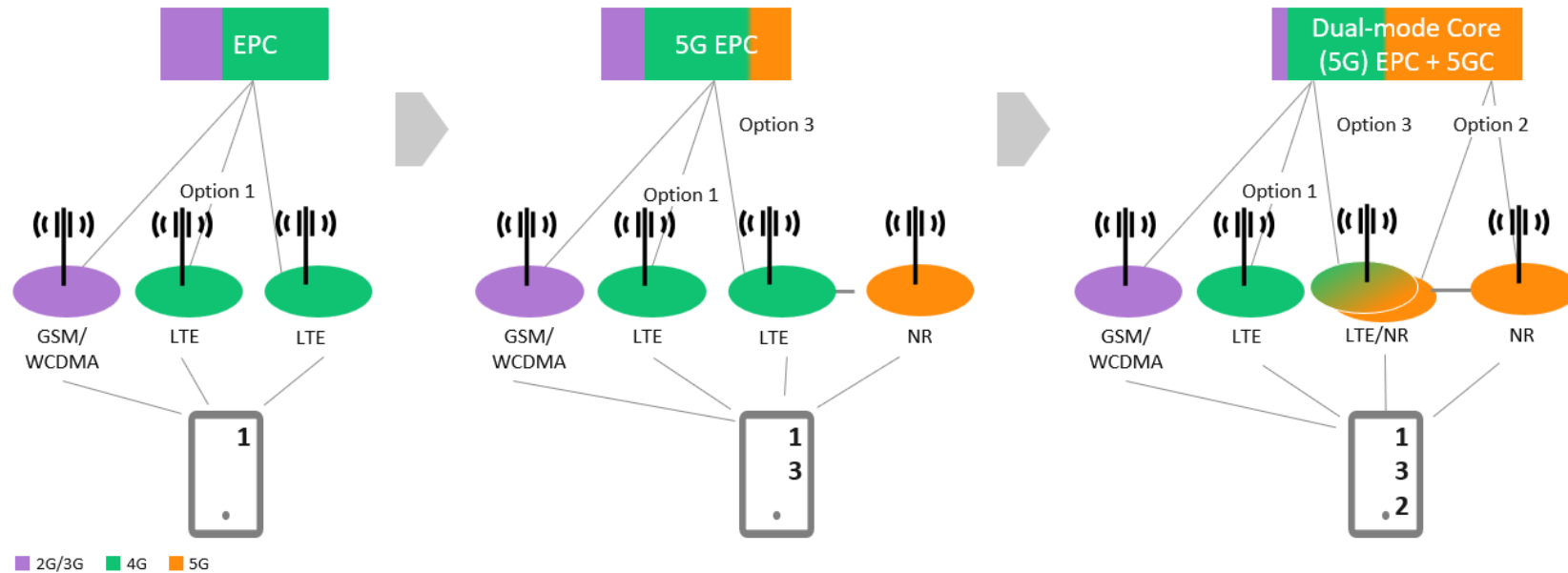


Best Server
NSA (today)



Unconstrained
SA (future)

Our approach transitioning 5G network to a Dual Mode Cloud Native Core Network



No impact to legacy services and in-market devices (incl. early 5G devices) while the network evolves

Stage 0: Infrastructure modernisation and capacity

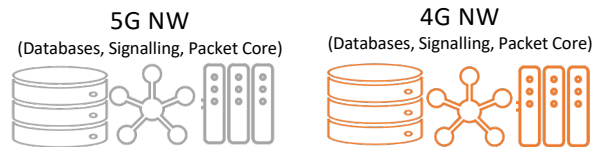
Cloud Native Layer

Compute

Storage

Network

Stage 1: Modernised Core Network



Stage 2: FWA and coverage layer on 5G Standalone



Overview of our Joint Venture (JV) with Optus

- Over 3300 sites in a passive Joint Venture with Optus
- No provision in MOU for 5G deployment
- New Contract required – with design, commercial models, management models, rollout structure etc
- Differentiation in timing between the MNO's

Antenna Reference	Technology	Antenna Type	Dimensions
V-AAU2	L7, U9, L850, L18, L21, L26	12 port large, Twin Beam or Hybrid Passive	2780(H)×499(W)×178(D)
V-AAU1	NR3500	AAU	800 (H) x 450(W)x 240(D)
O-AAU2	mmWave	AAU	330 (H) x 220 (W) 123 (D)
V-P1	L7, U9,L18,L21,L23,L26	12 port medium passive	2100(H)×650(W)×250(D)
O-AAU1	NR2300/3500	Dual band AAU	1400(H)×650(W)×200(D)
O-P1	NR FDD	Dual band AAU	1600(H)×650(W)×200(D)

TPG Telecom's 5G Journey: From Necessity to Innovation

The number '01' in a large, white, sans-serif font, positioned over a background image of a city at night with a bridge and light trails.

01

Where we started:
Our 5G Journey

The number '02' in a large, white, sans-serif font, positioned over a background image of a city at night with a bridge and light trails.

02

Overcoming
Challenges:
Rebuilding a
mobile network

The number '03' in a large, white, sans-serif font, positioned over a solid orange background.

03

Leading with
Innovation:
Fast-track rollout
and network
reach

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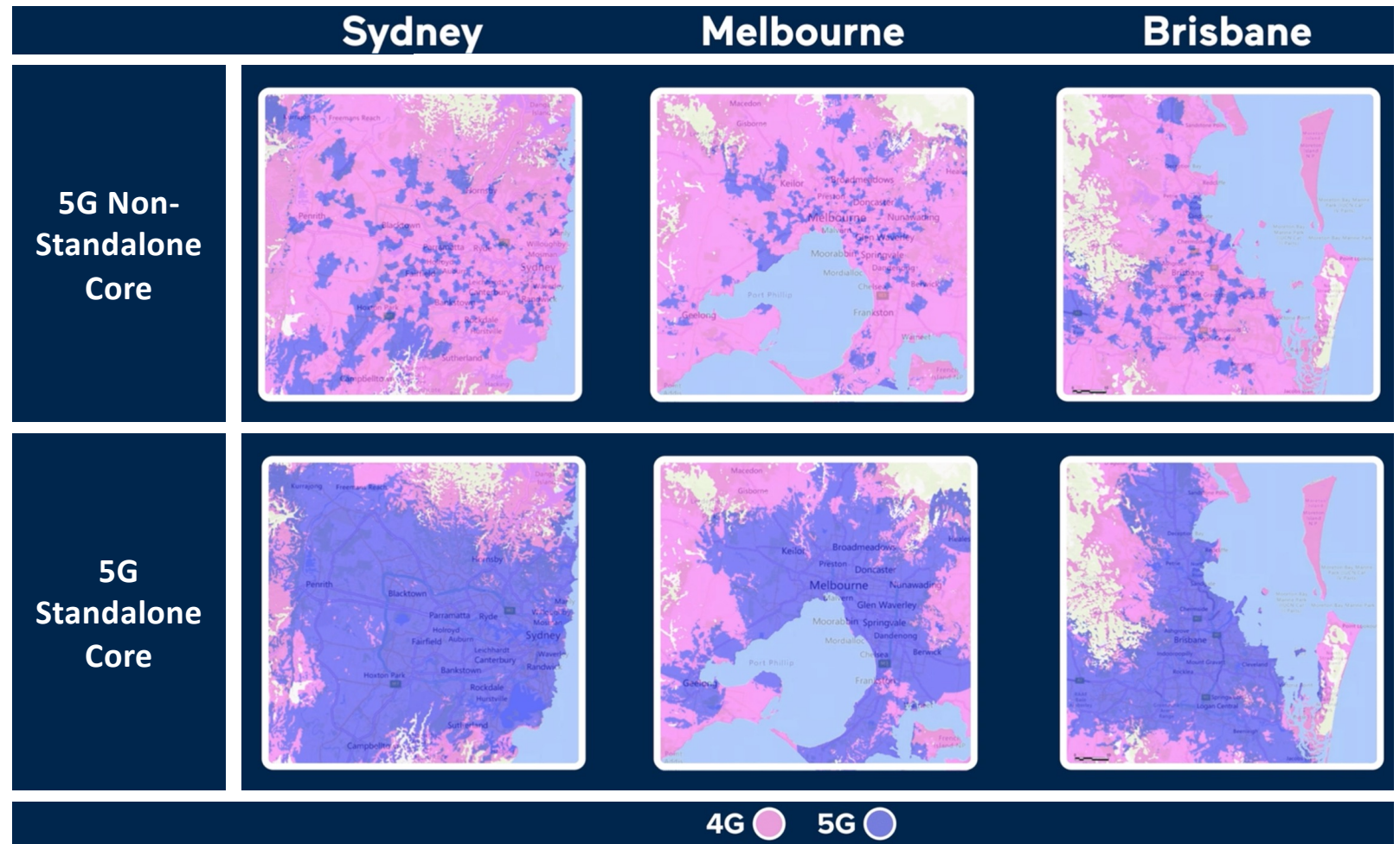
04

Where we stand
today:
Bold, Adaptive,
and Innovative

We were able to triple our 5G coverage through 5G Standalone core in 700MHz spectrum



Nokia and TPG
Telecom launch
**world's first¹ live 5G
standalone 700MHz**
service in Australia

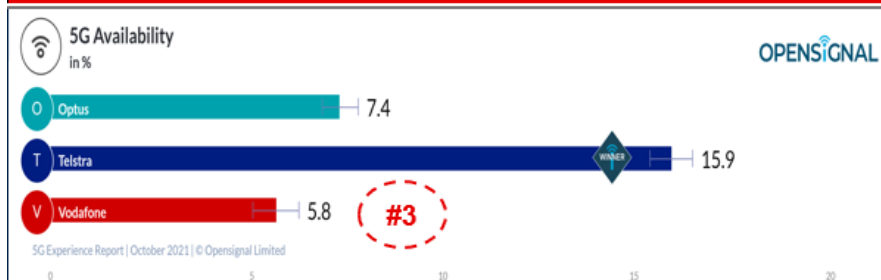


¹ <https://www.nokia.com/about-us/news/releases/2021/07/05/nokia-and-tpg-telecom-launch-worlds-first-live-5g-standalone-700mhz-service-in-australia/>

Award winning network rollout speed

Opensignal – 5G Achievements

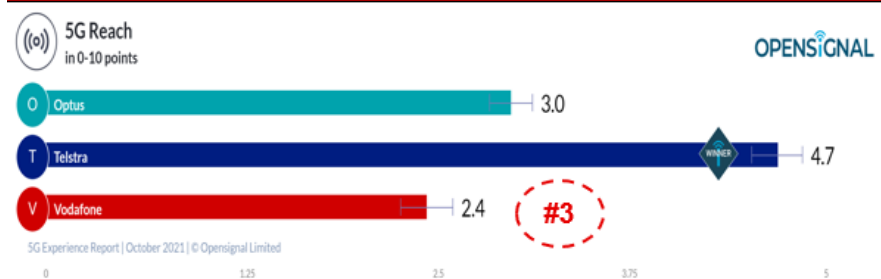
5G Availability | Oct 2021



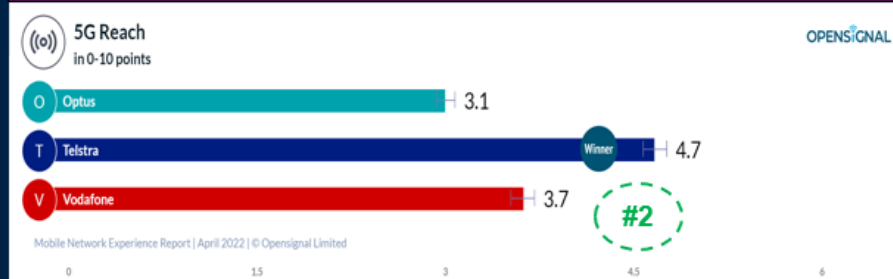
5G Availability | Apr 2022



5G Reach | Oct 2021



5G Reach | Apr 2022

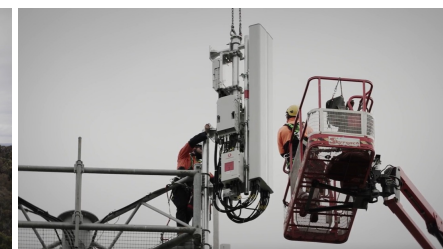
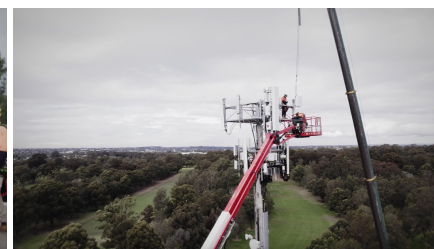
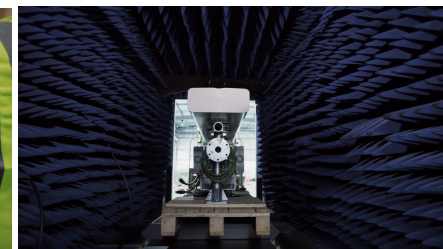


TPG's 5G Smart Module revolutionised the network deployment with **enhanced rollout speed and increased worker safety**

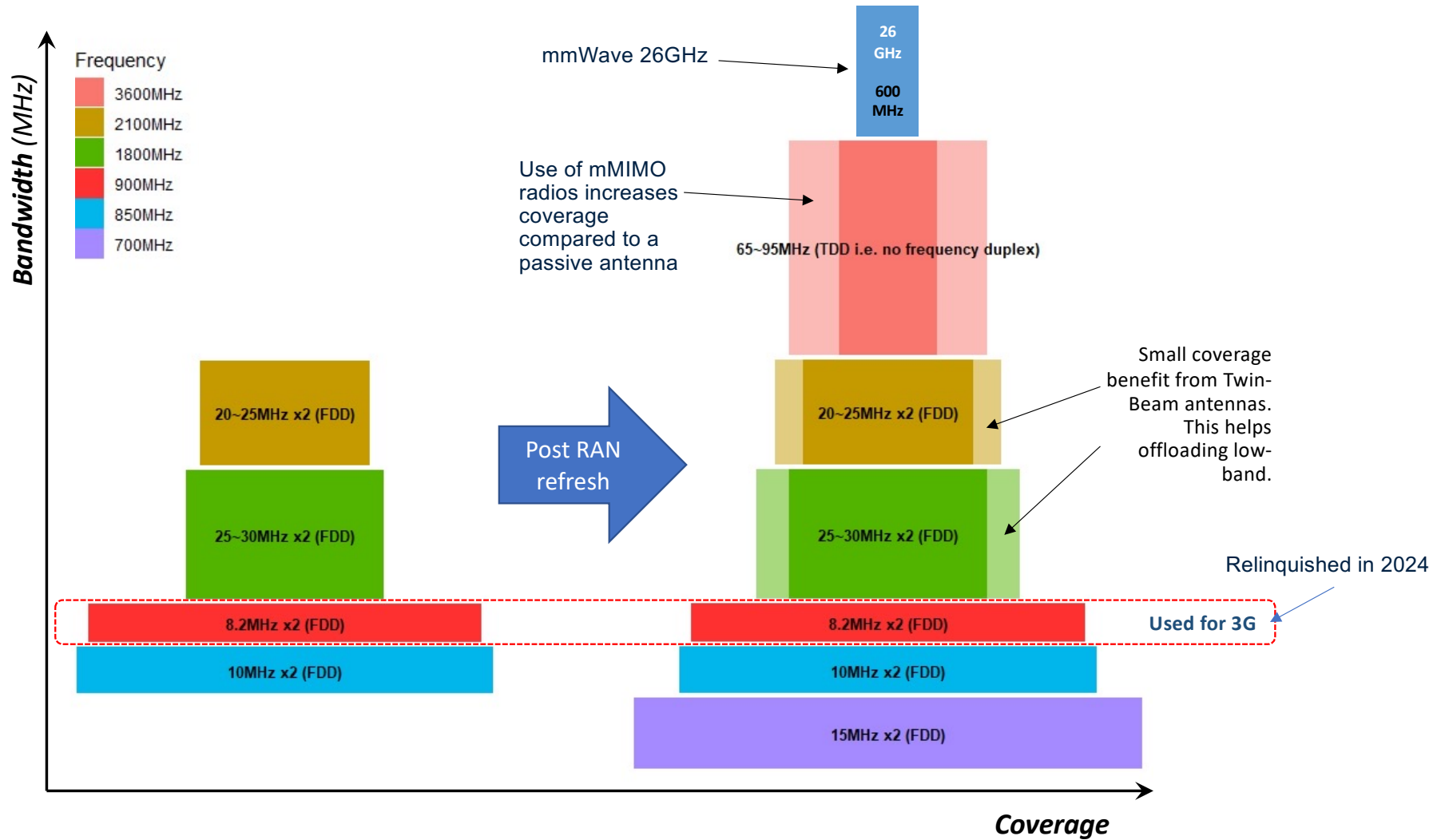


5G rollout innovation

- **5G Smart Module** by TPG and development partners
- Pre-assembled, tested radio equipment delivered as a **single assembly to sites**
- Reduction in rollout time and downtime to **fast track 5G rollout**
- **50% reduction** in onsite upgrade delivery time
- **70% reduction** in staff working at heights
- Increased network experience, worker safety, and package recycling



Spectrum Bandwidth vs Coverage – a 5G refreshed site



TPG Telecom's 5G Journey: From Necessity to Innovation

The background of the slide is a dark, blue-toned image of a city at night. It features light trails from cars on a bridge and various city buildings, including a prominent bridge with a rainbow arch. The overall aesthetic is futuristic and tech-oriented.

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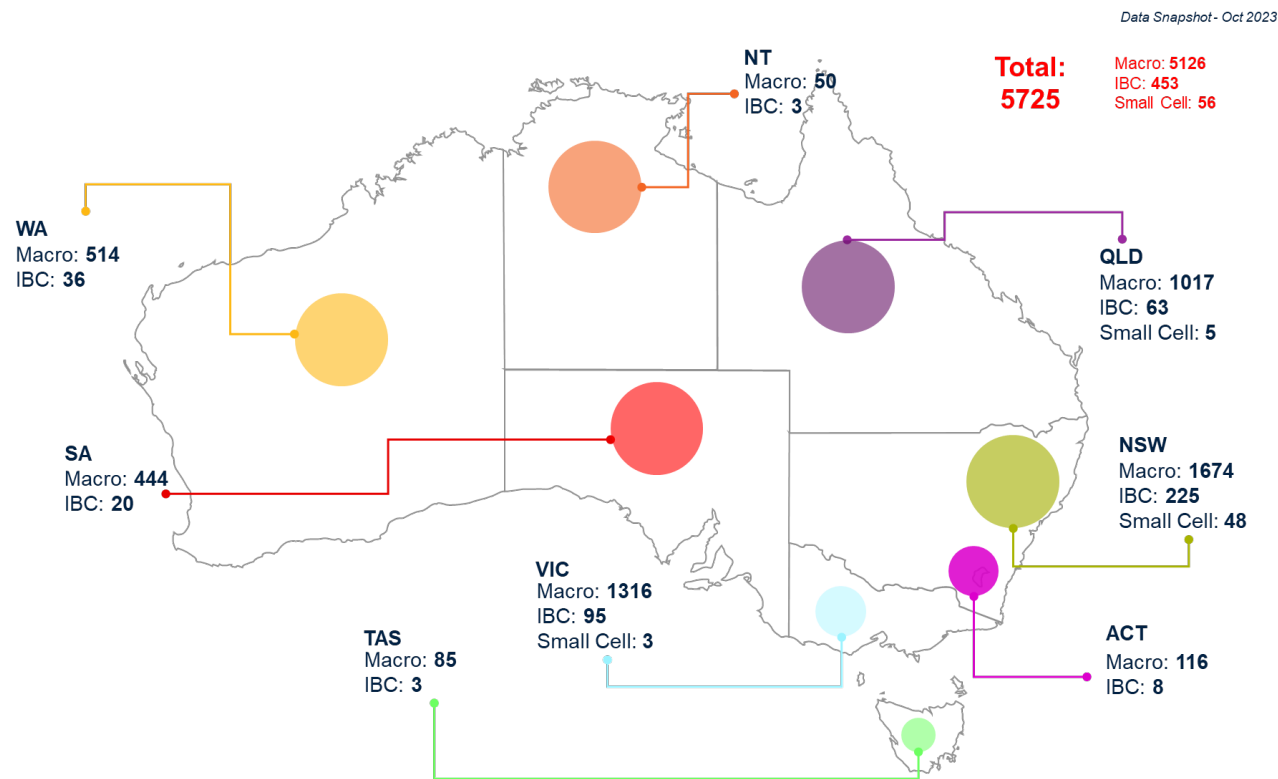
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Where we stand
today:
Our 5G Journey
Continues

Expansive Reach: A Snapshot of Our Network's Scale and Capabilities



Rolling out 5G across Australia (3400+ sites)

Our 5G network is rolling out to selected areas in Sydney, Melbourne, Brisbane, Adelaide, Canberra, Perth, Gold Coast, Central Coast, Wollongong, Newcastle, Geelong and the Sunshine Coast. Within these cities, 5G is available in selected areas in 3,174 suburbs.



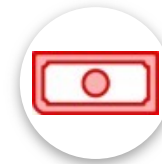
Over 23m Australians covered by 4G

Our 4G network is our best-ever and now covers over 23 million Australians. In the last 10 years, we have deployed over 1,828 new macro towers, small cells, and In-building coverage sites.



Increased capacity

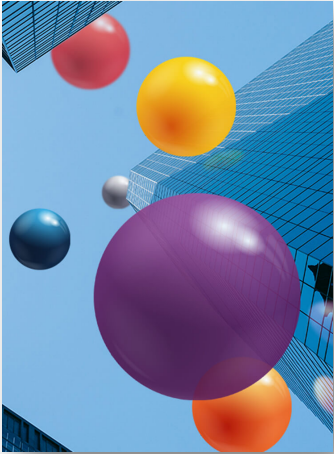
Our network now carries over 1649 Petabytes of data per year. To compensate for the traffic growth, we have activated over 24,855 additional technology upgrades, which provides 10 x more capacity to the network.



Over \$6B investment

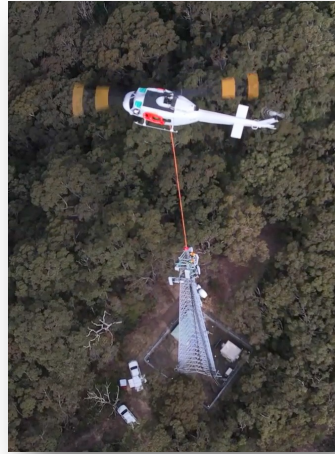
To improve our network resilience and customer network experience we have invested over \$6B in the last 10 years to enhance our Radio, Core and Transmission networks.

What our 5G Network is capable of



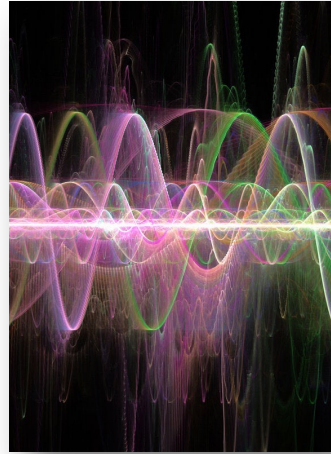
5G network

- **3400+ sites** upgraded to 5G covering more than half of its metro network
- **World's first** to launch 5G (700MHz) **Standalone core** (2021)
- Tripled 5G coverage to cover **over 85% of population** in ten major cities and regions (2021)



5G rollout innovation

- **5G Smart Module** by TPG and development partners
- Pre-assembled, tested radio equipment delivered as a **single assembly to sites**
- Reduction in rollout time and downtime to **fast track 5G rollout**
- Increased network experience, worker safety, and package recycling



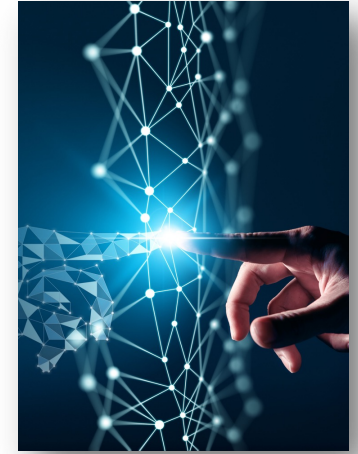
5G spectrum investments

- Secured **holdings in 26 GHz mmWave** (millimetre wave) band auction in (2021)
- Boosted 5G spectrum holdings in the **3.6 GHz band** acquired from Dense Air (2021)
- Boosted C-Band holdings (3.7GHz) in 2023 Auction



5G services records

- An Australian first, TPG Telecom hit a **5G uplink speed of 2Gbps** using mmWave spectrum at Nokia 5G Futures Lab (2022)
- TPG Telecom sets a new **5G high speed 2Gbps DL** score at the Sydney Cricket Ground (2023)
- TPG Telecom sets a world record for a **long-range (148km) video and voice call** on a 5G SA network (2021)



5G innovation

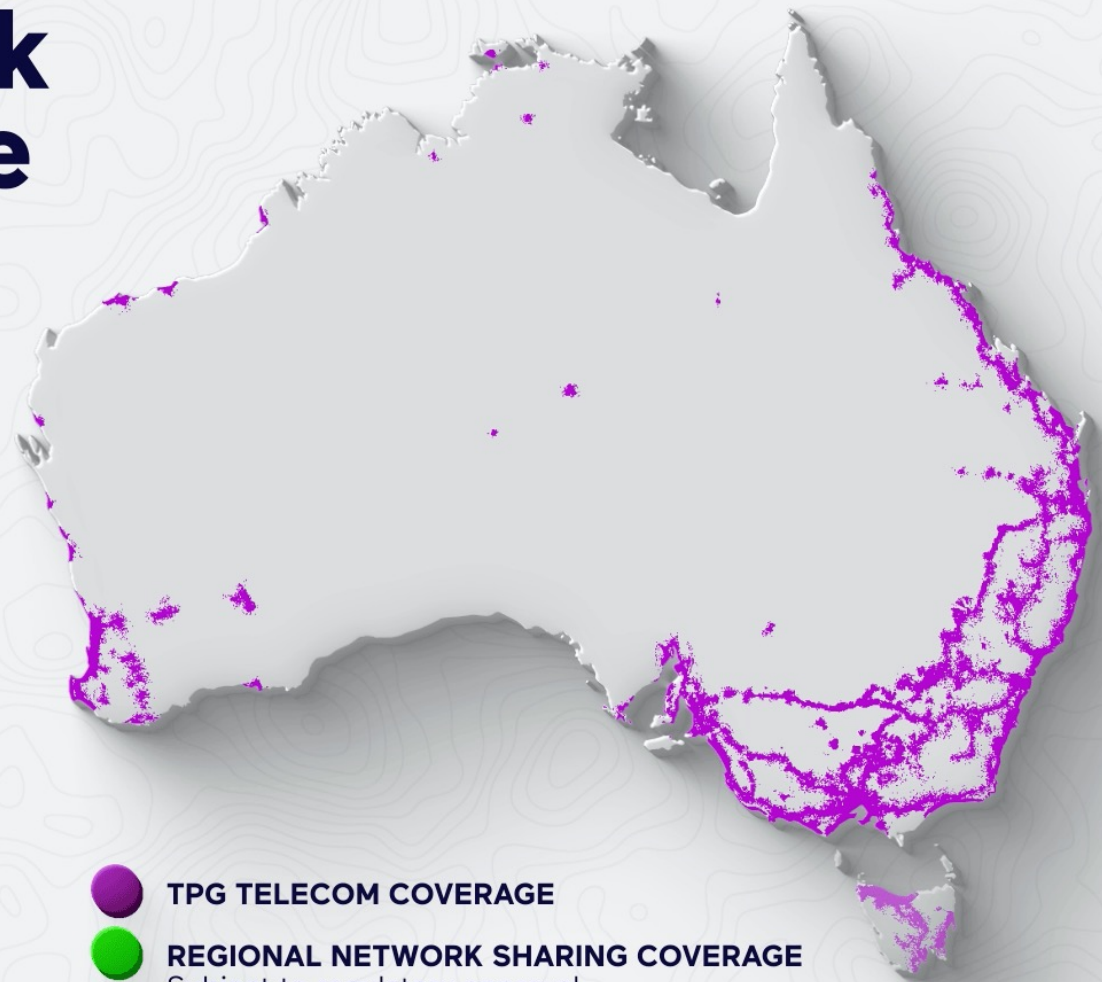
- First of its kind Innovation Lab in Sydney to **drive product and technology innovation** (2021)
- **Network Sensing Lab** at the University of Technology Sydney (UTS) to transform mobile networks into sensing systems for floods
- Network Slicing trials to begin
- Network as a Service – MOCN deal first of many in current market?

Regional Network Sharing will more than double our reach

Gain access to **2,444** Optus mobile network sites in regional Australia

Increase our national 4G coverage from around **400,000** to **1,000,000 sq km**

Boost Australian population coverage from **95.4%** to **98.4%**



What is MOCN?

Q What does MOCN mean?

A Mobile Operator Core Network

Q What is the purpose of a MOCN?

A It allows the sharing of radio access network between two operators.

Q What is shared on a MOCN?

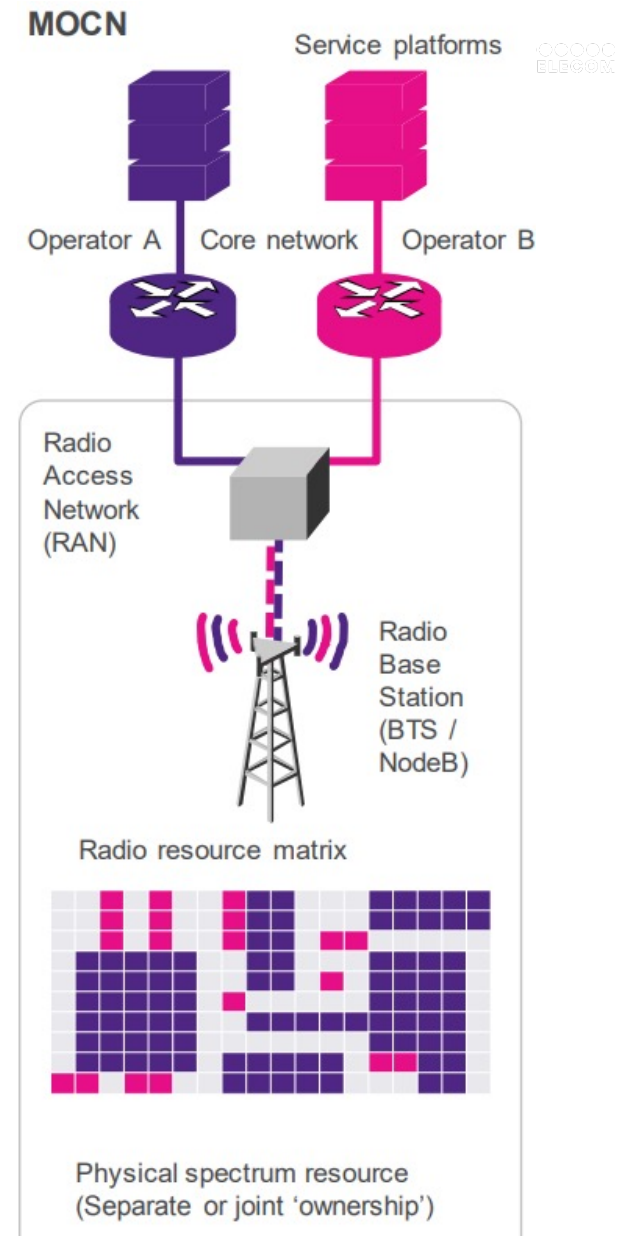
A All radio elements: Antennas, Radio Units, Nodes, Spectrum.

Q What is an important feature of a MOCN?

A Each operator is able to distinguish and manage it's own network, Services and users by having separate core networks.

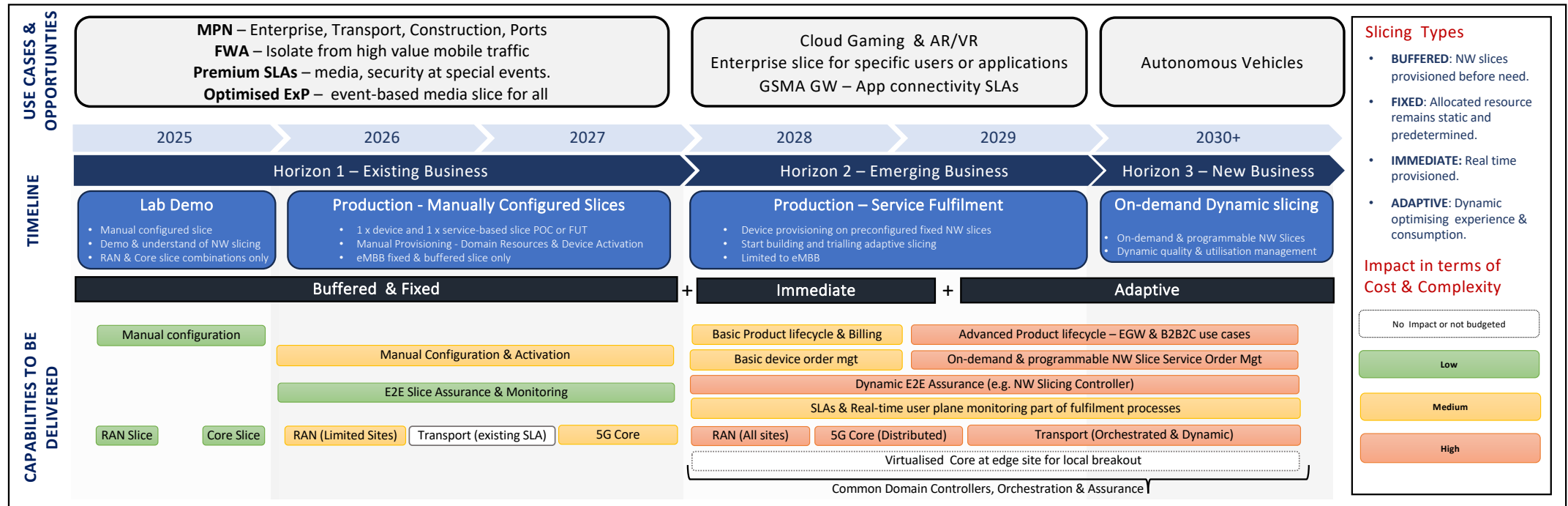
i.e - Each operator identifies it's network to it's users by broadcasting it's own network ID and conducting a handshake procedure.

A network ID is called PLMN (Public Land Mobile network).



Network Slicing – Use Case

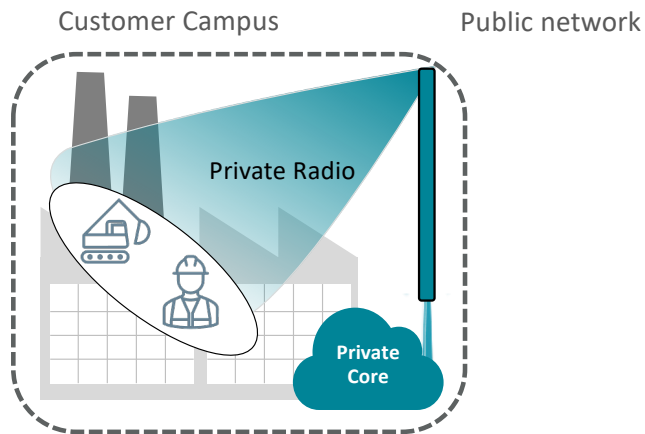
- E2E Network Slicing is coming and allows a wealth of opportunities for differentiation
- Manual Slicing is available now but the future is E2E Adaptive Slicing to make the most efficient use of Network resources



MPN Connectivity – Use Case

Dedicated MPN

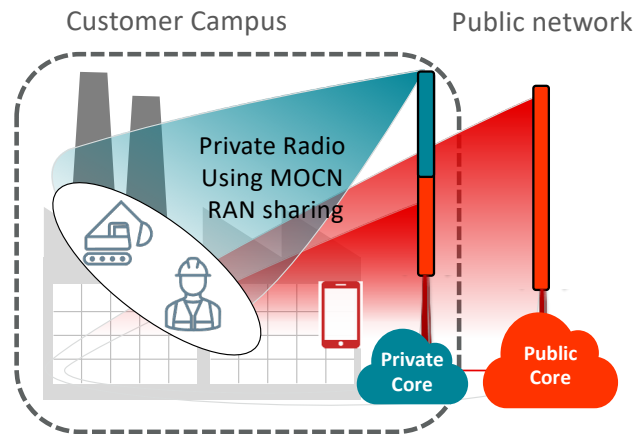
Physical standalone mobile private network



Assured Quality of Service ✓
 Keep your data on your site ✓
 100% control through customer ✓
 Interworking with public network ✗

Hybrid MPN

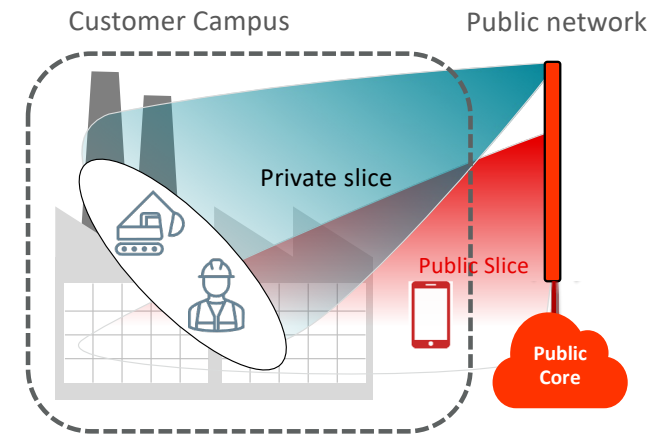
Physical private network elements deployed in conjunction with the public network



Assured Quality of Service ✓
 Keep your data on your site ✓
 100% control through customer ✓
 Interworking with public network ✓

Virtual MPN

QoS in the Vodafone network with Network Slicing



Assured Quality of Service ✓
 Keep your data on your site ✗
 100% control through customer ✗
 Interworking with public network ✓

Thank you!



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