# Modelling of network capacity in the area covered by the proposed Telstra-TPG MOCN

Report for Gilbert + Tobin

Public Version

27 July 2022

[redacted]

# Contents

# 1. Executive summary

Telstra Corporation Limited (Telstra) and TPG Telecom Limited (TPG) have entered into a series of interrelated agreements that together provide for a Multi-Operator Core Network (MOCN) commercial arrangement in an area of approximately 1.5 million square km, covering 17.4% of the Australian population (the 17% Regional Coverage Zone).

Aetha Consulting Limited (‘Aetha’) has been retained by Telstra’s solicitors, Gilbert + Tobin, as an independent expert in relation to the application by Telstra and TPG to the Australian Competition and Consumer Commission (ACCC) for merger authorisation under section 88(5) of the Competition and Consumer Act 2010 (Cth) (CCA)[1].

The ACCC has received a submission from Optus in response to the Authorisation Application[2] (the Optus Submission) together with a report from Analysys Mason[3]. Gilbert + Tobin’s Letter of Instruction to Aetha refers to two claims in the Optus response:

(a) “The level of spectrum asymmetry will grant Telstra material network quality and cost advantages which cannot be matched by Optus, or any other potential new entrant network” (para 5.25)
(b) “An abundance of spectrum, particularly low band, improves the cost efficiencies of network deployment while access to a disproportionate amount of mid band spectrum means that Telstra is able to out perform any competition on a capacity basis without the need to invest in expensive spectral efficiency technology” (para 5.27)

Aetha has been instructed to assess the claims made in the Optus Submission regarding the potential impact of the proposed transaction on the relative network capacity of Optus and the MOCN in the 17% Regional Coverage Zone.

In order to consider whether Telstra, with the MOCN, is able to out-perform any competition on a capacity basis, Aetha has analysed the quantity of spectrum available to each operator and has also prepared a network dimensioning model of the Radio Access Networks (RANs) of Telstra, the proposed MOCN and Optus in the 17% Regional Coverage Zone.

The model is used to estimate the level of growth in data usage per Service In Operation (SIO) over a five-year period (financial year ending 30 June 2024 to financial year ending 30 June 2028) that each of the networks could sustain within certain limits of cell site construction in the 17% Regional Coverage Zone.

The 17% Regional Coverage Zone is defined in the interrelated agreements as a list of 11 615 Statistical Areas Level 1 (SA1s) in their entirety, and in addition the surrounding area of a number of identified ‘boundary’ Telstra sites.

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[1] Aetha understands that the commercial arrangement is not a merger, but TPG’s grant of authorisation to Telstra to use its spectrum is deemed to be an acquisition within the meaning of s 50 of the Competition and Consumer Act 2010 (Cth)

[2] Optus, ‘Submission in response to ACCC market inquiry – Telstra and TPG application for merger authorisation for proposed spectrum sharing in regional Australia’, June 2022

[3] Analysys Mason, ’The ACCC’s consideration of the Telstra -TPG Agreement’, 27 June 2022

## 1.1 Background

According to the ACCC Internet Activity Report[4], traffic per service in operation (SIO) grew at a compound annual rate of 26% between the three months ending June 2019 and the three months ending June 2021; from 7.0 GB per SIO to 11.1 GB per SIO. These growth rates are broadly similar to those seen in other countries and, in Aetha's experience, most mobile operators plan to be able to support similar rates of growth for the foreseeable future.

In December 2021, the ACMA concluded an auction of 2×10MHz of spectrum in the 850MHz 'expansion band' and 2×25MHz in the 900MHz band. Telstra acquired the 850MHz spectrum, whilst Optus acquired the 900MHz spectrum. The licences awarded in this auction are not due to commence until 1 July 2024. In our modelling exercise, throughout the modelling period (FYE24 to FYE28), we have assumed that the MNOs' holdings in the 850MHz and 900MHz band are as of 1 July 2024 – i.e. post the commencement of the new licences.

In this report we investigate the ability of the networks in the MOCN region to serve growing traffic over the first five full financial years of operation of the MOCN (FYE24 to FYE28). Traffic growth is expected to result primarily from increasing data usage per SIO, but can also occur as a result of increasing SIOs in the 17% Regional Coverage Zone or, for a particular network operator, by increasing market share in the 17% Regional Coverage Zone.

We consider the data usage growth per SIO that could be served by Telstra and TPG in combination by use of the MOCN, which will effectively serve the traffic of both operators from a single pool of capacity. In addition, we consider the traffic growth that could be served by Optus and by Telstra as a stand-alone operator without the MOCN.

Based on the modelling undertaken we draw conclusions on the relative ability of the proposed Telstra-TPG MOCN and Optus to sustain various rates of traffic growth within reasonable limits of cell site construction. **[Confidential to Telstra]** [redacted]

The MOCN agreement covers a specified list of 11 615 Statistical Areas Level 1 (SA1s) in their entirety and in addition partial coverage of a further 664 SA1s, referred to as boundary SA1s in the MOCN agreement, which contain 371 Telstra sites.

The MOCN agreement covers the following spectrum bands:

- 700MHz FDD (band n28) – with the exception of 2×5MHz of TPG spectrum
- 850MHz FDD (band n5/n26) – with the exception of 2×10MHz of Telstra spectrum (band n26)
- 1800MHz FDD (band n3) spectrum of Telstra, but not that of TPG
- 2100MHz FDD (band n1)
- 2600MHz FDD (band n7)
- 3.4GHz and 3.6GHz TDD (band n78).

Figure 1-1, below, indicates the amount of sub-6GHz site-weighted average effective downlink[5] mobile spectrum held by Telstra, TPG, Telstra and TPG in combination as the MOCN, and Optus. Because the amount of spectrum licensed to each operator varies across the 17% Regional Coverage Zone, the

[4] Accessible at https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/internet-activity-record-keeping-rule-rkr/june-2021-report

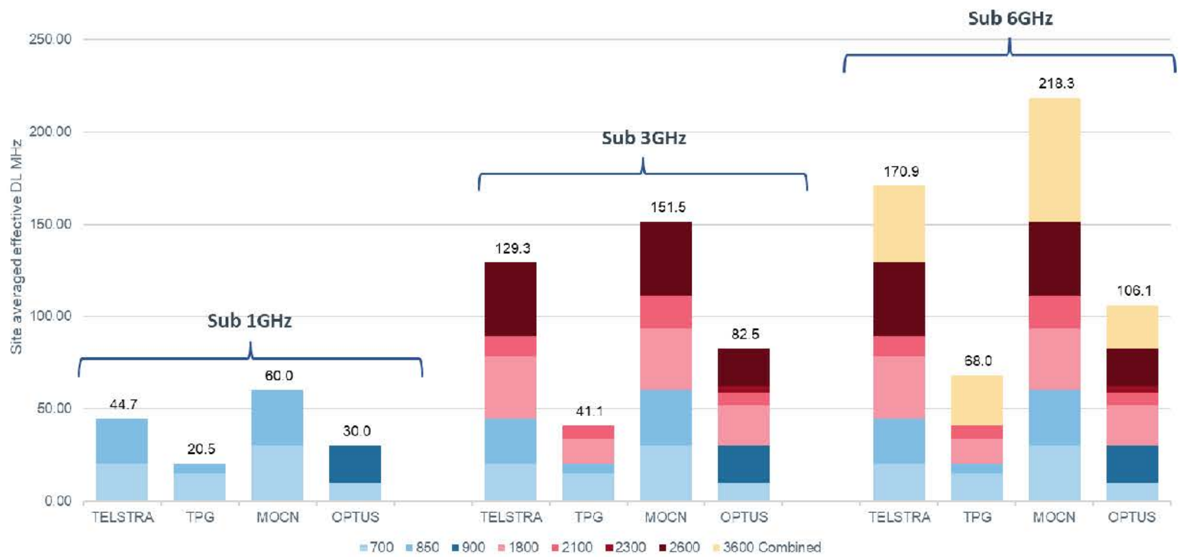
[5] For FDD spectrum, the downlink spectrum is included. For TDD spectrum, 75% of the total spectrum is included, being the proportion of the available traffic carrying radio resource dedicated to downlink in most TDD 4G and 5G networks.

[redacted]

data presented in Figure 1-1 is the average quantity available at sites of the respective operators in the 17% Regional Coverage Zone.

We have excluded the 2×5MHz of 700MHz licensed to TPG which is not included in the MOCN agreement and the TPG 1800MHz holdings which are also not included in the MOCN agreement. However, we have included in Figure 1-1, and in the modelling presented in this report, the lower 2×10MHz block of 850MHz which is licensed to Telstra (won at auction in 2021) and not included in the MOCN agreement. We include the 2×10MHz block of 850MHz because Telstra customers will have access to this spectrum from 1 June 2024 and therefore it can be used by Telstra to serve its traffic from the same sites as the spectrum that is in the MOCN and hence is effectively part of the overall available capacity to serve the demand of the MOCN network users.

**Figure 1-1: Site-weighted average effective downlink spectrum by operator / MOCN (MHz)**




As can be seen from Figure 1-1, when considering spectrum alone, Telstra has a greater effective downlink bandwidth than Optus or TPG, and the MOCN has a greater downlink bandwidth than any individual operator.

However, the capacity of a cellular mobile network is not defined by its spectrum alone. The spectrum is re-used at each cell site in the network[6], and capacity of the network is therefore related both to the amount of spectrum and the number of cell sites. Furthermore, it is the network capacity in relation to the number of customers that is relevant when considering the amount of data that each customer can consume. Therefore, a more reliable measure of a network's ability to meet the demand of its customers for data usage is the product of downlink spectrum and macro sites[7], divided by the number of SIOs (site DL MHz per SIO). We use effective downlink spectrum for this indicator because in mobile data networks the downlink is more highly utilised than the uplink due to the asymmetry of internet traffic.

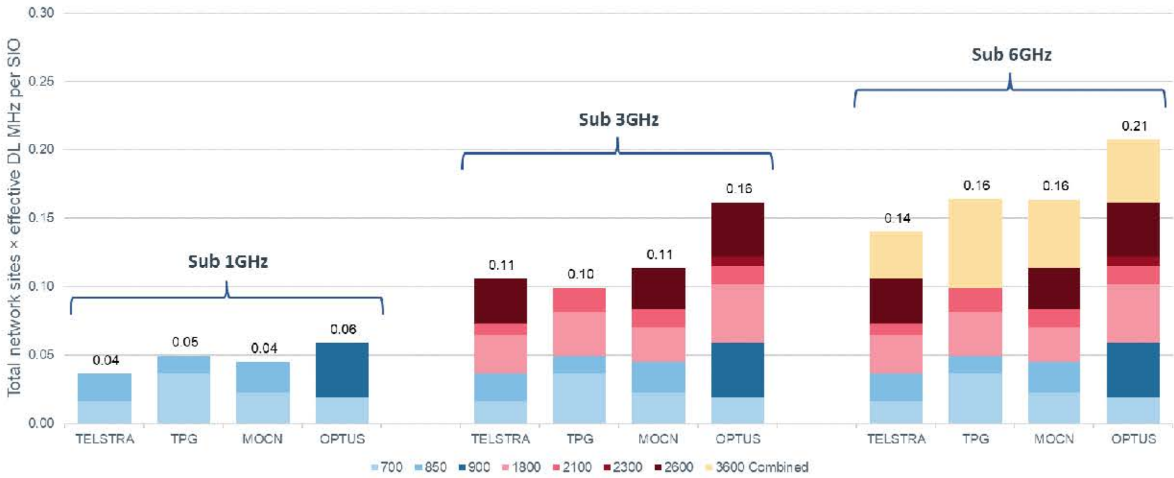
[6] In fact, the spectrum is used more than once at each cell site, using directional antennas. A typical arrangement is for a cell site to use the spectrum in each of three sectors. However, it is sufficient for comparison between networks to consider the number of sites, rather than sectors, because it is reasonable to assume the average number of sectors per site is similar for different operators.

[7] We use macro sites, rather than total sites because micro cells typically only use a small part of the available spectrum whereas a macro site can typically be expanded to use all the available spectrum bands if required.

[redacted]

Figure 1-2, below, provides the sites × effective DL MHz per SIO for each operator and the MOCN (including the lower 2×10MHz block of 850MHz which is licensed to Telstra but not included in the MOCN agreement).

**Figure 1-2: Site × effective DL MHz per SIO by operator within the 17% Regional Coverage Zone**




As Figure 1-2 indicates, by reference to the measure of site × effective DL MHz per SIO, Telstra and TPG, in the absence of the MOCN, are both materially behind Optus. Telstra and TPG are disadvantaged not only in total sub-6GHz downlink spectrum, but also in the portion that is sub-3GHz and the portion that is sub-1GHz, which is particularly important in low population-density areas. The MOCN, combining Telstra's spectrum and TPG's spectrum, is closer to Optus by this measure, although still behind Optus.

## 1.2 Approach

We run the network dimensioing model for the following networks in the 17% Regional Coverage Zone:

- Telstra's network as a stand-alone operator (in the case of no MOCN agreement)
- The MOCN network, carrying the traffic of both Telstra and TPG
- Optus's network.

Telstra has provided detailed data on the sites and traffic of its network. For Optus's network we rely on publicly available data, including the ACMA[8] and ACCC[9] site databases, and estimates of market share and traffic. To estimate the market shares in the 17% Regional Coverage Zone, and hence the traffic on Optus's network, we rely on data from **[Confidential to Telstra]** [redacted] in the 17% Regional Coverage Zone within each state and territory.

The distribution of traffic across the Optus sites is estimated by assuming that the relative traffic level on Optus sites within the 17% Regional Coverage Zone in each state and territory is similar to the relative traffic level on the nearest Telstra site to each Optus site.

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[8] ACMA Offline RRL, provided by Telstra (Exhibit_A10) retrieved from https://web.acma.gov.au/offline-rrl/

[9] ACCC Mobile Infrastructure Report – data release; retrieved from https://data.gov.au/dataset/ds-dga-4b472a18-d0fa-409c-994a-ab17162bcb90/details?q=ACCC

Using the site information, estimated market share and traffic for each network we run a network dimensioning model that calculates the required spectrum band usage and the number of new capacity sites that are required to carry the projected traffic over the modelled 5-year period. By running the model for traffic projections based on various growth rates for data usage per SIO, we determine the annual growth rate in data usage per SIO that each network can sustain without having to build more than 70, 140 or 210 cell sites per annum for capacity.

For each of the traffic projections that we run, the model calculates not only the new sites required but also the bands and equipment that are required to be deployed to carry the traffic.

## 1.3 Results

In Figure 1-3 we indicate the maximum annual compound growth rate of data usage per SIO that each of the modelled networks could sustain over the five-year period based on the three constraints on capacity sites that we have used: 70 sites per annum, 140 sites per annum and 210 sites per annum.

We use 140 sites per annum as a base indicator **[Confidential to Telstra]** [redacted] We use 70 (50% of the base) and 210 (150% of base) to illustrate the sensitivity of the results to the selected site build limit.

**Figure 1-3: Maximum growth in data usage per SIO in the five-year modelled period**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | | |
|---|---|---|---|
| **Operator** | 70 sites pa | 140 sites pa | 210 sites pa |
| **MOCN** | 24.5% | 29.5% | 33.5% |
| **Optus** (Constant 25.5% market share) | 29.5% | 34.5% | 38.5% |
| **Telstra** | 18.5% | 23.5% | 28.0% |

Over the period of the model, Telstra as a stand-alone network would not be able to sustain the 26% compound annual growth rate in usage per SIO that has been observed nationwide between the quarter ending June 2019 and the quarter ending June 2021, unless undertaking site build rates above its historic average rates.

However, the MOCN would be able to sustain a growth rate as high as 29.5% per annum within an average build rate of 140 capacity sites per annum and 24.5% per annum within a build limit of 70 capacity sites per annum.

Our model indicates that Optus's network is slightly superior to the MOCN in this regard, as one might expect due to its slightly superior sites × effective downlink spectrum per SIO. Our model results indicate that Optus could sustain a growth rate of 34.5% for a site build of 140 capacity sites per annum in the 17% Regional Coverage Zone, or 29.5% for 70 capacity sites per annum.

In Figure 1-4, below, we provide an additional case, where Optus is assumed to increase its market share from 25.5% to 35% in the 17% Regional Coverage Zone over the five-year period modelled. The model results suggest that even with this market share increase, Optus is able to sustain a compound annual growth of 28.5% in data usage per SIO for 140 capacity sites per annum, or 24.0% for 70 capacity sites per annum, putting it on an almost equal footing with the MOCN, despite growing its market share.

[redacted]

**Figure 1-4: Maximum growth in data usage per SIO in the five-year modelled period**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | | |
|---|---|---|---|
| **Scenario** | 70 sites pa | 140 sites pa | 210 sites pa |
| **Optus** (constant 25.5% market share) | 29.5% | 34.5% | 38.5% |
| **Optus** (market share increases to 35.0% by 2028) | 24.0% | 28.5% | 32.0% |

[redacted]

# 2. Introduction

Telstra Corporation Limited (Telstra) and TPG Telecom Limited (TPG) have entered into a series of interrelated agreements that together constitute a proposed transaction that provides for a Multi-Operator Core Network (MOCN) commercial arrangement, pursuant to which Telstra will supply TPG with MOCN 4G and 5G services within a defined coverage area across regional and fringe urban areas. The defined coverage area covers 17.4% of the Australian population over an area of approximately 1.5 million square km (the 17% Regional Coverage Zone).

Aetha Consulting Limited ('Aetha') has been retained by Telstra's solicitors, Gilbert + Tobin, as an independent expert in relation to a proposed application to the Australian Competition and Consumer Commission (ACCC) for merger authorisation under section 88(5) of the Competition and Consumer Act 2010 (CCA).

The ACCC has received a submission from Optus[10] in response to the Authorisation Application (the Optus Submission) together with a report from Analysys Mason[11]. Gilbert + Tobin's Letter of Instruction to Aetha refers to two claims in the Optus response:

(a) "The level of spectrum asymmetry will grant Telstra material network quality and cost advantages which cannot be matched by Optus, or any other potential new entrant network" (para 5.25)
(b) "An abundance of spectrum, particularly low band, improves the cost efficiencies of network deployment while access to a disproportionate amount of mid band spectrum means that Telstra is able to out perform any competition on a capacity basis without the need to invest in expensive spectral efficiency technology" (para 5.27)

Aetha has been instructed to assess the claims made in the Optus Submission regarding the potential impact of the proposed transaction on the relative network capacity of Optus and the MOCN in the 17% Regional Coverage Zone.

In order to consider whether Telstra, with the MOCN, is able to out-perform any competition on a capacity basis, we have considered the quantity of spectrum available to each of Telstra, Optus, TPG and the proposed Telstra – TPG MOCN in the 17% Regional Coverage Zone. We consider the spectrum in three categories: sub-6 GHz spectrum, sub-3GHz spectrum and sub-1GHz spectrum. In addition, we consider the spectrum in the context of the number of sites and subscribers of each network in the 17% Regional Coverage Zone.

To further assess any capacity advantage resulting from the MOCN, Aetha has prepared a network dimensioning model of the Radio Access Networks (RANs) of each mobile network operator in the 17% Regional Coverage Zone. The models can be used to analyse the RANs of the planned Telstra-TPG MOCN and Optus in the 17% Regional Coverage Zone, together with the stand-alone RAN of Telstra that would persist in the absence of the proposed transaction.

The network dimensioning model forecasts the deployment of capacity using additional spectrum bands at existing cell sites and using additional cell sites (capacity sites) that would be required for each of the networks to carry a growing level of traffic in the area covered by the MOCN over the first five-year period of operation of the MOCN (financial year ending 30 June 2024 to year financial year ending 30 June 2028). The model is used to estimate the level of annual growth in data usage per SIO over the five-year period that each of the networks could sustain within certain limits of cell site construction in

[10] Optus, 'Submission in response to ACCC market inquiry – Telstra and TPG application for merger authorisation for proposed spectrum sharing in regional Australia', June 2022

[11] Analysys Mason, 'The ACCC's consideration of the Telstra -TPG Agreement', 27 June 2022

the 17% Regional Coverage Zone, e.g. the growth in data usage per SIO that could be delivered by each network without exceeding an average build rate of 140 sites per year.

The results of the modelling provide a comparison of each network's capability to deliver services under growing volumes of data traffic, which would result from increasing usage per SIO, an increasing number of SIOs in the 17% Regional Coverage Zone or a combination of those two factors, and increased market share on the part of a particular operator. Of these factors we would expect increasing data usage per SIO to be the strongest, being an established trend in Australia and in mobile networks around the world.

In particular, the results of the modelling provide an indication of the ability of Optus to deliver the same growth in traffic per SIO as the proposed Telstra-TPG MOCN in the area covered by the MOCN.

This report has been prepared by Andrew Wright (Partner) and Lee Sanders (Managing Partner) with the support of consultants and business analysts at Aetha.

**Andrew Wright** (Partner) has over 25 years' experience advising operators, regulators and government bodies on telecoms strategy and spectrum. He has supported network operators in spectrum auctions and other spectrum transactions including EE (UK), eir (Ireland), Sprint (USA), WIND Hellas (Greece), Orange (Spain, Slovakia), T-STAR (Taiwan) Swisscom, Mobily (Saudi Arabia). In addition, Andrew has advised on network sharing ventures in Europe, Asia and Africa for Vodafone, Orange, Telenor and MTN. Andrew has also advised extensively on network and spectrum synergies in M&A transactions, including the merger of Sprint and T-Mobile in the USA. Recently he advised Ooredoo and C K Hutchison on the synergies that could be obtained through the merger of Indosat Ooredoo and Three Indonesia, a successful merger of two mobile operators in Indonesia.

**Lee Sanders** (Managing Partner) has over 20 years' experience of advising operators and regulators across a broad range of topics including spectrum issues. He has also supported Telstra to prepare for six spectrum auctions in recent years: the 700MHz/2.5GHz auction (2013), the 1800MHz Regional auction (2016), the Residual Lot auction (2017), the 3.6GHz auction (2018), the 26GHz auction (2021) and the 850/900MHz auction (2021). He has also supported numerous other operators to value spectrum and prepare for auctions including: Orange (Austria, Moldova, Romania, Switzerland), KPN (Belgium, Germany, Netherlands), eircom (Ireland), Play (Poland), ice (Norway), Telenor (Hungary), Three (UK), WIND Canada, and WIND Hellas (Greece). In addition, Lee developed a network sharing business plan for two national network operators in the UK.

We have read, complied with and agree to be bound by the requirements for expert reports set out in the Federal Court's Expert Evidence Practice Note (GPN-EXPT) (Practice Note) and the Harmonised Expert Witness Code of Conduct. We have attached a declaration of compliance with the Code at Annex D.

We understand that we are not an advocate, and this report is an objective and impartial assessment from Aetha's specialised knowledge in the telecommunications industry.

## 2.1 Background

Australia has a competitive market for mobile telecommunications consisting of three national mobile operators; Telstra, Optus and TPG. In addition to the three network operators there are a number of mobile virtual network operators (MVNOs) that are hosted on the networks of Telstra, Optus and TPG.

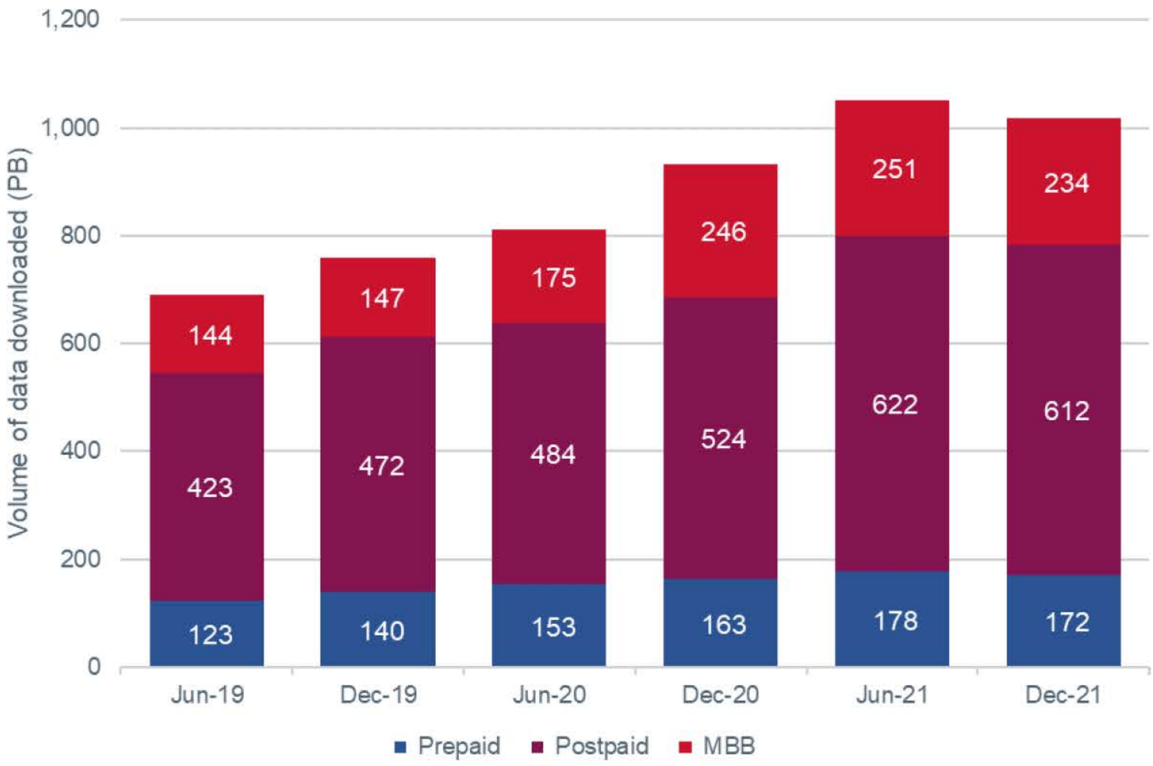
The market and the networks have followed a development path similar to that followed in most mobile telecommunications markets, with a succession of new network technologies being deployed and new spectrum bands being licensed as the networks have been transformed from voice networks to data networks delivering high speed internet connectivity.

## Mobile traffic growth

The SIO base predominantly uses 4G and 5G terminals, although 3G technology is still present in each of the three networks on the 850MHz or 900MHz band. Network usage and network operator revenue is dominated by data traffic, with voice traffic being small by comparison. Because 3G sunset for Telstra[12] is expected to be completed by June 2024 we assume the spectrum will be available for 4G and 5G.

According to the ACCC Internet Activity Report[13], total mobile data traffic on the Australian networks grew at 19.7% from the quarter ending 30 June 2019 to the quarter ending 30 June 2020 and this growth rate increased to 31.7% for the quarter ending 30 June 2021, compared to the quarter ending 30 June 2020, a CAGR of 25.6% over a two-year period. The growth in traffic per quarter and usage per SIO are shown in Figure 2-1 and Figure 2-2 below, respectively.

**Figure 2-1: Volume of data downloaded for mobile services in the period Jun 2019 – Dec 2021 (3 months' data) [Source: ACCC Internet Activity Reports]**

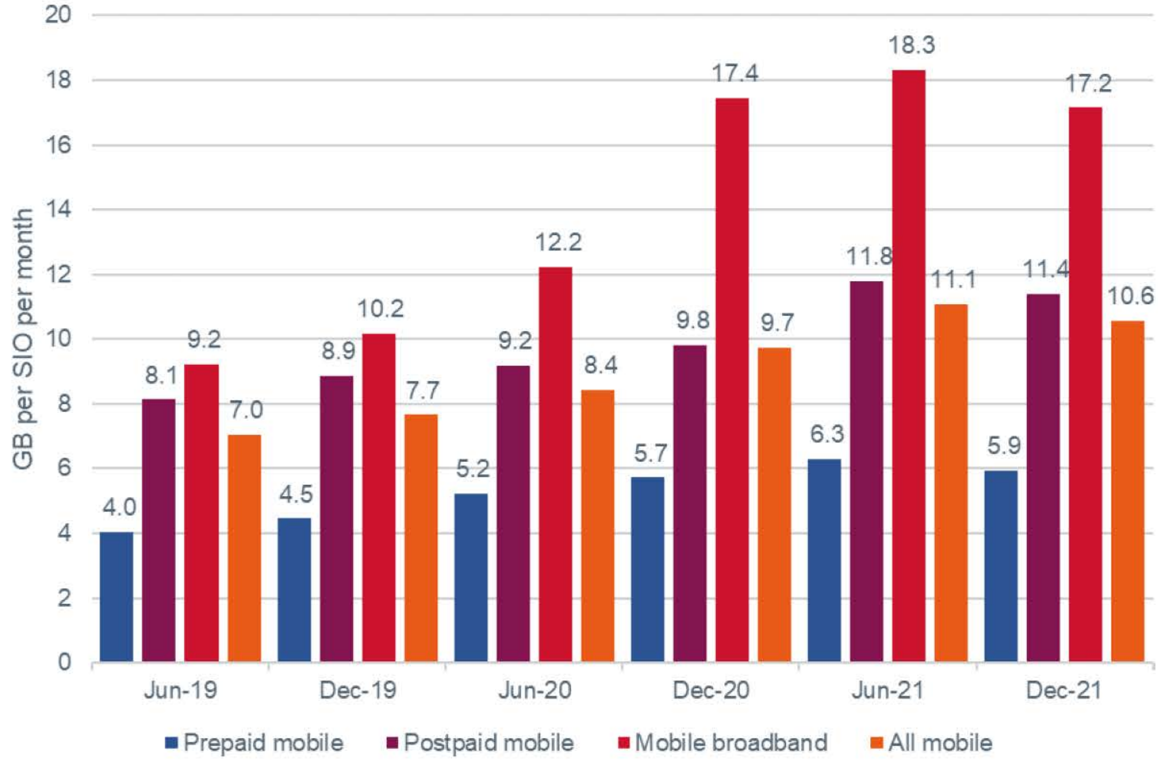



12 Neither Optus or TPG has announced a 3G closure date – based on its 900MHz holdings Optus could reasonably continue to offer 3G using 900MHz throughout the period modelled while still having 2 x 20MHz of 900MHz spectrum available for 4G/5G.

13 Accessible at https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/internet-activity-record-keeping-rule-rkr/june-2021-report

[redacted]

**Figure 2-2: Average data usage per SIO across period [Source: ACCC Internet Activity Reports]**




The level of data usage per SIO and the growth in traffic reported in Australia are not atypical of the usage levels and growth rates reported in other countries. The move to faster 5G networks, combined with improved terminals and the evolving application eco-system is stimulating increasing levels of data traffic per user in most markets. In Aetha's experience, mobile operators around the world are planning for continued growth in data usage per subscriber, supported by the further deployment of 5G technology, re-farming of spectrum from 3G and using greater quantities of spectrum.

### Spectrum awards

In December 2021, the ACMA concluded an auction of 2×10MHz of spectrum in the 850MHz expansion band' and 2×25MHz in the 900MHz band. Telstra acquired the 850MHz spectrum, whilst Optus acquired the 900MHz spectrum. The licences awarded in this auction are not due to commence until 1 July 2024. The 850MHz spectrum will be newly available for mobile broadband services and will complement the existing 2×20MHz already awarded to Telstra/TPG in the band. The 900MHz spectrum is currently licenced to Telstra (2×8.4MHz), Optus (2×8.3MHz) and TPG (2×8.3MHz). These licences will cease when the new 900MHz licences commence.

Because the MOCN will run for a minimum of 10 years, in our modelling exercise, throughout the modelling period (FY24 to FY28), we have assumed that the MNOs' holdings in the 850MHz and 900MHz band are as of 1 July 2024 – i.e. post the commencement of the new licences. Given that this change of spectrum holdings is known in advance, we expect that in the period from July 2023 to June 2024, the MNOs network investment behaviour to be primarily based on the new holdings (i.e. from 1 July 2024) rather than the expiring holdings.

Although we understand that the ACMA is currently conducting a consultation exercise on the release of a significant amount of additional spectrum for mobile broadband in the 3.4GHz and 3.7GHz bands, we have modelled the networks with their existing spectrum holdings in these bands. Assuming that

[redacted]

there are additional awards in the 3.4GHz and 3.7GHz bands, the operators will have the opportunity to improve their capability to serve growing data usage per SIO, beyond the projections presented in this report, by purchasing additional spectrum. However, in Section 5.2.2 we also illustrate the impact of additional 3.7GHz spectrum on the traffic growth rate that could be achieved.

### Active network sharing and MOCNs

Forms of network sharing (in which RAN infrastructure and/or equipment is shared) have been used as a means of reducing the cost of mobile networks over approximately the last 20 years. Active network sharing, where base station equipment is shared, was initially extensively used to reduce the high capital cost of rolling-out 3G networks using 2100MHz spectrum. Active sharing arrangements for 3G roll-out were entered into in many countries, including Australia.

Network sharing can take several forms with three common methods being referred to as:

- **Passive sharing** – where the tower is shared but the radio base station equipment is not shared
- **Multi-operator RAN (MORAN)** – a type of active sharing where the radio base station (or Node B in the terminology of UMTS/3G networks) is shared, but spectrum is not shared – each operator's traffic is carried in its own licensed spectrum.
- **Multi-Operator Core Network (MOCN)** – a type of active sharing where a single RAN connects to the core network of each sharing operator. The key difference between this and MORAN is that it uses the same radios and spectrum to carry the traffic of each sharing operator – the spectrum is pooled. This form of sharing was used in Australia between Telstra and Hutchison between 2004 and 2010 and was subsequently used in several European markets for the roll-out of 4G networks, enabling two operators to share both spectrum and the associated RAN costs.

The RAN of the proposed Telstra-TPG MOCN will be based primarily on Telstra's sites, it will only include up to 169 TPG sites from within the 17% Regional Coverage Zone the rest will be decommissioned. However, the Telstra-TPG MOCN will use spectrum from both network operators. As part of the proposed transaction, TPG will authorise Telstra to use certain spectrum pooled with Telstra's own spectrum to serve traffic in the 17% Regional Coverage Zone. In addition, Telstra will be authorized to use certain spectrum beyond the 17% Regional Coverage Zone, being areas beyond the first 98.8% of the population when ranked by population density. The initial term of the MOCN agreement is 10 years.

## 2.2 Objectives of this report

In this report we investigate the ability of the networks in the MOCN region to serve growing traffic over the first five years of operation of the MOCN. Traffic growth is expected to result primarily from increasing data usage per SIO, but can also occur as a result of increasing SIOs in the 17% Regional Coverage Zone or, for a particular network operator, by increasing market share in the 17% Regional Coverage Zone.

We consider the traffic growth that could be served by Telstra and TPG in combination by use of the MOCN, which will effectively serve the traffic of both operators from a single pool of capacity.

[redacted]

We also consider the traffic growth that could be served by the following networks in the 17% Regional Coverage Zone:

- Optus (at a constant 25.5% market share),
- Optus (growing to 35.0% market share by the end of FYE28),
- a stand-alone Telstra network which carries only Telstra's traffic using only Telstra's spectrum (i.e., Telstra's network in the case of no MOCN arrangement).

Based on the modelling undertaken we draw conclusions on the relative ability of the Telstra-TPG MOCN, Optus, and stand-alone Telstra to sustain certain levels of traffic growth within certain limits of site construction.

## 2.3 Structure of this report

The remainder of this report is structured as follows:

- **Section 3** describes our understanding of the current networks of Telstra and Optus in the 17% Regional Coverage Zone; their cell sites, spectrum and traffic distribution
- **Section 4** describes the methodology and the assumptions of the modelling that we have undertaken
- **Section 5** describes the results and conclusions of our modelling.

Further details on the modelling that we have undertaken is include in Annex A, and an index of data sources is provided in Annex B

# 3. The networks in the 17% Regional Coverage Zone

In this section we discuss the overall characteristics of the mobile operator networks in the 17% Regional Coverage Zone. In the sections below we discuss:

- The area covered by the proposed MOCN
- The spectrum licensed to each network operator in the 17% Regional Coverage Zone
- The network sites within the 17% Regional Coverage Zone.

## 3.1 The scope of the proposed MOCN

The proposed MOCN is defined in terms of its geographic scope and the spectrum that is included within the MOCN.

### 3.1.1 The area covered by the MOCN

We understand the 17% Regional Coverage Zone, to be the area which covers population between the first 81.4% of the population and the first 98.8% of population when ranked by population density.

The MOCN agreement covers a specified list of 11 615 Statistical Areas Level 1 (SA1s) in their entirety and in addition partial coverage of a further 664 SA1s, referred to as boundary SA1s in the MOCN agreement, which contain 370 Telstra sites (285 macro sites and 85 microcells).

For the purposes of our modelling work we take the 17% Coverage Zone to be the area defined by a list of SA1 areas and the coverage of a list of Telstra cell sites within a further 664 SA1s (Boundary SA1s) as defined in Annexure A and Annexure B to Schedule 3 of the MOCN Service Agreement.

For the MOCN network, and the stand-alone Telstra network, we base our modelling on a list of Telstra macro sites that will be included in the MOCN. For our model of Optus we include all of the Optus sites in the ACMA RRL site database[22] that are within the 17% Regional Coverage Zone.

Figure 3-1, below, indicates the full SA1s covered in the MOCN agreement in green and the 370 listed boundary sites (macro sites in red, micro in yellow).

[redacted]

**Figure 3-1: Visual representation of the SA1s and boundary sites that constitute the 17% Regional Coverage Zone (shaded areas are full SA1s, not network coverage) [Confidential to the Parties]**

[redacted]

The population in the SA1s listed in the MOCN agreement is 4 324 000 – approximately 18.5% of nationwide population (23 348 000) as of the 2016 census, and the area is 1 383 000sq km. We use the full population of these areas when calculating per SIO usages, as opposed to the 17.4% of the population Telstra estimates the MOCN will cover.

### 3.1.2 The mobile operator spectrum assignments in the 17% Regional Coverage Zone

The MOCN agreement covers the following spectrum bands:

- 700MHz FDD (band n28) – with the exception of 2×5MHz of TPG spectrum
- 850MHz FDD (band n26) – with the exception of 2×10MHz of Telstra spectrum
- 1800MHz FDD (band n3) spectrum of Telstra, but not that of TPG
- 2100MHz FDD (band n1)
- 2600MHz FDD (band n7)
- 3600MHz TDD (band n78).

In some spectrum licensing regions, the operators have some additional spectrum which is not included in the MOCN agreement. Of the 2×25MHz of 850MHz FDD spectrum that Telstra will be licensed for by FYE23, only 2×15MHz is included in the MOCN agreement. However, the Telstra spectrum that is not included in the MOCN agreement[14] is available to carry Telstra traffic at the same Telstra cell sites as the spectrum included in the MOCN agreement, so for the purpose of our model we have included it.

Of the 2×15MHz of 700MHz FDD spectrum which TPG is licensed to use, only 2×10MHz is included in the MOCN agreement. As the remaining 2×5MHz of this spectrum is not in the MOCN agreement it will not be in use at the Telstra cell sites and is therefore not included in our model of the MOCN capacity.

[14] Furthermore, we understand that the MOCN Agreement provides that the parties may agree to add this Telstra spectrum to the spectrum pool.

[redacted]

Similarly, we do not include in our analysis the 1800MHz spectrum belonging to TPG, which is not included in the MOCN and will therefore not be available for use at the MOCN sites. Furthermore, both Telstra and TPG have individually licensed 26GHz spectrum which is not included in the MOCN. We have excluded this spectrum from our model because it is not typically used at macro sites in low density areas due to its limited range.

The bandwidth of the spectrum assignments of Telstra and TPG in each band varies by licence area within the 17% Regional Coverage Zone. Figure 3-2, below, shows the lowest, highest, and average effective downlink bandwidth of each spectrum band assigned to Telstra and TPG and included in the MOCN in the area covered by the MOCN. The quantity of spectrum presented in Figure 3-2, referred to as effective downlink spectrum, is the downlink spectrum for the FDD bands and 75% of the total spectrum for the TDD bands. This is because, based on the frame configuration in use in the networks, the TDD spectrum is dedicated 75% of the time to downlink and 25% of the time to uplink.

A useful measure of the amount of spectrum available at the cell site locations is the site-weighted average effective downlink spectrum [15]. The site-weighted average is an appropriate measure to use to compare the holdings of the different networks in the 17% Regional Coverage Zone. In total the MOCN has 218.3 site-weighted effective downlink MHz.

**Figure 3-2: Effective downlink spectrum of Telstra and TPG that is included in the MOCN agreement within MOCN region [Source: Exhibit_A15, Exhibit_A11, Exhibit_A2]**

| | Lowest BW (eff. DL MHz) | Highest BW (eff. DL MHz) | Average BW (eff DL MHz, site-weighted) |
|---|---|---|---|
| 700MHz | 30.0 | 30.0 | 30.0 |
| 850MHz[16] | 30.0 | 30.0 | 30.0 |
| 900MHz[16] | 0.0 | 0.0 | 0.0 |
| 1800MHz | 15.0 | 40.0 | 33.8 |
| 2100MHz | 15.0 | 40.0 | 17.7 |
| 2300MHz | 0.0 | 0.0 | 0.0 |
| 2600MHz | 40.0 | 40.0 | 40.0 |
| 3.4GHz[17] | 0.0 (0.0) | 24.4 (32.5) | 2.5 (3.4) |
| 3.6GHz[17] | 0.0 (0.0) | 93.8 (125.0) | 64.2 (85.6) |
| Total effective DL MHz | - | - | **218.3** |

Optus has spectrum assignments in the area covered by the MOCN which are described in Figure 3-3, below. In total, Optus has 106.1 site-weighted effective downlink MHz.

[15] The site weighted average effective downlink spectrum is calculated by summing the total effective downlink spectrum available at each site in the 17% Regional Coverage Zone and dividing by the number of sites in the 17% Regional Coverage Zone.

[16] Holdings as of 01 July 2024

[17] 75% of bandwidth is indicated as the effective DL amount for TDD bands, value shown in brackets is the full bandwidth

**Figure 3-3: Effective downlink spectrum of Optus within MOCN region [Source: Exhibit_A15, Exhibit_A10]**

| | Lowest BW (eff. DL MHz) | Highest BW (eff. DL MHz) | Average BW (eff DL MHz, site-weighted) |
|---|---|---|---|
| **700MHz** | 10.0 | 10.0 | 10.0 |
| **850MHz**[18] | 0.0 | 0.0 | 0.0 |
| **900MHz**[18] | 20.0 | 20.0 | 20.0 |
| **1800MHz** | 15.0 | 25.0 | 22.0 |
| **2100MHz** | 5.0 | 20.0 | 6.9 |
| **2300MHz** | 0.0 | 73.5 (98.0) | 3.6 (4.9) |
| **2600MHz** | 20.0 | 20.0 | 20.0 |
| **3.4GHz**[19] | 0.0 (0.0) | 54.0 (72.0) | 2.6 (3.5) |
| **3.6GHz**[19] | 0.0 (0.0) | 26.3 (35.0) | 20.9 (27.9) |
| Total effective DL MHz | - | - | **106.1** |

Telstra as a stand-alone network has 170.9 site-weighted downlink MHz, as shown in Figure 3-4.

**Figure 3-4: Effective downlink spectrum of Telstra within MOCN region [Source: Exhibit_A15, Exhibit_A11]**

| | Lowest BW (eff. DL MHz) | Highest BW (eff. DL MHz) | Average BW (eff DL MHz, site-weighted) |
|---|---|---|---|
| **700MHz** | 20.0 | 20.0 | 20.0 |
| **850MHz[18]** | 20.0 | 25.0 | 24.7 |
| **900MHz[18]** | 0.0 | 0.0 | 0.0 |
| **1800MHz** | 15.0 | 40.0 | 33.8 |
| **2100MHz** | 10.0 | 30.0 | 10.8 |
| **2300MHz** | 0.0 | 0.0 | 0.0 |
| **2600MHz** | 40.0 | 40.0 | 40.0 |
| **3.4GHz[19]** | 0.0 (0.0) | 24.4 (32.5) | 2.5 (3.4) |
| **3.6GHz[19]** | 0.0 (0.0) | 60.0 (80.0) | 39.1 (52.1) |
| Total effective DL MHz | - | - | **170.9** |

TPG as a stand-alone network has 68.0 site-weighted DL MHz, as shown in Figure 3-5.

[18] Holdings as of 01 July 2024. Optus will have a holding of 25MHz of 900MHz spectrum from July 2024, but we have included only 20MHz because we understand the 5MHz of the spectrum is impaired pending the downshift of the adjacent 850MHz band.

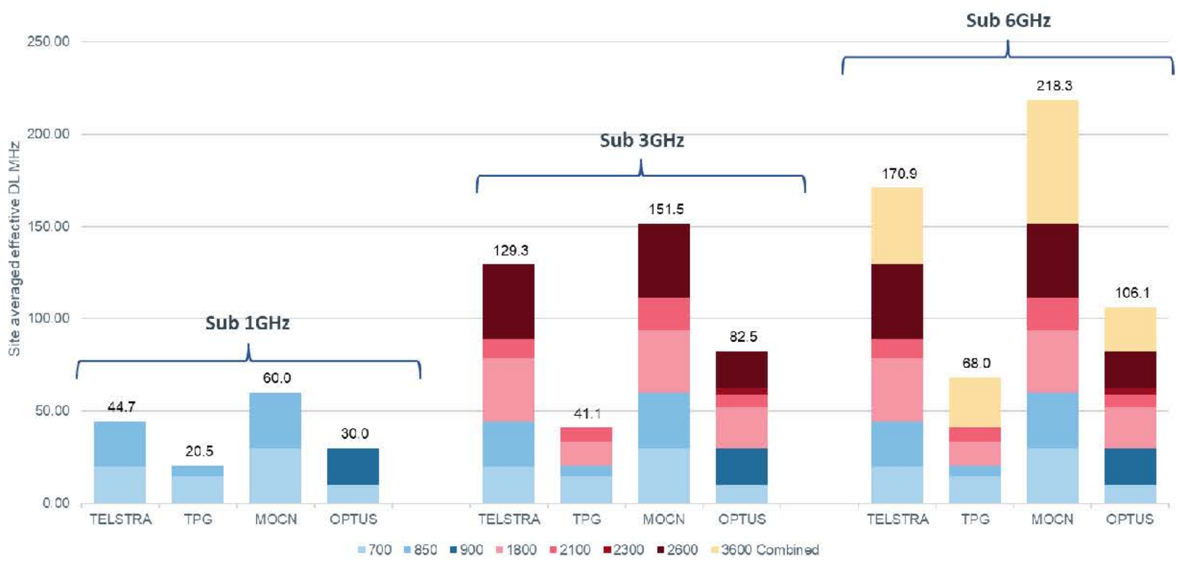
[19] 75% of bandwidth is indicated as the effective DL amount for TDD bands, value shown in brackets is the full bandwidth

**Figure 3-5: Effective downlink spectrum of TPG within MOCN region [Source: Exhibit_A15, Exhibit_A10]**

| | Lowest BW (eff. DL MHz) | Highest BW (eff. DL MHz) | Average BW (eff DL MHz, site-weighted) |
|---|---|---|---|
| 700MHz | 15.0 | 15.0 | 15.0 |
| 850MHz[20] | 5.0 | 10.0 | 5.5 |
| 900MHz[20] | 0.0 | 0.0 | 0.0 |
| 1800MHz | 0.0 | 30.0 | 13.3 |
| 2100MHz | 5.0 | 25.0 | 7.4 |
| 2300MHz | 0.0 | 0.0 | 0.0 |
| 2600MHz | 0.0 | 0.0 | 0.0 |
| 3.4GHz[21] | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) |
| 3.6GHz[21] | 0.0 (0.0) | 71.3 (95.0) | 26.9 (35.9) |
| Total effective DL MHz | - | - | **68.0** |

Figure 3-6, below, is a chart of the site-weighted average effective downlink holdings of each operator, divided into sub-1GHz spectrum, sub-3 GHz spectrum and overall sub-6 GHz spectrum.

**Figure 3-6: Site-weighted average effective downlink spectrum by operator / MOCN (MHz) [Source: Exhibit_A10, Exhibit_A11, Exhibit_A15**




[20] Holdings as of 01 July 2024

[21] 75% of bandwidth is indicated as the effective DL amount for TDD bands, value shown in brackets is the full bandwidth

[redacted]

In terms of effective downlink MHz, Telstra has the highest bandwidth of the three operators, and Telstra and TPG in combination as the MOCN have a higher quantity.

Although the total quantity of spectrum is an important determinant of a network's ability to serve traffic because the capacity of each cell site scales with the spectrum bandwidth available, it is also important to consider the spectrum bandwidth in relation to the number of SIOs because the demand for capacity scales with the number of SIOs. Figure 3-7 shows the amount of spectrum for each operator, and the MOCN, in terms of site-weighted average effective downlink MHz per million SIOs, where the number of SIOs has been estimated based on the population of the 17% Regional Coverage Zone, the expected penetration and estimated market share of each network operator.

**Figure 3-7: Site-weighted average effective download spectrum per million SIO by operator [Sources: Exhibit_A15; Exhibit_A10, Exhibit_A6, Exhibit_A7]**

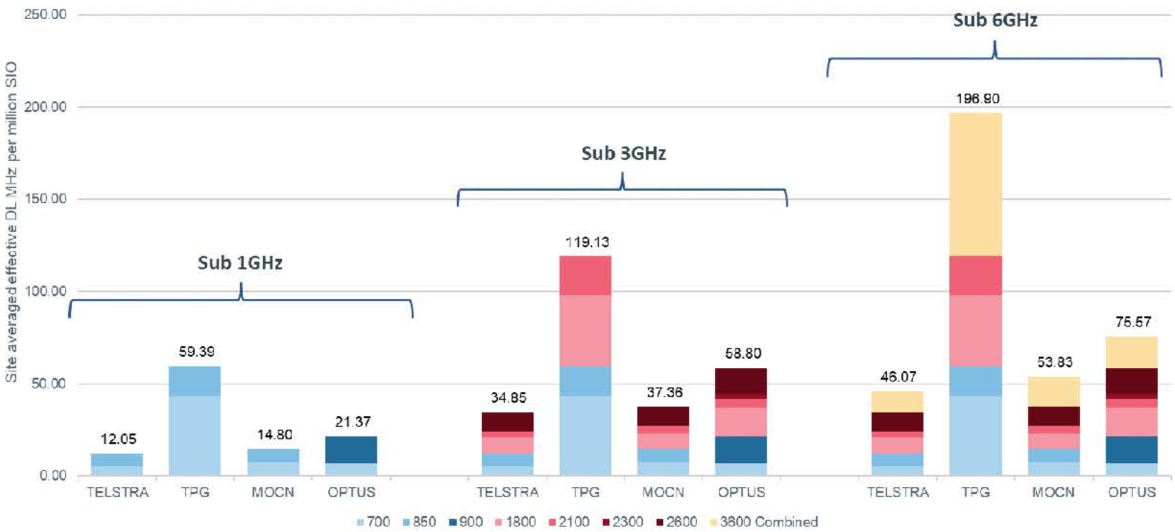



Figure 3-7 shows that, relative to the size of its SIO base, Optus has a greater amount of spectrum than Telstra, and TPG has a greater amount still. This is not only the case when considering total mobile spectrum below 6 GHz but is also true when considering only that part of the spectrum below 3GHz, or only that part of the spectrum below 1 GHz.

As can be seen in Figure 3-7, combining Telstra's spectrum and TPG's spectrum in the MOCN is an improvement compared to Telstra on a stand-alone basis. However, the MOCN remains inferior to Optus on this measure when considering total mobile spectrum below 6 GHz, and when considering only spectrum below 3 GHz and only spectrum below 1 GHz.

## 3.2 The network sites in the 17% Regional Coverage Zone

In Figure 3-8, below, we list the current mobile sites that each of the mobile operators has within the 17% Regional Coverage Zone, based on what we believe to be the most up-to-date publicly available source, the ACMA RRL database[22]. In the case of the Telstra network, we also have data that Telstra has supplied to Aetha which includes all sites up to April 2022. The data supplied by Telstra includes a small number of additional sites compared to the ACMA RRL database.

[22] ACMA Offline RRL, provided by Telstra (Exhibit_A10) retrieved from https://web.acma.gov.au/offline-rrl/

[redacted]

**Figure 3-8: Network sites in the 17% Regional Coverage Zone based on the ACMA database and for Telstra, based on a site database provided by Telstra [Sources: Telstra provided documents: Exhibit_A14, Exhibit_A10, & Exhibit_A14] [Confidential to Telstra]**

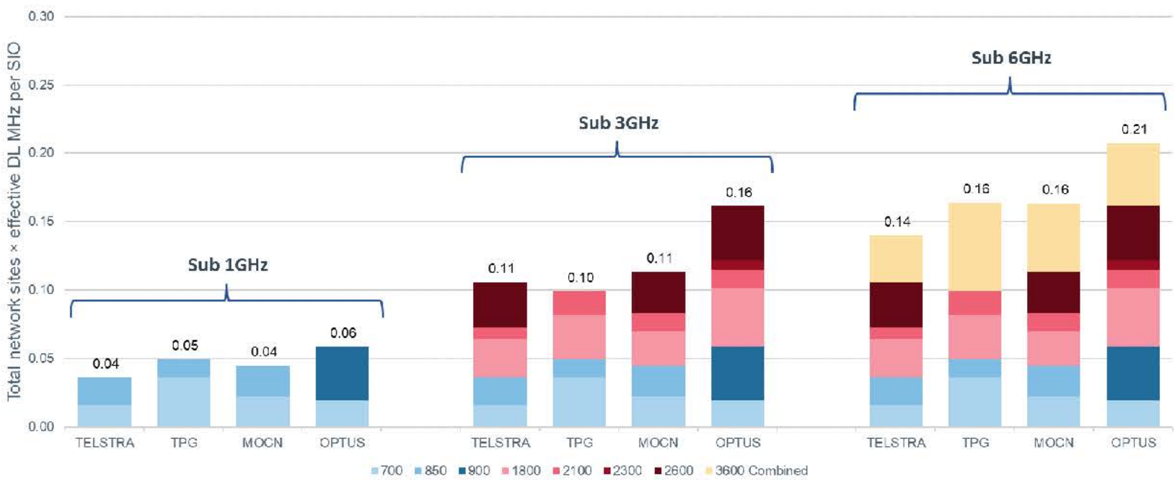
| | 17% Regional Coverage Zone | | | Total network | | |
|---|---|---|---|---|---|---|
| | Macro | Micro | Total | Macro | Micro | **Total** |
| **Telstra (internal)** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Telstra (ACMA)[22] | n/a | n/a | 3855 | n/a | n/a | 11 524 |
| **Optus**[22] | n/a | n/a | 2743 | n/a | n/a | 10 718 |
| **TPG**[22] | n/a | n/a | 834 | n/a | n/a | 7767 |

The MOCN includes [redacted][23] current sites on the Telstra network – [redacted] of which are macro sites and the other [redacted] are microcells, which have less scope for expansion than the macro sites.

Figure 3-9, below, provides a further indicator of a network's ability to deliver capacity to SIOs; the product of sites and average effective DL spectrum per macro site, divided by the number of SIOs (site DL MHz per SIO). This measure is a useful proxy for potential capacity per SIO, given a particular assignment of spectrum and a particular portfolio of sites.

In total Optus has 0.21 sites × effective DL MHz per SIO, significantly above Telstra and TPG which have 0.14 and 0.16, respectively. The MOCN, which combines the spectrum of TPG and Telstra, but uses almost entirely the sites of Telstra, has a value closer to Optus than Telstra, at 0.16 sites × effective DL MHz-sites per SIO. When only sub-3GHz spectrum, or only sub-1GHz spectrum, is considered the situation remains the same; Optus is superior to the MOCN, which is superior to Telstra.

**Figure 3-9: Site effective DL MHz per SIO by operator within the 17% Regional Coverage Zone [Sources: Exhibit_A15; Exhibit_A10, Exhibit_A6, Exhibit_A7]]**




23 The list of MOCN sites provided by Telstra is Exhibit A_11.

[redacted]

In the Optus Submission (para 5.47), a similar analysis is presented based on spectrum per site per SIO (kHz/Site/SIO) using total spectrum rather than effective downlink spectrum as used in Figure 3-9. In Optus's analysis, Telstra + TPG has an advantage over Optus considering all spectrum and also considering low band (below 1GHz) only and mid band (above 1 GHz) only.

We have attempted to reproduce Optus's analysis and compared it to our own. Figure 3-10 below shows our understanding of how Optus calculated its kHz × sites/SIO values, and our re-calculation of the same values using figures consistent with the tables that we present above, but expressed as total MHz rather than effective downlink MHz.

**Figure 3-10: Reconstruction of Optus's calculation of kHz × sites/SIO and Aetha's equivalent calculation [Confidential to Parties]**

| Parameters relating to MOCN (or Telstra + TPG) | | | | |
|---|---|---|---|---|
| **Paramater** | **Optus's value for (Telstra + TPG)** | **Values derived from Optus's Figure 9 and Figure 10** | **Aetha value (MOCN site average)** | **Comment** |
| a) Low band spectrum (MHz) | 120 | 120 | 120 | Uplink +downlink. Optus includes all low band that Telstra will have access to. Aetha effectively does the same by including the 2x10MHz of Telstra 850MHz spectrum that is not included in the MOCN because it remains part of the pool of spectrum available to serve customers at MOCN sites.<br>The 120MHz of total sub-1GHz spectrum is equivalent to the 60MHz of sub 1GHz spectrum indicated for the MOCN in Figure 1-1 and Figure 3-6 of this report. |
| b) Mid band spectrum (MHz) | 350 | 280 -332.5 (inc. TPG 1800MHz)<br>260 - 312.5 (excl. TPG 1800MHz) | 272 | There are several differences:<br>- Aetha's figure is calculated by averaging over the MOCN macro sites, which span different holdings for FDD as well as TDD<br>- Aetha has not included the TPG 1800MHz spectrum because this is not included in the MOCN<br><br>However, these two differences alone do not explain the full gap between the Aetha figure and the Optus figure of 350MHz, which appears to be inconsistant with the ranges that Optus presents in Figure 10. |
| c) Total spectrum (MHz) | 470 | 400 - 452.5 (inc. TPG 1800MHz)<br>380 - 432.5 (excl. TPG 1800MHz) | 392 | We are unable to replicate Optus's figure of 470MHz, even if we include TPG's 1800MHz, which is not included in the MOCN agreement. Figure of 392MHz is equivalent to the effective DL 218.3MHz in Figure 3-2. |
| d) Total sites / Macro sites | [redacted] | [redacted] | [redacted] | [redacted] |
| e) SIO's | [redacted] | [redacted] | [redacted] | Aetha SIOs estimated based market share estimated with Ookla data. |

| Parameters relating to Optus | | | | |
|---|---|---|---|---|
| **Paramater** | **Optus's value** | **Values derived from Optus's Figure 9 and Figure 10** | **Aetha value** | **Comment** |
| a) Low band spectrum (MHz) | 70 | 60 | 60 | Aetha excludes the 2 x 5 MHz that is impaired until downshift, as does Optus's Figure 9, we understand. |
| b) Mid band spectrum (MHz) | 150 | 130-135 | 134 | We do not obeserve 150MHz in Optus's Table 10 . Table 10 suggests 130-135 in the regional area, Aetha's value of 125.5 is the average across sites, based on the holdings at the location of the sites. |
| c) Total spectrum (MHz) | 220 | 190-195 | 194 | 194MHz is equivalent to the effective DL 106.1MHz in Figure 3-3. |
| d) Total sites / Macro sites | 2274 | 2274 | 2743 | Aetha is using sites in the ACMA RRL database that are in the SA1s that define the MOCN or within a km of boundary sites included in the MOCN. |
| e) SIO's | [redacted] | [redacted] | [redacted] | Aetha SIOs estimated based market share estimated with Ookla data. |

| Calculations of kHz x sites/SIO (c x 1000 x d)/e | | | | |
|---|---|---|---|---|
| Telstra + TPG / MOCN | 457 | 390-440 (inc. TPG 1800MHz)<br>370-421 (excl. TPG 1800MHz) | 293 | |
| Optus | 336 | 290-297 | 379 | |
| Optus (Adjusting Aetha figure for Optus sites and SIOs) | | | 296 | Uses Aetha spectrum figure, Optus values for sites and SIOs |

As indicated in Figure 3-10, we are able to reproduce Optus's stated kHz × sites/SIO based on the spectrum quantity stated for Telstra + TPG and Optus in Figure 14 of the Optus Submission, but we calculate a lower quantity of spectrum at the average MOCN site (392MHz) than Optus states (470 MHz). Part of the difference is that Optus has included the TPG 1800MHz spectrum which we have excluded because it is not included in the MOCN agreement. However, this does not explain the entire difference.

We have also calculated the range of Telstra + TPG spectrum implied by the quantities of spectrum presented for regional holdings in Optus's Figure 9 and Figure 10. Our value for the MOCN spectrum

[redacted]

(392MHz), based on a calculation of the average spectrum available at MOCN macro sites, is within the range implied by Optus's Figure 9 and Figure 10 if the TPG 1800MHz spectrum is excluded, as expected. Optus's stated 470MHz is above the range suggested by Figure 9 and Figure 10, even if the TPG 1800MHz spectrum is included.

Based on our calculation Optus has a higher value of kHz × sites/SIO than the MOCN, as it does for the equivalent calculation in terms of effective downlink spectrum presented in Figure 3-9.

Our calculation is based on our understanding of the number of macro sites on each of the networks in the MOCN area. We used the Optus site numbers from the ACMA RRL database, which included more sites than the ACCC RKR database. We checked the ACMA RRL Optus site locations against a list of Optus small cells provided by Telstra and found no close matches, suggesting that the Optus sites in the ACMA RRL database were all macro sites.

Optus uses a higher figure for Telstra sites and a lower figure for Optus sites. We have calculated the kHz × sites/SIO for Optus using our understanding of the spectrum, but using Optus's number for sites (2274) and SIOs (1,491,018). On this basis Optus has 296 kHz × sites/SIO, comparable to the MOCN figure of 293 that we calculate.

## 3.3 The current network operator traffic in the 17% Regional Coverage Zone

In order to build a model of the mobile operator networks in the 17% Regional Coverage Zone, it is necessary to start with actual or estimated network traffic in the area. For Telstra's network we have detailed information on traffic by cell site in the 17% Regional Coverage Zone. For TPG and Optus we make estimates of the current traffic levels in the 17% Regional Coverage Zone using market share estimates based on **[Confidential to Telstra]** [redacted] provided by Telstra[24].

A summary of the Telstra traffic on the network in the 17% Regional Coverage Zone is provided in Figure 3-11, below.

[24] **[Confidential to Telstra]** [redacted]

**Figure 3-11: Telstra's network traffic on macro sites (first 28 days of Mar 2022) [Sources: Telstra provided documents: Exhibit_A10, Exhibit_A11; ACMA & ABS population data: Exhibit_A6 and Exhibit_A7] [Confidential to Telstra]**

| | SIOs (est.) | | Traffic on MOCN sites | |
|---|---|---|---|---|
| | Total | Telstra | TB per day | GB/SIO/month |
| **MOCN-wide** | 5 499 000 | [redacted] | [redacted] | [redacted] |
| **NSW** | 1 784 000 | [redacted] | [redacted] | [redacted] |
| **VIC** | 1 066 000 | [redacted] | [redacted] | [redacted] |
| **QLD** | 1 066 000 | [redacted] | [redacted] | [redacted] |
| **WA** | 483 000 | [redacted] | [redacted] | [redacted] |
| **SA** | 480 000 | [redacted] | [redacted] | [redacted] |
| **TAS** | 316 000 | [redacted] | [redacted] | [redacted] |
| **NT** | 80 000 | [redacted] | [redacted] | [redacted] |

In the remainder of this report, we describe our approach to modelling each of the networks under differing levels of traffic growth.

# 4. Approach

In this section we discuss the modelling approach used to calculate the rate of traffic growth that each of the networks could sustain.

## 4.1 Principles for forecasting networks

Our modelling approach is to calculate the sites and equipment that will be required for each network in the 17% Regional Coverage Zone for a range of traffic growth rates over the period from FYE23 to FYE28, which covers the first five financial years of the MOCN's operation. We use the results of our modelling to determine the rate of growth in data per SIO that each of the networks could reasonably support over that five-year period given current (as of 1 July 2024) spectrum assignments, together with the current and expected future performance of network technology, subject to a constraint on the number of new cell sites per annum that are constructed over the period.

Although, in principle, the same modelling approach could be used to consider a longer period, we would expect the availability of additional spectrum[25] to significantly enhance the capabilities of all

[25] We anticipate that further spectrum will become available for mobile use in due course. For example, the ACMA 'Five-year spectrum outlook 2021-26' discusses the 600 MHz band, stating that 'Like the original 700 MHz digital dividend, mobile broadband is a likely candidate if 600 MHz spectrum is freed-up for reallocation.'(page 26). The 600MHz band is also addressed in the Media Reform Green Paper published in December 2020. In May 2022 ACMA undertook a consultation on the 1.5GHz band (https://www.acma.gov.au/consultations/2022-05/review-15-ghz-band-consultation-162022) which has been assigned to mobile network operators in some international markets, and could similarly be made available to mobile network operators in Australia. Internationally there are further spectrum bands being allocated to mobile use, or considered for allocation to mobile use, and it is likely that some of these bands will also be considered in Australia.

[redacted]

networks in the medium- to long-term. Furthermore, improvements in network technology might be expected to improve network performance in the long-term to an extent that cannot currently be forecasted[26]. We therefore limit our modelling to the first five years of the MOCN, a period over which the networks might be required to handle traffic growth using the existing spectrum assignments described in Section 3 of this report and currently available technology.

We run the model for the following networks in the 17% Regional Coverage Zone:

- Telstra's network as a stand-alone operator (in the case of no MOCN agreement)
- The MOCN network, carrying the traffic of both Telstra and TPG
- Optus's network.

For Telstra and the MOCN, the model includes the Telstra macro sites that will be included in the MOCN, whereas for the Optus network we include all sites in the 17% Regional Coverage Zone.

### 4.1.1 Model inputs

We use a single model which can be adjusted to represent each of the three networks being modelled by changing the input assumptions, including the existing site numbers, the bands in use at those sites, the traffic level, and the spectrum available at each site.

Some of the information required to run the model is available from public domain sources. For example, databases of sites are available from the ACMA and the ACCC. In the case of Telstra's network, we have been provided with detailed information that helps us to configure the model, including:

- Detailed traffic data by cell
- A list of sites that will be included in the implementation of the MOCN
- For each site, the current configuration (i.e. spectrum bands and equipment type in use).

Because of the data made available by Telstra, we are able to model Telstra's network and the network of the MOCN with the same level of accuracy as the models that we build for internal operator use.

Two important inputs to the model are:

- The spectral efficiency (in bps/Hz) that can be achieved by each combination of spectrum band and technology. This parameter is used to indicate the busy hour throughput (in Mbps) that can be provided by each DL spectrum band (in MHz)[27].

- The sector traffic coverage of each frequency band (expressed as % of sector). Sub-1GHz spectrum provides the largest coverage and therefore defines the edge of the coverage provided by each cell site. Each of the higher frequency bands (e.g. 2100MHz) can cover a certain proportion of the traffic, being the traffic closest to the cell site. The traffic closest to the cell site can be carried by any band whereas the traffic furthest away from the cell site must be carried on a sub-1GHz band. Therefore, depending on the relative capacity available on different bands, the site could be limited by its total

[26] Mobile network technology has benefited from continuous innovation which has improved the capability of networks over time. As an example, the massive MIMO technology that is now widely deployed in 5G networks was only proposed as a theoretical concept in 2010 and its performance in real networks has only become widely understood in the last 5 to 8 years. As 5G technology matures and the industry looks to develop new technologies for 6G we believe it is reasonable to expect further innovations to emerge which are not currently widely known, or which have not yet been invented.

[27] See Section 4.3.3, Figure 4-10

[redacted]

spectrum (i.e. total capacity) or by a subset of spectrum (for example, the sub-1GHz spectrum alone or the combination of sub-1GHz, 1800MHz and 2100MHz together)[28].

### 4.1.2 Estimating model inputs for Optus and TPG

To understand the Optus and TPG sites in the 17% Regional Coverage Zone we have made use of both the ACMA RRL site database[22] and the ACCC site database[29] which provide both site locations and information on the current spectrum bands in use at those sites.

### 4.1.3 Model traffic

Telstra has provided data on traffic for each cell, and hence each site in the 17% Regional Coverage Zone. We therefore have good information on the overall level of traffic on Telstra's network in the 17% Regional Coverage Zone and on the distribution of traffic across sites. Telstra's traffic data also provides us with data on the relationship between busy hour traffic (which we use to dimension the network) and the overall traffic in a month. In addition, Telstra's traffic data tells us the proportion of traffic that is carried on the busiest sector of each site, which is also required for network dimensioning.

When modelling Telstra's network, the traffic per site is projected based on an overall traffic growth and the known distribution of traffic across sites that are included in the MOCN. The overall traffic growth is arrived at by assuming a growth rate in traffic per SIO (i.e. GB/month/SIO) and the growth in SIOs which simply results from an estimate of population growth and penetration in the 17% Regional Coverage Zone.

#### Estimating traffic levels on Optus's network and TPG's network

We do not have data on the traffic or SIOs of Optus and TPG in the 17% Regional Coverage Zone and so for the purpose of this modelling exercise we have estimated that traffic using Telstra's traffic and two sources of market share estimates that Telstra has provided to Aetha. These are:

- **[Confidential to Telstra]** [redacted]
- **[Confidential to Telstra]** [redacted]

In Figure 4-1, below, we present an overview of the market share that is implied by **[Confidential to Telstra]** [redacted] in the 17% Regional Coverage Zone in each state and territory.

[28] See Section 4.3.4, Figure 4-11

[29] Accessible at https://data.gov.au/dataset/ds-dga-4b472a18-d0fa-409c-994a-ab17162bcb90/details?q=ACCC

[redacted]

**Figure 4-1: Market shares implied [Confidential to Telstra] [redacted]] [Source: Exhibit_A12]**

| | Telstra | | Optus | | TPG | |
|---|---|---|---|---|---|---|
| | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| MOCN-wide | 67.5% | 59.9% | 25.5% | 29.0% | 6.3% | 6.4% |
| NSW | 65.0% | 54.3% | 27.5% | 31.8% | 6.7% | 8.3% |
| VIC | 66.1% | 62.3% | 26.1% | 29.3% | 7.1% | 4.6% |
| QLD | 68.3% | 58.9% | 26.3% | 30.3% | 4.7% | 6.6% |
| WA | 75.3% | 72.1% | 17.5% | 18.5% | 6.4% | 5.1% |
| SA | 63.2% | 62.6% | 28.7% | 27.0% | 7.6% | 5.3% |
| TAS | 75.1% | 63.8% | 19.7% | 18.5% | 4.5% | 5.2% |
| NT | 80.7% | 60.8% | 13.9% | 20.1% | 4.7% | 17.5% |

We believe that the [Confidential to Telstra] [[redacted]

**Figure 4-2: Market shares implied [Confidential to Telstra] [[redacted]] data compared to retail market shares reported by the ACCC [Source: ACCC Communications market report 2020- 21][30]**

| | [redacted] | ACCC |
|---|---|---|
| Telstra | 36.7% | 44.0% |
| Optus | 25.7% | 31.0% |
| TPG | 13.0% | 17.0% |
| MVNOs | 20.2% | 9.0% |
| Unknown | 4.3% | 0.0% |

[30] Accessible at https://www.accc.gov.au/publications/accc-telecommunications-report/accc-communications-market-report-2020-21

[redacted]

**Figure 4-3: Market shares implied by [Confidential to Telstra] [[redacted]] data compared to Telstra's Internet Activity RKR submission for the period ending June 2021 and ACCC Internet activity report for the period ending June 2021[Source: [Confidential to Telstra] [[redacted]], Telstra, ACCC Internet activity report, December 2021[31]]**

| | [redacted] | ACCC Internet Activity Report RKR |
|---|---|---|
| Telstra | 52.0% | 52.2% |

The **[Confidential to Telstra]** [[redacted]] data suggests a national Telstra market share of 52.0% (retail and wholesale combined). By comparing Telstra's Internet activity RKR submission for the period ending 30 June 2021 to the ACCC RKR internet activity data for the same period, taking both wholesale and retail SIOs (prepaid, postpaid and mobile broadband excluding IoT) we calculate that Telstra has an overall market share (retail+wholesale) of 52.2%, which is close to the **[Confidential to Telstra]** [[redacted]] figure. This close agreement between the **[Confidential to Telstra]** [[redacted]] data and the Internet activity RKR data suggests that the **[Confidential to Telstra]**[redacted]] data is a reasonable guide to market share.

We therefore use the state and territory 17% Regional Coverage Zone market shares suggested by the **[Confidential to Telstra]** [redacted] data to estimate the traffic levels on the Optus and TPG networks in the MOCN. Furthermore, we assume similar usage per SIO for Optus and TPG as for Telstra within the 17% Regional Coverage Zone in each state.

### Estimating traffic distribution on Optus's network and TPG's network

Although we have details on the traffic distribution across sites on Telstra's network, shown in Figure 4-4, we do not have similar data on the distribution of traffic on Optus's network. We therefore use the level of traffic on the nearest Telstra site to each Optus site as a guide to the relative traffic level on the Optus sites in the 17% Regional Coverage Zone in each state.

The resultant distribution of traffic across cell sites is shown in Figure 4-5, below. We make similar estimates for TPG's sites, shown in Figure 4-6 and for the MOCN, shown in Figure 4-7.

[31] Internet Activity RKR data June 2021, Table 2

[redacted]

**Figure 4-4: Traffic distribution across sites for Telstra (actual)**

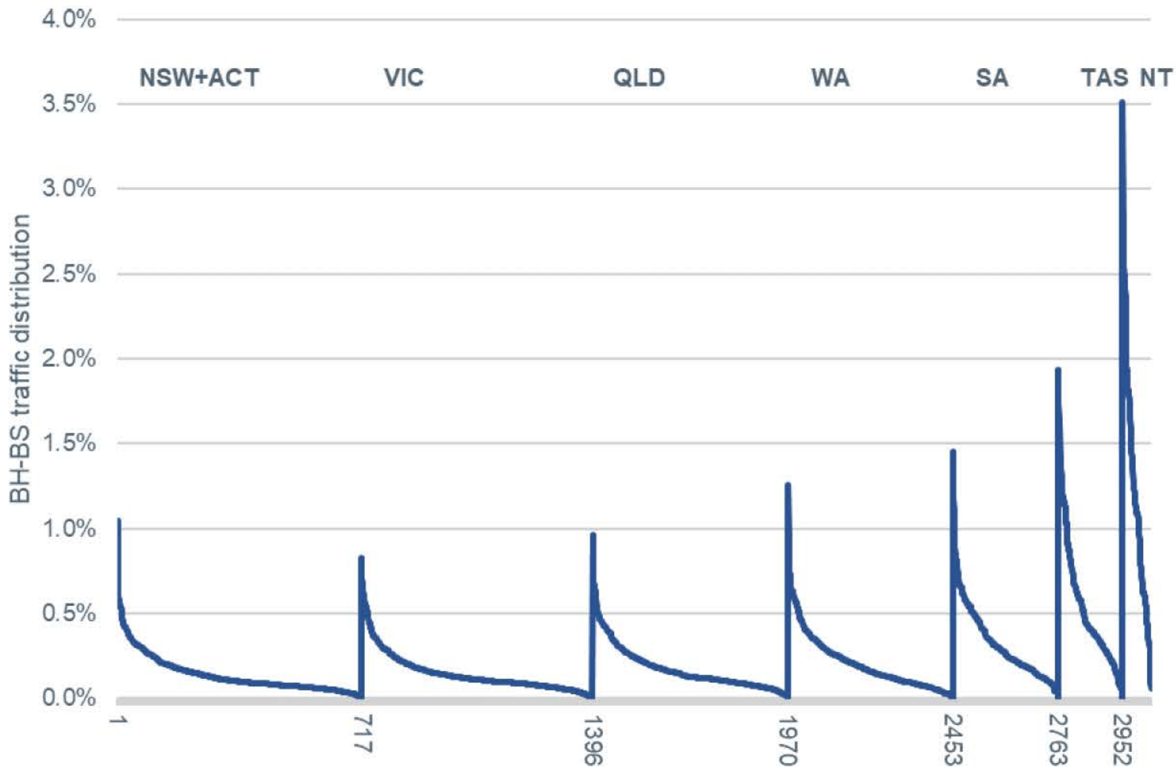
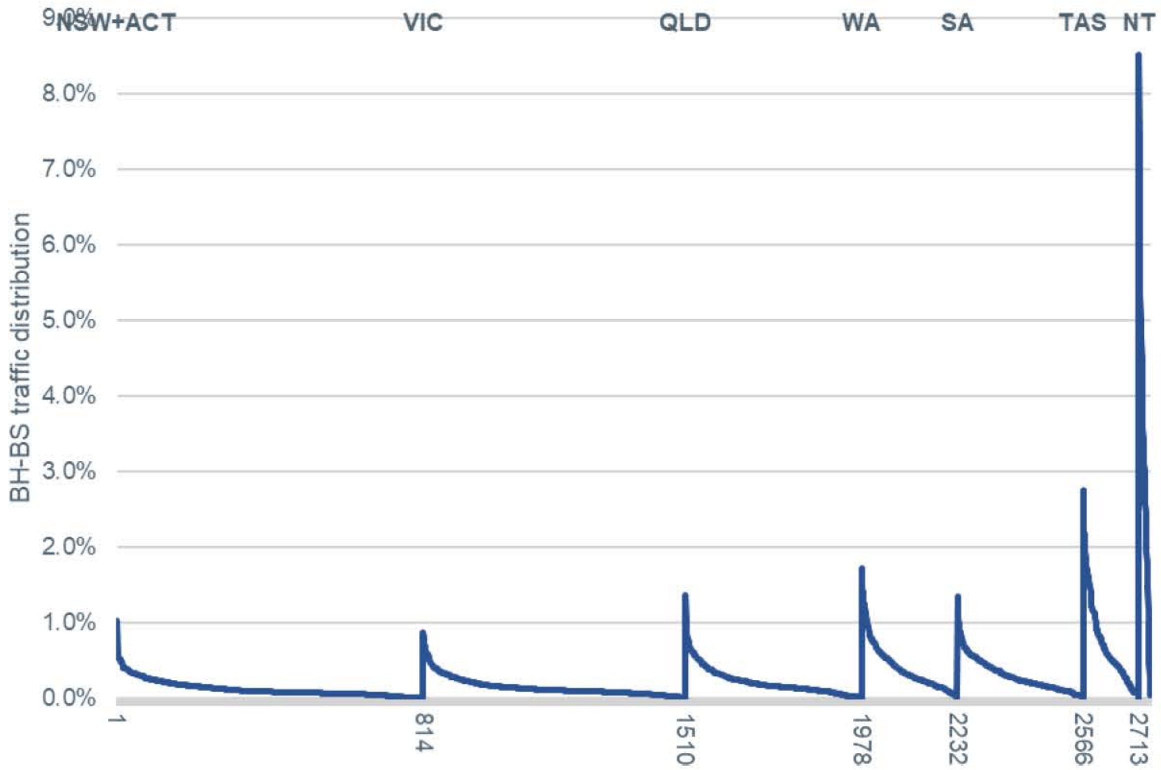



**Figure 4-5: Traffic distribution across sites for Optus (estimated)**




[redacted]

**Figure 4-6: Traffic distribution across sites for TPG (estimated)**

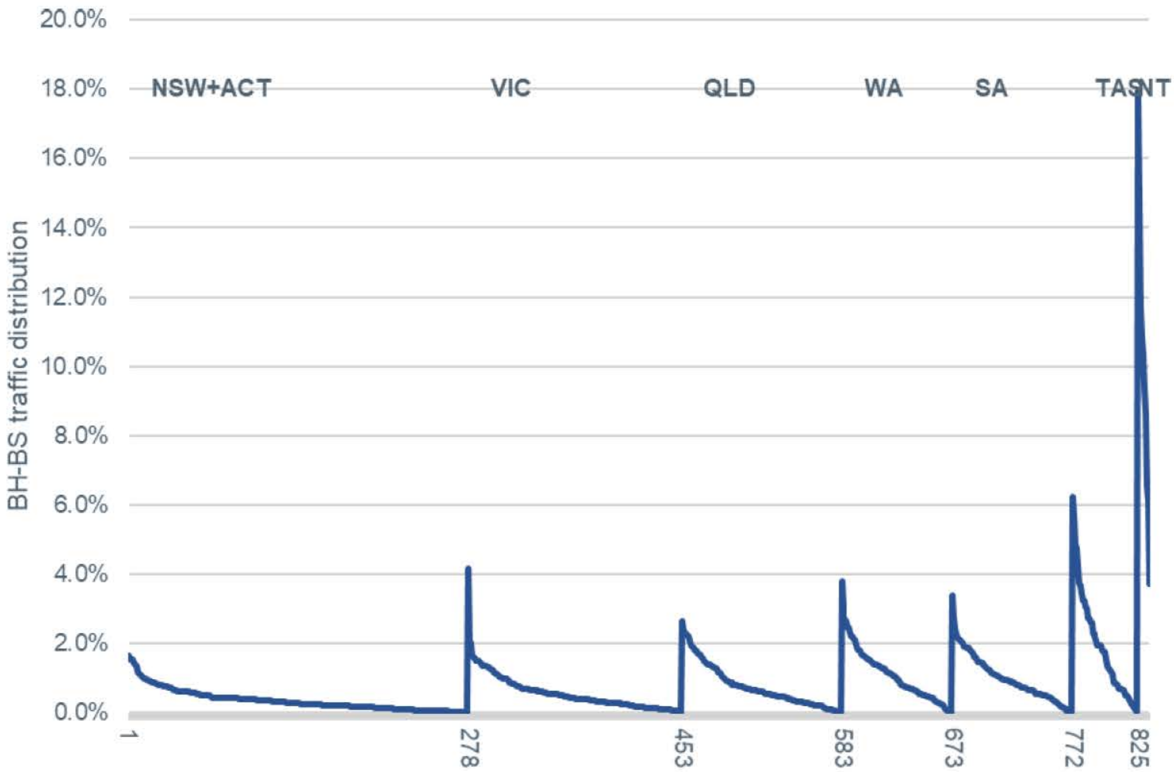
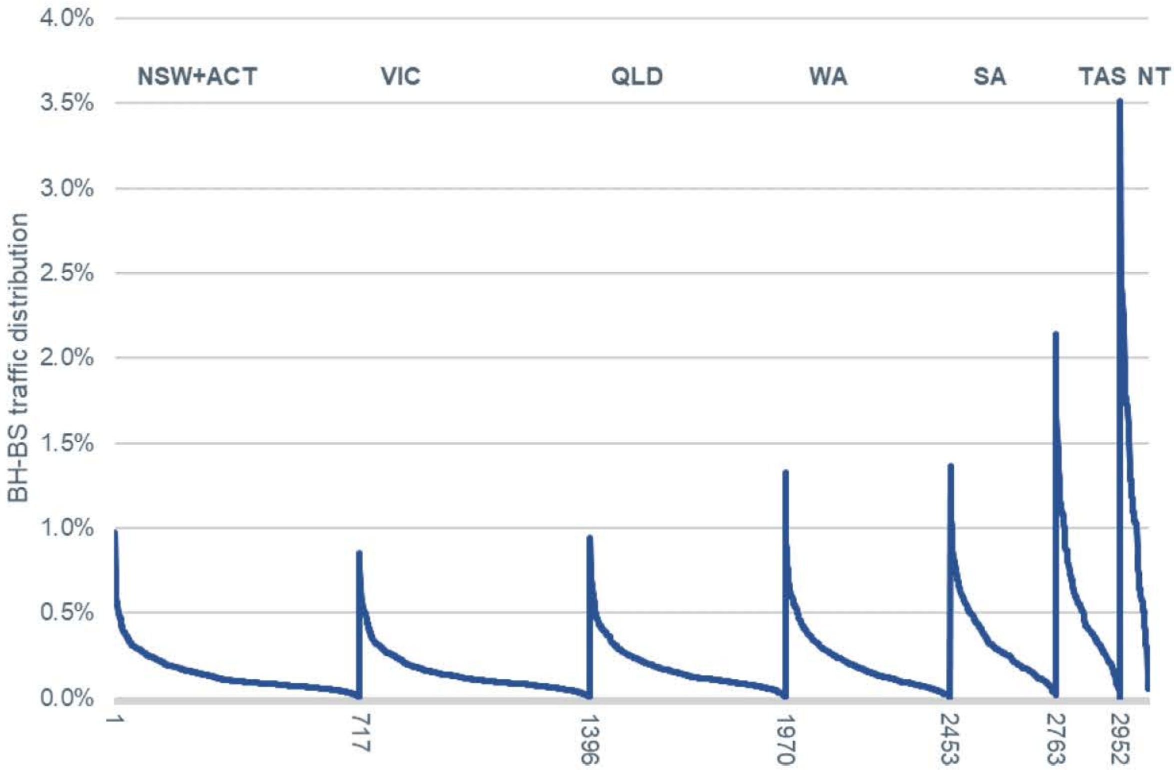



**Figure 4-7: Traffic distribution across sites for MOCN (actual Telstra + TPG estimated)**



## 4.2 Network dimensioning methodology

Our model uses traffic projections, traffic distribution and the location and configuration of exiting cell sites together with a range of technical parameters to calculate for each year of the modelling period, with a certain traffic projection, the number of cell sites required. The model also calculates the bands and equipment that would need to be deployed at those sites.

### 4.2.1 Dimensioning traffic

The model has, as an input, the spectrum that can be used at each site (or group of sites) and the model assumes that those spectrum bands will be used at the site, sufficient to carry the *dimensioning traffic*. For each site, the dimensioning traffic is the traffic in the busy hour in the busy sector. Our model assumes that each cell site is equipped with spectrum bands and associated equipment sufficient to carry the traffic in the *Busy Hour* in the busiest sector of the cell. We discuss the concept of Busy Hour and Busy Sector further in Annex A.

In dimensioning for the traffic in the Busy Hour in the Busy Sector, the model is dimensioning the network to carry all of the demand for traffic, without congestion. In reality, network operators are not always able to upgrade the sites to this level due to practical constraints or budgetary constraints.

### 4.2.2 Grouping of cell sites into categories

Although it is possible to build a model which dimensions each cell site individually, to allow for fast model run times we group sites in up to 300 ‘categories’ in the model. Each category contains sites that are similar in the following respects:

- They have the same spectrum available
- They have a similar level of busy hour busy sector traffic
- They have similar frequency zones.

By categorising the sites in this way, we are able to run multiple scenarios rapidly in the model with no material loss of accuracy by performing dimensioning calculation 300 times (once for each category) rather than several thousand times (once for each cell site).

### 4.2.3 Capacity and spectral efficiency

#### Dimensioning sites for capacity

The model adds capacity to sites by either adding spectrum bands or by upgrading technology. For example, if the 3.6GHz band is available but not used at a site, it could be added to meet a capacity shortfall.

On a site that is not yet fully equipped to use all bands with the highest capacity technology, there are typically several ways to add capacity (e.g. several different bands that could be added and several technology upgrades). We refer to the various ways of adding capacity as ‘network elements’.

One of the network elements available to increase the capacity of a site is the addition of a new site – referred to as a ‘capacity site’. A capacity site is a relatively high-cost upgrade, so the model would only select this if there are no more cost effective upgrades available to provide the required capacity. The model will install all available bands that are capable of meeting the demand for traffic with the highest capacity technology, and only then install a capacity site to expand the capacity beyond the capacity that can be achieved on the existing site. Although, as we will discuss below, sometimes the model will

[redacted]

install a capacity site because of insufficient capacity in sub-1 GHz spectrum, or sub-1GHz spectrum and 1800MHz/2100MHz spectrum in combination.

Installing large numbers of new capacity sites would be both costly and potentially difficult from the perspective of environmental impact. We would therefore expect there to be a limited number of capacity sites built in each network in the 17% Regional Coverage Zone per annum. The number of capacity sites installed serves as a proxy for network investment.

Although there is no single hard limit on the number of capacity sites that could be built, for this exercise we have considered three different limits; 70 sites per annum, 140 sites per annum and 210 sites per annum, over the five-year period modelled. 140 sites per annum is a base indicator **[Confidential to Telstra]** [[redacted]]. We then compare this with a 50% build constraint and a 150% relaxation for sensitivity purposes. We use the model to test what rate of traffic growth each network can deliver within each of those three limits.

Telstra has indicated that it has a standard antenna configuration for the type of region which the 17% Regional Coverage Zone falls under, and therefore the option of upgrading low band technology is restricted to the deployment of a 'Combined LF radio' – this is an upgrade over currently deployed LF spectrum which allows the use of any sub-1GHz frequency the respective operator is licensed to use. We consider the Telstra 2×10MHz of 850MHz not included in the MOCN agreement to be a separate element.

The relationship between various capacity-bearing network elements are inputs to the model (for example, if you deploy the Combined LF radio on a site, you must remove any existing LTE700MHz or legacy 900MHz, or the Combined LF radio must be installed in order to add the 2×10MHz of 850MHz in the case of the MOCN) and the normalised cost of deploying each network element is also an input to the model. The model seeks to install the lowest normalised cost combination of network elements to serve the dimensioning traffic, in each site category.

### Spectral efficiency

The relationship between the available throughput in a cell (measured in Mbps) and the amount of spectrum used (measured in MHz) is dependent on the radio conditions, the distance of the users from the cell site, the technology in use and several other factors. Although the throughput varies according to the specific conditions, it is conventional in network dimensioning to use a spectral efficiency figure (in bps/Hz) which indicates (for a given technology and band) the relationship between the bandwidth of the carrier (in MHz) and the throughput the carrier contributes to the overall sector throughput in the busy hour (in Mbps) that is typically achieved in the network.

For example, if a spectral efficiency of 1.8bps/Hz can typically be achieved on a 4G network using a 2T2R antenna, then by deploying 20MHz downlink carrier, one would expect to add 36Mbps of downlink throughput. Because the throughput will sometimes exceed the level implied by the spectral efficiency, and sometime fall short, the spectral efficiency should be seen as a planning assumption rather than a precise determinant of the throughput.

In the model we use spectral efficiency parameters[32] that are representative of those that we would expect to be achieved in Telstra's network. We use the same spectral efficiencies when modelling the MOCN and Optus. Although the spectral efficiency achieved can vary from one network to another, we expect broadly similar performance in networks in the same area, such as the MOCN and Optus.

[32] See Section 4.3.3, Figure 4-10

[redacted]

### 4.2.4 Frequency zones

Sub-1GHz frequencies have a greater coverage area than higher frequencies, and where they are deployed on a cell site, they usually define the area the cell site can serve. Other, higher-frequency, bands can cover only a proportion of the area covered by the sub-1GHz spectrum.

In addition to dimensioning the network for the required capacity, the model also ensures that the combinations of the bands installed can serve all of the traffic, including the traffic at the cell edge.

To achieve this, we define a parameter that describes the proportion of traffic than can be addressed by each band, or group of bands. In general, we split the bands into low bands (sub-1GHz), lower mid-band (1800MHz to 2100MHz in this instance) upper mid-band (2600MHz), and high-band (3.4 and 3.6GHz) and a frequency zone is defined for each group of bands. The frequency zone is specified in terms of the proportion of traffic the frequency can address; low band can address 100% by definition, higher frequencies can typically address less than 100%.

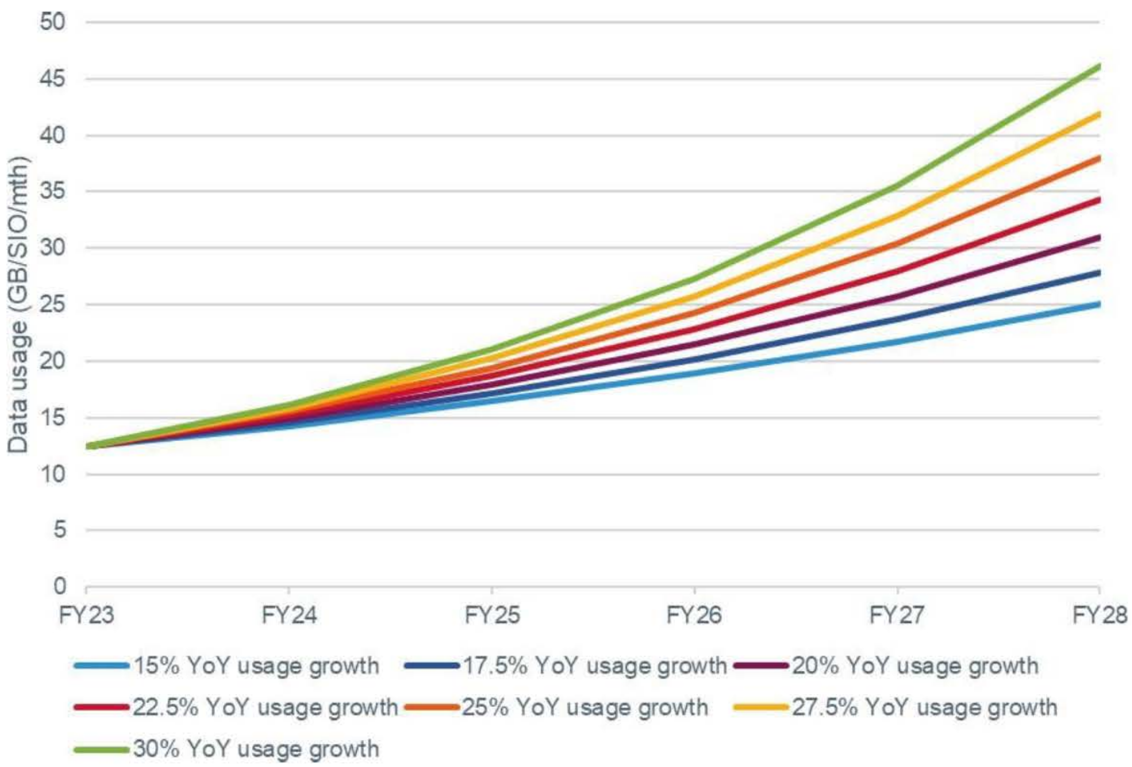
## 4.3 Key assumptions

As discussed in the sections above, the model is based on a range of input data. In this section we summarise the key assumptions used in the model.

### 4.3.1 Data growth rate

We run the model for various data growth rates, corresponding to growth in data usage per SIO of 12.5% to 40.0% in 0.5% intervals. Figure 4-8, below, illustrates the effect of various intermediary growth rates on the traffic per SIO.

**Figure 4-8: Traffic per SIO across the modelling period for a range of growth rates [Source: Aetha]**




[redacted]

### 4.3.2 Number of current cell sites in the 17% Regional Coverage Zone

As shown in Figure 4-9,below, we have used the ACMA site database[33] to determine the site count for Optus and TPG within the 17% Regional Coverage Zone, as we believe it is the most up-to-date publicly available source. In the case of the Telstra network, we also have data that Telstra has supplied which includes all sites up to April 2022. The data supplied by Telstra includes a small number of additional sites compared to the ACMA database.

**Figure 4-9: Number of current cell sites in the 17% Regional Coverage Zone per operator [Source: Telstra provided documents: Exhibit_A10, Exhibit_A11] [Confidential to Telstra]**

| | Number of sites | | |
|---|---|---|---|
| **Area** | Telstra | Optus | TPG |
| **MOCN-wide** | [redacted] | 2743 | 834 |
| **New South Wales** | [redacted] | 813 | 277 |
| **Victoria** | [redacted] | 696 | 175 |
| **Queensland** | [redacted] | 468 | 130 |
| **Western Australia** | [redacted] | 254 | 90 |
| **South Australia** | [redacted] | 334 | 99 |
| **Tasmania** | [redacted] | 147 | 53 |
| **Northern Territories** | [redacted] | 31 | 10 |

Telstra has the greatest number overall, with **[Confidential to Telstra]** [redacted] macro sites. These sites form the base grid to serve network traffic within the 17% Regional Coverage area, and upgrades are applied as detailed in the next section.

### 4.3.3 Network elements and spectral efficiencies

The network elements available at a site depend on the spectrum available and the technology available. An example of the capacity-bearing elements for a typical site in the 17% Regional Coverage Zone would be:

- A new capacity site
- Legacy low-frequency radio
- Combined low-frequency radio (700MHz, 850MHz, 900MHz)
- 850MHz extension radio (if available)
- 1800MHz radio
- 2100MHz radio
- 2600MHz radio
- 3600MHz radio.

For each network element we use a spectral efficiency to calculate the busy hour throughput based on the quantity of spectrum available. The spectral efficiency can vary from sites to site – the figures used in the model and presented in Figure 4-10 are those that we would expect in a low density environment

[33] Accessible at https://web.acma.gov.au/offline-rrl/

such as the 17% Regional Coverage Zone. There is some uncertainty over the spectral efficiency that might be achieved with 3600MHz spectrum using massive MIMO active antennas, so a sensitivity analysis for this spectral efficiency is presented in Section 5.2.3. In our base case we assume 5.00 bps/Hz and in the sensitivity case we use 2.00 bps/Hz.

**Figure 4-10: Spectral efficiencies by frequency / technology [Source: Aetha]**

| | Base technology | Spectral efficiency (bps/Hz) | YoY growth (%) |
|---|---|---|---|
| **LF (700MHz, 850MHz, 900MHz)** | 2T4R | 1.50 | 3.0% |
| **1800MHz** | 4T4R | 2.25 | 3.0% |
| **2100MHz** | 4T4R | 2.25 | 3.0% |
| **2600MHz** | 4T4R | 2.25 | 3.0% |
| **3600MHz** | 64T64R | 5.00[34]<br>2.00 (sensitivity) | 3.0% |

The spectral efficiency, indicated in Figure 4-10, is assumed to gradually improve over time and is represented as a year-on-year percentage improvement. Several factors contribute to a gradual improvement over time in spectral efficiencies, including improvements in terminals, through developments such as a higher proportion of terminals having four receive antennas.

### 4.3.4 Frequency zones used in the model

Data on the proportion of traffic that can be covered by each spectrum band is provided by Telstra for each cell site, based on radio planning tool simulations. Figure 4-11 shows the frequency coverage estimates provided by Telstra for each site on the Telstra network in the 17% Regional Coverage Zone.

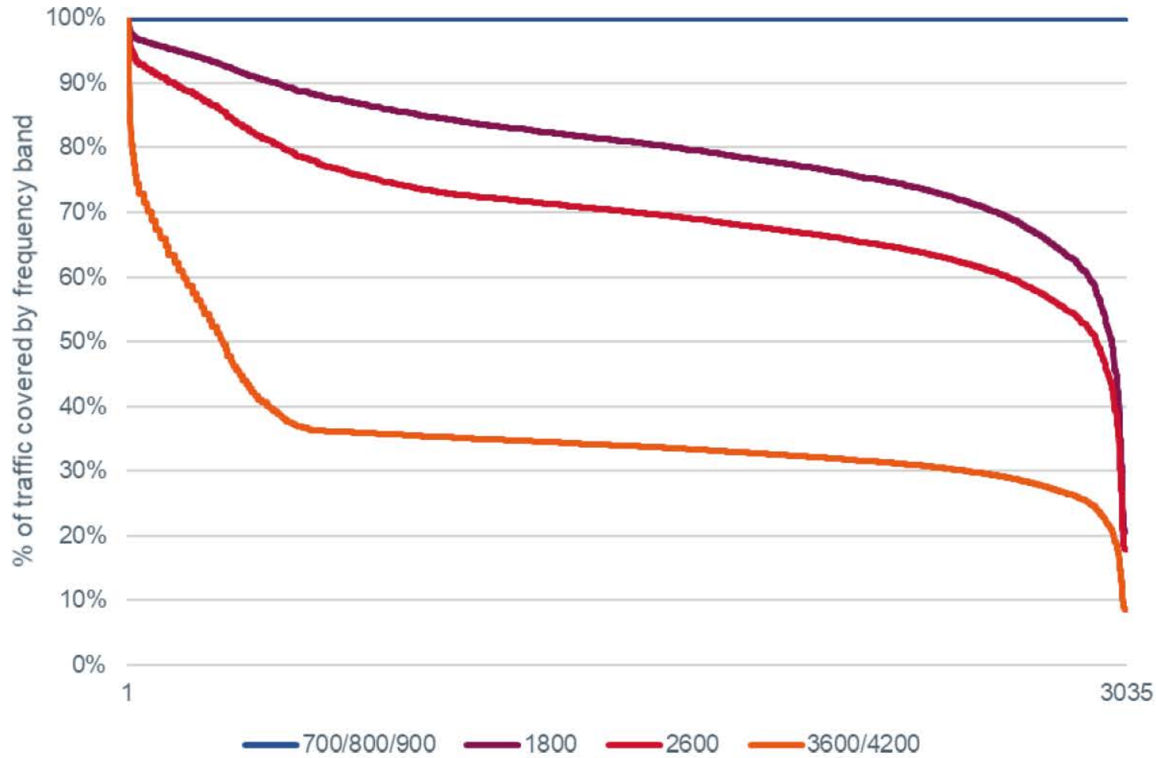
As with spectral efficiency, there is some uncertainty around the coverage performance of 3600MHz with massive MIMO antennas in rural areas. In urban 5G deployments, 3600MHz has been used to provide capacity with a range similar to 1800MHz spectrum, although radio propagation analysis provided by Telstra suggests a lower coverage in the regional areas.

In line with our approach on the spectral efficiency, we assume the performance benefits of mMIMO are achieved in the 17% Regional Coverage Zone, and we therefore assume in our modelling that the coverage of 3600MHz using mMIMO is equivalent to the 1800MHz. However, we also run a sensitivity case in Section 5.2.4, where we use the frequency coverage suggested by Telstra's analysis.

[34] The spectral efficiency performance of 3.5GHz 64T64R mMIMO is expected to be lower in rural areas than in urban areas. Here we take a value of 5.0 bps/Hz, which is approaching the values achieved in urban areas and represents a best case performance in rural areas. However, we also run a sensitivity case in section 5.2.3 where we assume a value of 2.0 bps/Hz, representing a situation whether the 64T64R mMIMO technology is delivering no significant gain in spectral efficiency.

[redacted]

**Figure 4-11: Estimated frequency coverage by cell site on Telstra's network [Source: Telstra: Exhibit_A3][35]**




[35] The 3600MHz curve shown here is based on propagation models and traffic distribution data provided by Telstra. However, in the best case with mMIMO technology, 3600MHz spectrum could be used to provide capacity to a greater proportion of the cell, similar to the performance of 1800MHz spectrum.

[redacted]

# 5. Results

In this section we discuss the results of the modelling exercise. We run the model repeatedly with different growth rates of data usage per SIO to test how much traffic growth each network can serve within the following build constraints:

- 70 capacity sites per annum in the 17% Regional Coverage Zone on average over five years
- 140 capacity sites per annum in the 17% Regional Coverage Zone on average over five years
- 210 capacity sites per annum in the 17% Regional Coverage Zone on average over five years.

We use 140 sites per annum as the base indicator **[Confidential to Telstra]** [[redacted]], and provide the results for 70 (base -50%) and 210 (base +50%) to indicate the level of sensitivity of the results to the limit selected.

In this section we review the overall results of the modelling, in terms of traffic growth rates per SIO that each network can serve, and we then go on to explore some of the detailed results for some individual traffic growth rates per SIO.

## 5.1 Core results

In Figure 5-1 below we indicate the maximum growth rate that each of the modelled networks could sustain in the model period based on the three constraints on capacity sites that we have used; 70 sites per annum, 140 sites per annum and 210 sites per annum.

**Figure 5-1: Maximum growth in data usage per SIO in the five-year modelled period**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | | |
|---|---|---|---|
| **Operator** | 70 | 140 | 210 |
| **MOCN** | 24.5% | 29.5% | 33.5% |
| **Optus** (constant 25.5% market share) | 29.5% | 34.5% | 38.5% |
| **Telstra** | 18.5% | 23.5% | 28.0% |

In Section 2, we observed that nationally the growth in data usage per SIO was 25.6% per annum between the quarter ending June 2019 (7.0GB per SIO) and the quarter ending June 2021 (11.1 GB per SIO). As we can see from Figure 5-1, for a capacity site build of 140 sites per annum in the 17% Regional Coverage Zone, the model results indicate that the MOCN is able to sustain growth in usage per SIO of 29.5% per annum and Optus to be able to sustain a slightly higher growth in data usage per SIO of 34.5%. For a limit of 70 capacity sites per annum the growth rates fall to 24.5% for the MOCN and 29.5% for Optus. For a higher limit of 210 sites per annum the figures increase to 33.5% per annum for the MOCN and 38.5% for Optus.

Based on these results, it would appear that both the MOCN and Optus can deliver broadly similar rates of growth in data usage per SIO to those that have been observed nationally since June 2019. These results are based on existing spectrum, and as we note there is expected to be a further award of spectrum in the time period modelled, so each of the MOCN and Optus would have the opportunity to purchase additional spectrum if they wished to have the capability for higher growth, or to achieve the growth rates discussed above with a lower site build.

In Figure 5-2 and Figure 5-3 below, we show the current configuration, the configuration as of FY23 and final site configuration as of FY28 for both MOCN at 29.5% traffic growth and Optus at 34.5% traffic growth (corresponding to an average capacity site build of 140 sites per annum).

**Figure 5-2: MOCN network build profile for 29.5% traffic growth [Confidential to Telstra]**

| | Network configuration | | |
|---|---|---|---|
| **Element** | Current | FY23 | FY28 |
| **Total sites** | [redacted] | [redacted] | [redacted] |
| **Legacy LF** | [redacted] | [redacted] | [redacted] |
| **Combined LF** | [redacted] | [redacted] | [redacted] |
| **Extra 850MHz** | [redacted] | [redacted] | [redacted] |
| **1800MHz** | [redacted] | [redacted] | [redacted] |
| **2100MHz** | [redacted] | [redacted] | [redacted] |
| **2300MHz** | [redacted] | [redacted] | [redacted] |
| **2600MHz** | [redacted] | [redacted] | [redacted] |
| **3.4 + 3.6GHz** | [redacted] | [redacted] | [redacted] |

**Figure 5-3: Optus network build profile for 34.5% traffic growth**

| | Network configuration | | |
|---|---|---|---|
| **Element** | Current | FY23 | FY28 |
| **Total sites** | 2743 | 2750 | 3408 |
| **Legacy LF** | 2481 | 2414 | 1019 |
| **Combined LF** | 0 | 95 | 1862 |
| **Extra 850MHz** | 0 | 0 | 0 |
| **1800MHz** | 1107 | 1981 | 3332 |
| **2100MHz** | 1269 | 1276 | 1834 |
| **2300MHz** | 0 | 0 | 34 |
| **2600MHz** | 1267 | 1285 | 2063 |
| **3.4 + 3.6GHz** | 14 | 14 | 639 |

In summary, both the MOCN and Optus would appear to be able to serve the traffic growth in the MOCN over the next five years, although if growth rates increased further, beyond 35.0%, they would not be able to do so without a greater rate of site construction than 140 sites per annum. Based on the model results, the two networks have a broadly similar capability to serve growing traffic levels, with Optus having a slight advantage over the MOCN.

[redacted]

These results are not surprising given the metrics presented in Section 3.1 and Section 3.3, which indicated a small advantage for Optus over the MOCN in terms of spectrum per SIO and sites × MHz per SIO.

The results also show that Telstra, as a stand-alone network, would only be able to serve a growth rate of 23.5% for a limit of 140 capacity sites per annum (18.5% for 70 sites per annum, 28.0% for 210 sites per annum).

The results of the modelling suggest that the creation of the MOCN will allow Telstra and TPG to sustain growth rates in the region of 24.0% to 34.0% based on current spectrum holdings and a reasonable level of construction of new capacity sites. The modelling suggests that Telstra would not be able to achieve those growth rates without the MOCN, unless it builds in excess of 140 sites per annum. Optus, on the other hand, thanks to a superior spectrum position relative to its SIO base, would appear to be able to achieve similar growth rates based on its own network and current spectrum holdings with a rate of site build below 140 sites per annum.

## 5.2 Sensitivity analysis

We have also run additional scenarios in the model to understand how sensitive the model is to assumptions used in the model.

- Market share growth: This sensitivity considers a case where Optus's market share increases to 35.0% by FYE28, detailed in Section 5.2.1.
- Additional spectrum: This sensitivity assumes an award 40MHz of 3.7GHz spectrum to the modelled operator, in addition to its current 3.4GHz and 3.6GHz holdings. This sensitivity is included to illustrate the potential impact of the upcoming 3.7GHz award, detailed in Section 5.2.2.
- High-frequency spectral efficiency: The spectral efficiency assumption for 3600MHz in the regional area in the base case is close to what would be expected in an urban area, where massive MIMO on such frequencies performs well. We have run a sensitivity with a lower spectral efficiency, detailed in Section 5.2.3.
- Frequency coverage adjustments: This sensitivity examines the effect of a lower coverage being achieved using the 3600MHz band in rural areas, detailed in Section 5.2.4.
- 3.4 and 3.6GHz coverage adjustments: This sensitivity adjusts the size of the frequency zones for the bands above 3GHz, allowing the model to look at how the size of these zones affects the results, also detailed in Section 5.2.4
- Competitor usage vs. Telstra usage: This sensitivity uplifts the usage of Optus and TPG SIOs by 30%, representing a case where Optus and TPG usage per SIO in the 17% Regional Coverage Zone is higher than the usage per Telstra SIO. .

### 5.2.1 Market share growth for Optus

As noted above, the model results suggest that Optus has a slight superiority to the MOCN in the rate of growth in usage per SIO that it can sustain. Those results were based on a constant market share for each of the network operators. However, we have also run the model with an assumed increase in market share for Optus.

Based on the **[Confidential to Telstra]** [redacted] data presented in Section 4.1, we have taken the Optus market share in 17% Regional Coverage Zone to be 25.5%. In the results presented in this section we assume that the market share of Optus increases from 25.5% to 35.0%. Figure 5-4 below presents the compound annual growth in usage per subscriber that Optus could achieve, both for a constant and increasing market share.

[redacted]

**Figure 5-4: Maximum growth in data usage per SIO in the five-year modelled period for Optus market share growth scenario**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | | |
|---|---|---|---|
| **Operator** | 70 | 140 | 210 |
| **Optus** (constant 25.5% market share) | 29.5% | 34.5% | 38.5% |
| **Optus** (market share increases to 35.0% by FYE28) | 24.0% | 28.5% | 32.0% |

The results presented in Figure 5-4 indicate that Optus could increase its market share to 35% over the period and still deliver 28.5% per annum growth in data per SIO at a build rate of new sites which seems in line with market trends.

### 5.2.2 Additional 3.7GHz spectrum sensitivity

As mentioned, we have run sensitivities for each of the operators where additional 3.7GHz is awarded and assumed to be available for use throughout the modelling period. As the exact amount of spectrum to be awarded is yet to be determined, we ran each operator with an additional 40MHz of 3.7GHz spectrum (across all sites).

**Figure 5-5: Maximum growth in data usage per SIO in the five-year modelled period for additional 3.7GHz spectrum sensitivity scenario**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | |
|---|---|---|
| **Operator** | No additional 3.7GHz | 40MHz of 3.7GHz |
| **MOCN** | 29.5% | 29.5% |
| **Optus** (constant 25.5% market share) | 34.5% | 34.5% |
| **Optus** (market share increases to 35.0% by FYE28) | 28.5% | 28.5% |
| **Telstra** | 23.5% | 24.0% |

As can be seen in Figure 5-5 above, awarding additional 3.7GHz spectrum has no significant impact on ability to cope with growing traffic demand per SIO. This is because, given the limited range of 3.7GHz spectrum, the network is limited by the quantity of spectrum in lower frequency bands.

### 5.2.3 High-frequency spectral efficiency sensitivity

We also ran sensitivities on the spectral efficiency of the 3.4GHz, 3.6GHz, and 3.7GHz bands. Our base case assumption that 3600MHz using mMIMO technology can deliver a spectral efficiency of 5.0 represents a performance similar to that achieved in urban areas. Given the uncertainty over mMIMO performance in rural areas, we have prepared a sensitivity with a spectral efficiency of 2.0bps/Hz, representing no efficiency gain for mMIMO. We ran this for each operator and then in conjunction with the additional 3.7GHz spectrum sensitivity, as detailed in Section 5.2.2.

**Figure 5-6: Maximum growth in data usage per SIO in the five-year modelled period with increased HF spectral efficiency and additional 3.7GHz spectrum**

| | YoY growth supportable with 140 average yearly capacity site build FYE2r-FYE28 | | | |
|---|---|---|---|---|
| **3.7GHz awarded** | No additional spectrum | | 40MHz additional spectrum | |
| HF spectral efficiency | 2.0bps/Hz | 5.0bps/Hz | 2.0bps/Hz | 5.0bps/Hz |
| **MOCN** | 29.5% | 29.5% | 29.5% | 29.5% |
| **Optus** (constant 25.5% market share) | 34.5% | 34.5% | 34.5% | 34.5% |
| **Optus** (market share increases to 35.0% by FYE28) | 28.5% | 28.5% | 28.5% | 28.5% |
| **Telstra** | 23.5% | 23.5% | 24.0% | 24.0% |

As Figure 5-6 above shows, there is no material impact from changing the spectral efficiency of the high frequency bands (3.4, 3.6, and 3.7GHz) on an operator's ability to cope with growing demand per SIO in the 17% Regional Coverage Zone. This is because the ability of the networks to serve additional demand for traffic is constrained by amount of low band spectrum available.

### 5.2.4 Frequency zone coverage sensitivity

As discussed at the beginning of Section 5.2, we have run sensitivities on the traffic-covering capabilities of each frequency which may be deployed by each operator.

We ran a sensitivity on the following: bands (1800MHz, 2100MHz, 2300MHz, 3.4+3.6GHz), that assumed they could achieve full traffic coverage.

The resulting traffic per SIO growth supportable, presuming a yearly capacity site build of 140 sites (between FY23 and FY28) is shown in Figure 5-7.

**Figure 5-7: Results using different frequency zone assumptions**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | |
|---|---|---|
| **Operator** | Base coverage | Full traffic coverage |
| **MOCN** | 29.5% | 30.5% |
| **Optus** | 34.5% | 35.0% |

As can be seen in Figure 5-7 above, adjusting the frequency coverage of the modelled bands relative has no significant impact on the amount of traffic growth which may be sustained by either MOCN or Optus (with constant market share) – only a small change in sustainable traffic growth per user, as it increases by 1.0% (for MOCN) and by 0.5% (for Optus with constant market share).

[redacted]

In addition to these sensitivities, we ran a sensitivity where the 3.4GHz and 3.6GHz bands have smaller coverage zones than the 1800MHz, 2100MHz, and 2300MHz bands based on the level indicated in the chart in Figure 4-11.

The results for this sensitivity are shown in Figure 5-8 below.

**Figure 5-8: Maximum growth in data usage per SIO in the five-year modelled period with improved 3.4+3.6GHz coverage**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | |
|---|---|---|
| **Operator** | Base 3.4+3.6GHz coverage | Decreased 3.4+3.6GHz coverage |
| **MOCN** | 29.5% | 29.5% |
| **Optus** (constant 25.5% market share) | 34.5% | 34.5% |
| **Optus** (market share increases to 35.0% by FYE28) | 28.5% | 28.5% |
| **Telstra** | 23.5% | 23.5% |

The results demonstrate that the conclusions are not sensitive to the coverage level achieved using 3.4+3.6GHz spectrum, suggesting that the quantity of spectrum in the low bands is a limiting factor.

### 5.2.5 Competitor mobile data usage sensitivity

As discussed previously in Section 5.2, we have run sensitivities on the usage per SIO for Optus and TPG.

We ran the base case where the usage per SIO is assumed to be equal to Telstra's, and then also ran a case where the usage per SIO was uplifted to 130% for Optus and TPG – this affected the MOCN traffic due to distribution of TPG SIO traffic.

[redacted]

**Figure 5-9: Results using different competitor SIO usage assumptions**

| | Maximum YoY usage growth rate for average yearly capacity site build FYE24-FYE28 | |
|---|---|---|
| **Operator** | Base usage per SIO | Uplifted usage per SIO (+30%) |
| **MOCN** | 29.5% | 29.0% |
| **Optus** (constant 25.5% market share) | 34.5% | 29.5% |
| **Optus** (market share increases to 35.0% by FYE28) | 28.5% | 24.0% |
| **Telstra** | 23.5% | - |

As can be seen in Figure 5-9 above, by uplifting the usage per SIO by 30% for Optus and TPG, there is very little effect in the sustainable traffic growth rate for the MOCN. However, the sustainable traffic growth rate for Optus decreases by 5.0pp when market share remains flat – still substantially higher than Telstra's sustainable traffic growth rate and only slightly behind the MOCN's, and by 4.5pp when the market share is increased to 35% – which puts Optus about equal to Telstra.

## 5.3 Conclusions

After performing the sensitivity analyses using our network dimensioning model, we conclude that the frequency zone parameters, future HF spectrum awards, and spectral efficiency of HF bands is of no material effect to the final results.

The sensitivity towards Optus's market share shows us that even if Optus increased its market share, Optus could keep up with the recent historical traffic growth in Australia with a reasonable rate of construction of capacity sites. The mobile data usage sensitivity suggests that even if Optus and TPG have 30% higher usage per subscriber than Telstra, Optus is still able to broadly match the MOCN in terms of the growth in usage per subscriber that it can support.

# Annex A Network dimensioning methodology – additional detail

The modelling approach used is based on a network dimensioning calculation which aims to calculate the sites and equipment required to carry a particular level of traffic in the network.

## Dimensioning traffic

The traffic in the model is expressed as 'busy hour' traffic, in the 'busy sector'; that is to say the traffic level at the busiest time in the busiest sector of the cell site. The model dimensions the network on the basis of busy hour busy sector traffic in the final month of the period being modelled (e.g. if the model is running in financial years running from July-June, then it is the calculated busy hour busy sector traffic in the month of June, at the end of the period, that is used to dimension the network required at the end of the period.

## Busy Hour

Traffic levels on a mobile network vary according to time of day, by day of the week, potentially by season and for a wide variety of other reasons. Network operators typically design the network to cater for a specific 'busy hour', so that the network is not congested during that busy hour. The exact definition of busy hour varies from network to network, but for this model we have taken as our definition the fifth busiest hour in a given month.

## Busy Sector

In most cases a cell site serves traffic in several 'sectors', each sector being served by antennas oriented towards that sector. A common approach is to use three sectors per site; three sets of antennas each with a beam width of approximately 120 degrees are used to serve the area around the cell site. It is also possible to have a single sector, using omnidirectional antennas or other numbers of sectors (e.g. two, four, six) using antennas with appropriate beam widths.

In the 17% Regional Coverage Zone the vast majority of Telstra's sites have three sectors, which is typical of most mobile networks.

Usually, the traffic at the site will not be uniformly distributed across the sectors; one sector will have higher traffic levels than the others. We refer to this as the 'busy sector' and we use the traffic in the busy sector as the measure by which the cell site is dimensioned. That is, the sites is upgraded with additional equipment, or ultimately another site is added, when the busy sector busy hour traffic reaches a particular threshold.

We have used historical data from Telstra's network to calculate the ratio between the overall traffic in the MOCN and the busy hour busy sector traffic on each sites, so that the model calculates the capacity upgrades required at each site to carry the increased traffic over time.

## Distribution of traffic across the site grid

The model uses historic data from Telstra's network to determine how traffic is distributed across the site grid. The model therefore has a relationship between the total traffic carried in the MOCN region and the busy hour busy sector traffic of each sites, or group of sites (a 'category').

### Grouping of sites

Rather than modelling the capacity upgrade required at each site individually, the model groups the sites in 300 ‘categories’ – sites which are similar and have similar levels of busy hour busy sector traffic. This allows for more rapid calculations in the model without a material loss of accuracy.

The sites are first grouped together based on assigned geotypes. A geotype represents the spectrum available for a site as well as the state or territory in which the site is situated. Within each geotype the sites are then grouped together by a weighting of BH-BS traffic and frequency zones.

### Adding capacity to the network sites

For each network site, the model takes as an input the spectrum bands that are already deployed on that cell site. For each period in the model (in this case, each year) the model checks if the spectrum and technology used on the site is sufficient to carry the dimensioning traffic for that site (or category of sites). If the spectrum and associated equipment on the site provides sufficient capacity to carry the dimensioning traffic, no additional equipment or spectrum is assumed to be deployed on the site.

However, if the dimensioning traffic is greater than the capacity of the site, and additional spectrum is available (or technology upgrades are available) then sufficient additional spectrum bands or technology upgrades are assumed to be added to the site such that it is appropriately dimensioned to carry the dimensioning traffic.

If there are not sufficient additional spectrum bands and technology upgrades available to carry the dimensioning traffic, then it is assumed that an additional site (a capacity site) is built to carry some of the traffic.

The model therefore calculates the appropriate configuration (spectrum and technology) of existing cell sites and additional new capacity sites in the network that are sufficient to carry the dimensioning traffic as it grows over time.

### Network elements

The spectrum and technology combinations that can be used at each cell site are organised in the model into ‘network elements’. An example of a network element might be ‘1800MHz LTE using a 4T4R antenna’. There could be another network element which is ‘2100MHz LTE using 2T2R antenna’. Each of these elements has a different capacity, which is calculated in the model based on a series of inputs, including the quantity of spectrum in each band at each site, the spectral efficiency that is usually achieved in each band, etc.

The model incorporates rules about spectrum and technology deployment to ensure that suitable combination of spectrum and equipment provisioned at each site category to carry the dimensioning traffic, up to the point where all the spectrum is deployed using the highest capacity equipment and the site can be upgraded no further.

The network elements available at a site depend on the spectrum available and the technology available. An example of capacity-bearing elements for a typical site in the 17% Regional Coverage Zone would be:

- A new capacity site
- Legacy LF radio
- Combined low-frequency radio (700MHz, 850MHz, 900MHz)
- 850MHz extension radio (if available)
- 1800MHz radio

- 2100MHz radio
- 2600MHz radio
- 3600MHz radio

The model therefore calculates a capacity upgrade path for each site to carry the growing traffic, including deploying new capacity sites when required. In Figure A-1, below, we provide an example of an upgrade path for a category of sites dimensioned to carry a growing traffic over the five-year period in the model.

**Figure A-1: Capacity builds for Category 273, 29.5% growth per SIO usage**

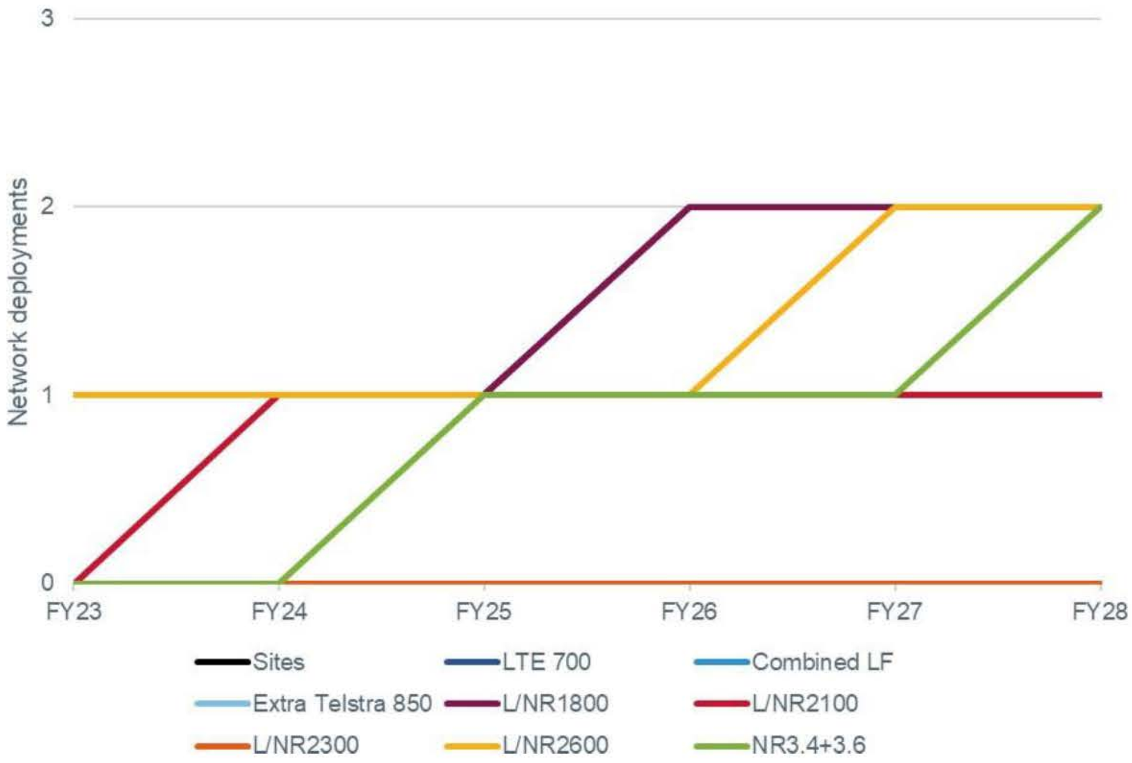


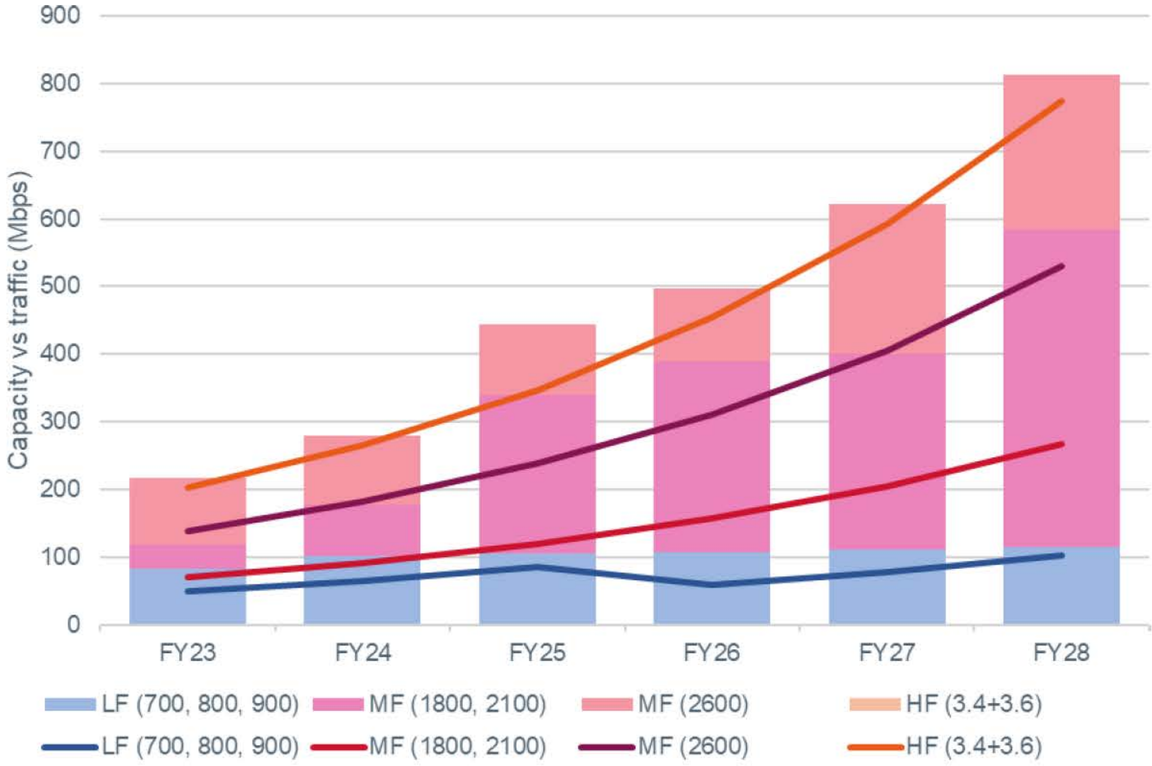
**Figure A-2: Tabulated capacity builds for Category 54, 29.5% growth per SIO usage**

| | Builds per site at FYE | | | | | |
|---|---|---|---|---|---|---|
| **Capacity element** | FY23 | FY24 | FY25 | FY26 | FY27 | FY28 |
| **Capacity site** | 0 | 0 | 0 | 1 | 1 | 1 |
| **Legacy LF** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Combined LF** | 1 | 1 | 1 | 1 | 1 | 1 |
| **Extra 850MHz** | 0 | 1 | 1 | 1 | 1 | 1 |
| **1800MHz** | 1 | 1 | 1 | 2 | 2 | 2 |
| **2100MHz** | 0 | 1 | 1 | 1 | 1 | 1 |
| **2300MHz** | 0 | 0 | 0 | 0 | 0 | 0 |
| **2600MHz** | 1 | 1 | 1 | 1 | 2 | 2 |
| **3.4 + 3.6GHz** | 0 | 0 | 1 | 1 | 1 | 2 |

In Figure A-3, below, we illustrate why these network builds have been calculated by the model. We plot the traffic per frequency zone (LF, MF 1800/2100MHz, MF 2600MHz, HF 3.4+3.6GHz) as lines against the capacity installed per site (calculated as described previously, using spectral efficiency, spectrum available, etc.). We can see that in each year where the traffic in that zone would surpass the previous year's capacity available, the network model has added an element which provides the best capacity to serve this surplus traffic at the lowest calculated normalised cost.

[redacted]

**Figure A-3: Illustrative capacity installed vs traffic served for Category 54, 30% growth per SIO usage**




The capacity of each network element is based on the amount of spectrum available (and used) in the band in question and the spectral efficiency of the technology used.

## Spectral efficiency

The spectral efficiency, expressed in bps/Hz is used to calculate the traffic (in Mbps) that each network element in the network can carry based on the quantity of downlink spectrum (in MHz) used. For example, if a 4x4 MIMO LTE has a spectral efficiency of 2.25 bps/Hz, and there is 20MHz of 1800MHz spectrum available in the downlink (i.e. 2 x 20MHz total) then the capacity of the LTE 1800MHz 4x4 MIMO network element will be 45bps.

In Figure A-4 we provide the spectral efficiencies used for each of the technologies in the model.

[redacted]

**Figure A-4: Spectral efficiency by frequency / technology [Source: Aetha]**

| | Base technology | Spectral efficiency (bps/Hz) | YoY growth (%) |
|---|---|---|---|
| **LF (700MHz, 850MHz, 900MHz)** | 2T4R | 1.50 | 3.0% |
| **1800MHz** | 4T4R | 2.25 | 3.0% |
| **2100MHz** | 4T4R | 2.25 | 3.0% |
| **2600MHz** | 4T4R | 2.25 | 3.0% |
| **3600MHz** | 64T64R | 5.00 (sensitivity 2.00) | 3.0% |

The spectral efficiency achieved in a cell in reality will depend on the radio conditions in that cell at the time. A range of phenomena can affect the spectral efficiency achieved; for example, if there is a low SINR (Signal to interference and noise ratio) a lower spectral efficiency will be achieved than if there is a high SINR. The spectral efficiencies used in the model are representative of those that we would expect to be achieved in Telstra's network.

### Frequency zones

Different radio frequencies have different propagation characteristics, and as a result the size of a radio cell in a cellular network is usually smaller the higher the frequency. For example, in Telstra's network the sub-1GHz spectrum (e.g. 700MHz) provides greater coverage than the 1800MHz, which in turn provides more coverage than the 2600MHz or 3500MHz.

The model regards the sub-1GHz spectrum deployed as covering the entire area and traffic served by a sector and each of the other bands as covering a proportion of the area and traffic served by the sector. This is defined in the model by the percentage of traffic in the sector that, from a coverage perspective (capacity limits not withstanding), could be carried on a particular frequency band.

An example for a particular cell of the parameter used in given in Figure A-5, below.

**Figure A-5: Site category 54 characterising parameters**

| | 700 / 850 / 900MHz | 1800/2100MHz | 2600MHz | 3600MHz | BH-BS traffic (%) |
|---|---|---|---|---|---|
| **Site 1** | 100.0% | 69.8% | 60.4% | 29.2% | 0.38% |
| **Site 2** | 100.0% | 75.0% | 65.0% | 31.4% | 0.33% |
| **Site 3** | 100.0% | 86.5% | 75.4% | 35.9% | 0.67% |
| **Site 4** | 100.0% | 76.1% | 65.9% | 31.9% | 0.43% |
| **Site 5** | 100.0% | 70.2% | 60.8% | 29.4% | 0.33% |
| **Category 54** | 100.0% | 75.5% | 65.5% | 31.5% | 2.14% |

As a result of these frequency zones the model not only deploys the required capacity to carry the overall dimensioning traffic, it deploys the required sub-1GHz spectrum to carry that part of the dimensioning traffic that only sub-1GHz spectrum can meet and it deploys that sufficient sub-1GHz spectrum and 1800MHz/2100MHz spectrum in combination to carry traffic that higher frequency bands cannot meet. In effect there are several dimensioning constraints to be met simultaneously, rather than just the single constraint of total capacity being greater than total traffic.

The model therefore deploys a mix of spectrum bands, with the required combination of capacities, to carry the dimensioning traffic based on the proportion of that traffic that each band can address. Where this cannot be achieved, an additional capacity sites is assumed to be deployed. For example, a site may have very limited sub-1GHz capacity, plentiful 2600MHz and no 1800MHz/2100MHz spectrum. The model would assume a capacity site is built once the sub-1GHz spectrum is able to provide sufficient capacity for the traffic that can only be addressed with sub-1GHz spectrum, regardless of how much spare 2600MHz capacity there might be.

In other words, the model ensures that the network is equipped with sites and equipment to carry all of the traffic in the busy sector at busy hour across all frequency zones.

### Selecting network elements to deploy

Given the overall constraints of dimensioning traffic, frequency zones and available network elements, the model nevertheless typically has more than one network upgrade path available to provide sufficient capacity to be able to carry the dimensioning traffic.

The model contains an algorithm which seeks to deploy the most cost-effective solution. Given the cost of adding new sites, this means the model will typically use all network available (i.e. all spectrum and the most advanced technology) at a site before choosing to deploy an additional cell site.

Where the model deploys a new cell site, it is because the dimensioning traffic cannot be served from the existing cell site, given the spectrum available.

# Annex B Index of Exhibits

| Exhibit name: | Title: | Source: | Uses: |
|---|---|---|---|
| Exhibit_A1 | Spectrum area polygons | Telstra | Spectrum availability on sites |
| Exhibit_A2 | Spectrum Authorisation TPG and Telstra (Variation No 1 - 07.04._931406_1 | Telstra | Spectrum included in the MOCN |
| Exhibit_A3 | Frequency zone data | Telstra | Frequency coverage zones |
| Exhibit_A4 | Annexure A to Schedule 3 - Execution SA1 List | Telstra | 17% regional coverage zone |
| Exhibit_A5 | Annexure B to Schedule 3 - Execution Sites in Boundary SA1s List | Telstra | 17% regional coverage zone |
| Exhibit_A6 | ExtASMG-PopulationData-2011_2016 | Accessed at: https://www.acma.gov.au/convert-hcis-area-description-placemark | Market population |
| Exhibit_A7 | HCIS Polygons | Accessed at: https://www.acma.gov.au/australian-spectrum-map-grid | Market population |
| Exhibit_A8 | Industry Spectrum Charts | Telstra | Spectrum holdings |
| Exhibit_A9 | SA1 2016 Polygons | Accessed at: https://www.abs.gov.au/statistics/standards/australian-statistical-geography-standard-asgs-edition-3/jul2021-jun2026/access-and-downloads/digital-boundary-files | 17% regional coverage zone |
| Exhibit_A10 | Telstra response to Aetha data request 220422 | Telstra | Competitor sites & configuration [ACMA-RRL_Extract]<br>17% regional coverage zone [TPG-Contract Data]<br>Network traffic [TLS-MergedTrafficSummary; TLS-MergedTraffic]<br>Telstra configuration [lut] |
| Exhibit_A11 | MOCN Site List | Telstra | Telstra MOCN sites |

| Exhibit name: | Title: | Source: | Uses: |
|---|---|---|---|
| Exhibit_A12 | **[Confidential to Telstra]** [redacted] data RCZ | Telstra | Market shares |
| Exhibit_A13 | **[Confidential to Telstra]** [redacted] data national | Telstra | Market shares |
| Exhibit_A14 | Site Build History | Telstra | Telstra MOCN sites |
| Exhibit_A15 | Regional Coverage Zone Spectrum Analysis | Aetha | Spectrum holding comparison |

# Annex C Curriculum Vitae of Andrew Wright and Lee Sanders

## Andrew Wright – Summary of experience

Andrew has over 25 years' telecoms industry experience, much of which have been spent advising operators, regulators and government bodies across a broad range of topics. Andrew's areas of expertise include all aspects of mobile communications, including regulatory policy, spectrum auctions, network sharing, pricing, product development, business planning and transaction support.

Andrew is one of the founders of Aetha and acted as its Managing Partner from 2011 to 2021. Prior to that Andrew held a range of management positions in specialist telecommunications consulting firms Analysys and Analysys Mason including Head of the Mobile Practice and Managing Director of Analysys Consulting.

Andrew has extensive expertise in spectrum issues, regularly working for operators acquiring spectrum in auctions as well as for regulators and investors. He has led numerous projects to advise operators on spectrum issues, in particular to develop spectrum strategies and to value spectrum. He has supported operators in numerous European and Asian countries to prepare for and bid in spectrum auctions covering 2G, 3G, 4G and 5G spectrum.

In addition to spectrum acquisition, Andrew works on a wide range of other strategic issues and financial transactions in the mobile telecommunications industry.

### Education

- MBA, Imperial College, University of London (1990-1992)
- B.A. Honours Degree in Natural Sciences (Physics and Theoretical Physics), Churchill College, University of Cambridge (1985-1988)

### Employment history

| | |
|---|---|
| 2011 – Present | Managing Partner / Partner, Aetha Consulting Ltd. |
| 1994 – 2011 | Consultant, Partner, Managing Director, Analysys Mason Ltd. |
| 1988 – 1994 | Research Engineer / Senior Research Engineer, Bell Northern Research/Nortel |

Examples of specific projects undertaken by Andrew are presented below. These have been categorised in the following areas:

- Spectrum projects for operators and other spectrum users (including spectrum valuation and auction support)
- Spectrum projects for regulators and government bodies
- Network (RAN) sharing projects
- Other mobile operator projects
- Other regulatory projects
- Litigation support projects
- Other projects.

[redacted]

### Spectrum projects for operators and other spectrum users

- **Mobile Operator (Saudi Arabia)** – Valuation models and bidding strategy for a mobile operator in a sequence of two 5G spectrum auctions – acquiring 2.6GHz and 3.5GHz spectrum (2019)
- **Mobile operator (Spain)** – Developed a bid strategy, auction support tools and ran mock auctions for an MNO bidder in the 3.5GHz auction (2018)
- **Sprint Corporation (USA)** – Re-run of a valuation of a portfolio of Sprint's 2.5GHz and PCS spectrum in support of a further issuance of Sprint spectrum bonds.
- **Mobile operator (Saudi Arabia)** – Development of valuation model and spectrum strategy for 800MHz and 1800MHz spectrum auction. The operator successfully achieved its objective in the auction (2017)
- **Fixed and Mobile operator (UK)** – Preparation of spectrum valuation in support of an operator participating in a 5G spectrum auction (2017)
- **Sprint Corporation (USA)** – Valuation of a portfolio of Sprint's 2.5GHz and PCS spectrum assets in support of a securitization and issuance of spectrum bonds (2016)
- **Fixed network operator (UK)** – Evaluation of the spectrum assets and network strategies of UK mobile operators in support of a decision to acquire a mobile operator (2016)
- **Mobile operator (Turkey)** – Development of the commercial, regulatory and technical strategy for the launch of LTE services, including an assessment of its competitive impact and the value of additional spectrum (2015)
- **WIND Hellas (Greece)** – End-to-end auction preparation support ahead of an 800MHz and 2.6GHz auction, including valuation, bid strategy development and support during the auction itself (2014)
- **Omani multi-band award** – Spectrum valuation and regulatory lobbying support for an incumbent operator ahead of the planned award (800MHz and 2.6GHz award, 2013-14)
- **Mobile operator (New Zealand)** – Assessment of the value of 700MHz spectrum for a New Zealand mobile operator (2013)
- **Mobile operator (Slovakia)** – Development of 800MHz / 2.6GHz valuation model (2013)
- **eircom (Ireland)** – support in its preparations for a multi-band auction (2012)
- **Western European mobile operator** - Development of a spectrum valuation model ahead of a multi-band GSM/LTE auction (2011)
- **Cellular Operators Association of India** – Developing a response to the proposed new spectrum usage fee methodology developed by the Telecoms Regulatory Authority of India (TRAI) (2011)
- **Middle East full service operator (fixed and mobile)** – Response to consultation process on the future of spectrum management. This involved all aspects of allocation, assignment and management of radio frequencies in the country (2010)
- **International Mobile Operators** – Valuation model for 3G license in India for a multinational operator with an existing 2G license (2008)
- **International Mobile Operator** – Led a team bidding for a mobile licence application in the MENA region. We undertook overall project management responsibility for the entire application process on the client's behalf and co-ordinated the input from the other advisers (financial, legal and market research). (2007)
- **International Mobile Operator** – Supported a Middle Eastern incumbent operator with its bid for a mobile licence (2G/3G/DVB-H) in Qatar. Led a team that was responsible for the licence application documentation, detailed technical roll-out plan, and a detailed business plan, which was used for licence valuation purposes (2006)
- **South East Asian mobile operator** – Preparation for a 3G license auction, including business planning and valuation (2001)
- **South East Asian mobile operator** – Evaluation of a 3G opportunity in South-East Asia for an established mobile telecoms operator. Development of a business case and a bid book for a 3G licence beauty contest (2001)

- **International mobile operator** – Evaluation of a 3G opportunity in Scandinavia for an international telecoms operator. Included business modelling, valuation and preparation of a bid submission for a beauty contest (2000)
- **International Mobile Operator** – Business Plan and valuation model for 3G licence bid in Germany (2000)
- **International Mobile Operator** – Business Plan and valuation model for 3G licence bid in Switzerland (2000)
- **International Mobile Operator** – A project to build a generic model of personal handyphone system (PHS) mobile operations for a consortium of major telecoms operators wishing to apply for spectrum and operating licences in a series of Asian countries. Used to rapidly develop business cases and value licence opportunities (1997)
- **Australian potential new entrant** – A study to develop a business plan for a new entrant into the mobile market in Australia (1996)
- **International equipment vendor and private investors** – A project to value 3 GSM licenses in different Indian states as preparation for a sealed bid auction (1995)

### Spectrum projects for regulators and government bodies

- **TRA (UAE)** – Project to develop the Digital Switchover plan for the UAE. The project made recommendations on the switchover, the release of a "Digital Dividend" and the licensing structure applicable for DTT. The work included a review of the TV market, collection of stakeholder input, assessment of technical aspects related to DTT, frequency planning, development of recommendations for licensing options, creation of business models for a TV broadcaster and a MUX operator, and development of a DTT switch-over plan. (2010)
- **OFTA (Hong Kong)** – Study on the introduction of spectrum trading in Hong Kong. The project recommended a route to the introduction of limited spectrum trading, including transition measures. (2009)
- **Ofcom (UK)** – Study for Ofcom on the liberalisation of spectrum in relation to the mobile sector. Assessment of the impact of allowing spectrum not currently used for mobile services to be used to provide 3G or other mobile services, the impact of liberalising existing 2G spectrum (2007/8)
- **NITA (Denmark)** – Study on the use of spectrum auctions, and the potential introduction of spectrum trading and liberalisation. We developed recommendations for improvements to the regulator's current process for primary spectrum awards, and undertook a cost/benefit analysis of the introduction of new spectrum management tools (2007)
- **Ofcom (UK)** – High profile study to recommend an award process for the digital dividend (2006/7)
- **European Commission** – Project Director for a study on harmonisation of spectrum trading frameworks across Europe. This included identification of the options associated with introducing spectrum trading (e.g. property rights definition, trading mechanisms, phasing of implementation) which Member States could potentially adopt and an assessment of any areas in which harmonisation would result in additional benefits for the Community (2006)
- **OFTA (Hong Kong)** – Project to explore alternative options for the licensing of 3G spectrum. The analysis included an assessment of the value of 3G spectrum in that market, as well as an in-depth examination of the likely economic impact of different spectrum licensing options on the overall economy. (2000)

### Network (RAN) sharing and Towers

- **Mobile operator in Western Europe** – Vendor due diligence of a tower portfolio that will be brought to market in 2019 (2019)
- **TowerCo investor** – Due diligence of two mobile operator tower portfolios in Saudi Arabia – detailed commercial and technical due diligence of each portfolio and developed an model of the synergy available from acquiring both portfolios (2016)
- **TowerCo investor** – Technical and Commercial due diligence on a tower portfolio in Kuwait (2016)

[redacted]

- **Two mobile operators in a Middle East market** – Project to assess the consolidation and future joint evolution of two mobile operators networks with the objective of forming a jointly owned TowerCo with the involvement of a third-part investor (2011)
- **Two mobile operators in a Western European market** – Supported a Western European mobile operator in its evaluation of alternative proposed RAN sharing deals. Included a quantitative analysis in which we evaluated the benefits to our client of the various deals and alternatives. This enabled our client to gain confidence and move the process forward with the preferred party by signing an MoU and starting negotiations. Our scope of work also included advice on the principles of equalisation relating to the potential transaction structure and advice on the roadmap to structuring a potential joint venture (2010/2011)
- **Two South East Asian mobile operators** – Project to develop a blueprint for network sharing. The two clients had signed an MoU for network sharing and wanted us to fulfil advisory role involving financial benefits modelling, operating structures and operating models. The scope of the network sharing included sites, access transmission, aggregation transmission and trunk transmission, and an evaluation of active RAN share (2010)
- **Two mobile operators in an African market** – Development of a business plan for passive network sharing and formation of a JV for tower infrastructure. The project included detailed business planning and radio optimisation studies to maximise the level of network sharing (2009)
- **Two mobile operators in an African market** – Development of a benefits case and business plan for active sharing of a 3G RAN between two mobile operators (2010)
- **Two mobile operators in a Western European market** – Assessed the 'current cost' valuation of both individual networks on a standalone basis and on a combined basis, to support balancing payments that would be made at completion of a RAN-share transaction. The analytical approach was based on detailed analyses of the fixed asset registers of both operators, as well as purchase ledger information and recent quotations from equipment manufacturers and other suppliers (2008)
- **Two mobile operators in a Western European market** – Large project to firstly assess the business case for network sharing between, and then to assist in the creation of the new joint venture (2006/7)

### Other mobile operator projects

- **Western European mobile operator** – review of a business case model for the acquisition of another operator in the market (2012)
- **West African Mobile operators** – Project to undertake a synergy analysis for the proposed merger of two mobile operators in West Africa, which provided three years of cashflow increase/decrease compared to the standalone plans as a basis for the valuation of the synergies. The analysis – which covered network optimisation, operating efficiencies, competition and fixed networks – was used in the final negotiation for the merger (2010)
- **Inmarsat** – Directed a project involving the development of tariff structures for an innovative mobile broadband satellite service (BGAN). We worked closely with our client's commercial and technical project teams, as well as the company's distributors, to identify the most appropriate wholesale pricing structures for their new mobile broadband service. Our work also included a detailed total cost of ownership competitive assessment of the new service for target customer segments (2005)
- **European incumbent mobile operator** – Project to optimise of the tariffs of a national subsidiary of a major mobile operator, with the objective of increasing revenues. Working closely with the client's pricing team, we used our proven methodology and analytical models to identify the most effective set of tariff changes and quantify their likely impact on revenues. Resulted in hitting a targeted ARPU uplift. (2004)
- **European incumbent mobile operator** – For the largest mobile operator in a major European country, we provided follow-on support in its preparations for the expected application of LRIC by the regulator. This involved updating the top-down LRIC model (earlier developed by another team in the same firm) with the most current data and the examination of several scenarios to investigate

further some of the strategic issues that would become relevant throughout the regulatory process (2003)

### Other regulatory projects

- **Communication and Information Technology Commission (Kingdom of Saudi Arabia)** – A project to assess the impact of new technologies on the telecoms market in KSA, together with analysis of the associated changes required in the regulatory framework. The project included an assessment of the current market situation, foreseeable changes in the market as a result of new technologies and networks in the pipeline, and the development of a regulatory roadmap in response to the expected market developments. The project defined a process for CITC to regularly update its regulatory roadmap in response to new technologies (2011)
- **Ministry of Communications (Israel)** – Provided support to the ministry with the implementation of cost-oriented mobile interconnection. This involved the construction a bottom-up LRIC model for GSM, CDMA and IS-136 cellular technologies. The project also included providing recommendations on pricing policy for both voice and SMS termination (2004)
- **IDA (Singapore)** – Provided support in the development of policy recommendations for the most effective charging method for mobile services given current and future market conditions. The IDA was considering a move to a ‘calling party pays’ (CPP) tariff regime in place of the existing ‘mobile party pays’ (MPP) approach in Singapore, and we assessed the suitability and the implementation of such a move (2002)

### Litigation support projects

- **France Telecom Mobile Limited vs. Republic of Lebanon** - Directed a project for FTML to act as a technical and commercial expert witness before an International Chamber of Commerce arbitration hearing of a dispute with the network’s licensing authority. We reviewed the claims and counter-claims of both parties and passed our opinion upon these. This involved a review of the technical and commercial practices and procedures of the business. We also developed a cashflow model to calculate independently the total damages to be paid to our client as a result of the licensing authority’s decision to revoke the client’s operating licence. Our model was used as the basis of a sizable award to our client.
- **Rumeli Telecom vs. Republic of Kazakhstan** – Acted as an expert witness services for the claimants in an arbitration case between the former owners of a mobile network operator in a CIS state and the government of that state. We first reviewed and analysed all available internal company information, historical market data and market forecasts. We then created a detailed discounted cashflow (DCF) model designed to assess the quantum of the damages due to our client. Our damages model was accepted as the basis of an award by the tribunal of the International Centre for the Settlement of Investment Disputes (ICSID).

### Other projects

- **eircom (Ireland)** – Analysis of the costs of providing Digital-Agenda compliant high speed broadband using wireline and wireless technologies (2014)
- **Private equity firm** – Supported a private equity firm during the due diligence process of a major integrated (fixed, mobile and pay-TV) operator in South East Asia. This involved attending management presentations and site visits. We also carried out a detailed review of the management’s forecasts for each area of the business and supported the client’s financial advisers in developing a revised case for valuation. As part of the project, we provided a number of case studies examining the impact of multi-play offerings
- **Lenders to a mobile operator** – Project Director of a due diligence on an Eastern European mobile operator on behalf of a consortium of North American and European lenders. We undertook a detailed assessment of the operator’s marketing strategy, network technology, business plan and

management team, in support of a transaction in excess of USD100 million. Our work led to several major revisions being made to the operator's business model and financing structure

- **Government of Pakistan Privatisation Commission** – Privatisation of a fixed and mobile operator in Pakistan. Advisers to the government o on the privatisation of its incumbent operator, PTCL (fixed and mobile businesses). Acted in consortium with investment banks and legal advisers to draw up the legal framework, estimate key operational variables (especially traffic), carry out the valuation of the operator and contribute to key sections of the Information Memorandum

## Languages

- English (mother tongue)

# Lee Sanders – Summary of experience

Lee has over 20 years' experience of advising operators, regulators and government bodies across a broad range of topics, including network sharing, fibre networks and transaction support. Notably Lee has extensive expertise in spectrum issues and has led several high-profile spectrum-related studies for regulators, such as the European Commission, Ofcom (UK) and the IDA (Singapore). He has also led numerous projects to advise operators on spectrum issues, in particular to develop spectrum strategies and to value spectrum. He has supported operators to prepare for and bid in more than 30 spectrum auctions worldwide.

Prior to founding Aetha Consulting in 2011, Lee was a Partner at Analysys Mason, a specialist telecoms strategy consultancy. In 2015/16 Lee was seconded to Telstra's network strategy team, where he managed a range of spectrum and network strategy projects.

## Education

- M.Eng, Manufacturing Engineering, St. John's College, University of Cambridge (1999-2000)
- B.A., Manufacturing Engineering, St. John's College, University of Cambridge (1996-1999)

## Employment history

| | |
|---|---|
| 2011 – Present | Partner / Managing Partner, Aetha Consulting, UK |
| 2015 – 2016 | Network and spectrum strategy manager, Telstra, Australia (Secondment) |
| 2005 – 2011 | Partner, Analysys Mason, UK (Promoted to Partner in 2008) |
| 2000 – 2005 | Associate, Mercer Management Consulting (now Oliver Wyman), UK |

Examples of specific projects undertaken by Lee are presented below. These have been categorised in the following areas:

- Spectrum valuation and auction/award projects for operators
- Spectrum policy/management projects for operators and spectrum users
- Spectrum projects for regulators and government bodies
- Other regulatory projects
- Network strategy projects
- Business strategy/planning projects
- Transaction support
- Other tender and auction projects.

## Spectrum valuation and auction/award projects for operators

- **Private Client (Asia Pacific)** – Valuation and bid strategy support ahead of an auction of 850MHz and 900MHz spectrum
- **Telstra (Australia)** – Valuation and bid strategy support ahead of an auction of 26GHz spectrum, include the assessment of the business case for FWA using mmWave spectrum
- **Private Client (Eastern Europe)** – Valuation of spectrum ahead of an auction of 3.4-3.8GHz spectrum; including competitor valuations and valuation of specific lots
- **Tigo (El Salvador)** – Bid strategy support for an auction of AWS spectrum
- **Private Client (Eastern Europe)** – End-to-end auction support ahead of a multi-band spectrum auction, including consultation support, valuation and bid strategy development
- **WIND Hellas (Greece)** – End-to-end auction support ahead of a 700MHz, 2.1GHz, 3.5GHz and 26GHz spectrum auction, including consultation support, valuation and bid strategy development
- **1&1 Drillisch (Germany)** – Bid strategy support for an auction of 2.1GHz and 3.6GHz spectrum, including on-site support during the auction itself

- **WOM (Chile)** – Development of an expert report for use in submissions to the Antitrust Tribunal regarding spectrum caps
- **Private Client (Western Europe)** – Development of a white paper to investigate the relationship between spectrum caps and auction outcomes, including revenues.
- **Telstra (Australia)** – End-to-end auction support ahead of an auction of 3.6GHz spectrum, including consultation support, valuation and bid strategy development
- **Private Client (Western Europe)** – End-to-end auction support ahead of a multi-band spectrum auction, including consultation support, valuation and bid strategy development
- **KPN (Netherlands)** – Critique of a third-party report published by the regulator discussing the most suitable format for an upcoming multi-band auction.
- **WIND Hellas (Greece)** – End-to-end auction support ahead of an 1800MHz auction, including valuation and bid strategy development
- **Telstra (Australia)** – Valuation and on-site bid strategy support for a multi-band auction that included spectrum in the 1800MHz, 2.1GHz, 2.3GHz and 3.4GHz bands
- **Salt (Switzerland)** – Support to respond to a regulatory consultation regarding a multi-band spectrum auction
- **Tigo (Colombia)** – End-to-end auction support ahead of a 700MHz auction, including valuation and bid strategy development
- **KPN (Netherlands)** – Development of a white paper on the most appropriate format for a multi-band spectrum auction
- **Telstra (Australia)** – Support to respond to a consultation regarding the sale of unassigned 700MHz spectrum to VHA
- **Telstra (Australia)** – Assessment of the merits of a spectrum trade with another mobile operator
- **Telstra (Australia)** – Seconded to Telstra to lead its team to prepare for an auction of 1800MHz spectrum. Included organisation of auction logistics and war room, bid strategy development and leading the war room during the auction itself
- **Orange (Romania)** – Support ahead of an 3.5/3.7GHz auction, including bid strategy development and support during the auction itself
- **WIND Hellas (Greece)** – Benchmarking of 1800MHz renewal processes and valuation
- **Cable Bahamas** – End-to-end support ahead of the auction of a 2nd mobile licence, including valuation and bid strategy development
- **WIND (Canada)** – Valuation support ahead of the AWS-3 auction
- **Play (Poland)** – Competitor analysis ahead of an auction of 800MHz and 2.6GHz spectrum
- **WIND Hellas (Greece)** – End-to-end auction preparation support ahead of an 800MHz and 2.6GHz auction, including valuation, bid strategy development and support during the auction itself
- **Orange Group (Global)** – Development of materials that investigate which spectrum auction formats are most appropriate for emerging markets
- **Orange (Moldova)** – Support ahead of an 800MHz, 900MHz and 1800MHz spectrum award, including valuation, lobbying support and bid strategy development
- **Ice (Norway)** – Competitor valuation support ahead of a 800MHz, 900MHz, and 1800MHz auction
- **BASE Company (KPN Belgium)** – End-to-end auction preparation support ahead of an 800MHz auction, including valuation, bid strategy development and support during the auction itself
- **Telstra (Australia)** – Development of a spectrum valuation model, auction bid strategy and on-site tactical support during the 700MHz and 2.6GHz auction
- **Play (Poland)** – Development of a regulatory consultation response regarding an award process for 800MHz and 2.6GHz spectrum
- **E-Plus (Germany)** – Assessment of spectrum caps ahead of the 700MHz, 900MHz and 1800MHz auction
- **Orange (Romania)** – development of a spectrum valuation model, auction bid strategy and on-site tactical support during the multi-band auction
- **eircom (Ireland)** – support in its preparations for the multi-band spectrum auction

- **Orange (Switzerland)** – development of a spectrum valuation model, auction bid strategy and on-site tactical support during the multi-band auction
- **Play (Poland)** – development of a regulatory consultation response regarding an award process for 1800MHz spectrum
- **KPN (Netherlands)** – Development of a spectrum valuation model ahead of a large multi-band auction
- **Telenor (Hungary)** – Development of a competitor spectrum valuation model ahead of a 900MHz auction
- **Play (Poland)** – White paper on impact of frequency distribution amongst mobile operators on the competitive dynamics in the market
- **E-Plus (Germany)** – Spectrum valuation support ahead of the German 'big bang' auction
- **Orange (Austria)** – Valuation and bid strategy support during 2.6GHz spectrum auction
- **GO Mobile (Malta)** – Spectrum valuation and award process strategy
- **KPN (Netherlands)** – White paper to illustrate how low spectrum caps in the 2.6GHz band would restrict the development of the LTE market
- **Play (Poland)** – Development of spectrum strategy
- **KPN (Netherlands)** – Valuation and auction strategy support in relation to its successful acquisition of 2.6GHz spectrum
- **O2 (Ireland)** – Support to respond to a regulatory consultation regarding the re-award of 900MHz and 1800MHz spectrum
- **Play (Poland)** – Valuation support ahead of the 900MHz auction
- **Private Client (Eastern Europe)** – Spectrum price benchmarking in order to verify the value of 2.3GHz and 2.4GHz spectrum
- **Two railroad companies (USA)** – Valuation of 220MHz spectrum
- **Financial organisation (USA)** – Valuation of 220MHz specialised mobile radio (SMR) spectrum

### Spectrum policy/management projects for operators and spectrum users

- **Digital UK (United Kingdom)** – White paper on potential long-term re-organisation of low-frequency mobile spectrum from 694-960MHz
- **Orange (France)** – Analysis of the cost of clearing existing users from the 700MHz band
- **Three (UK)** – Development of white paper regarding the device ecosystem of the 1.4GHz band, which was included by Three in its response to a regulatory consultation
- **Abertis, Arqiva, BBC, BNE, EBU and TDF (Europe)** – Assessment of the economic benefits across the EU from mobile gaining access to the 470–694MHz band, compared to continued use for DTT
- **The GSM Association (Global)** – Development of a series of country-specific reports regarding the economic benefits from making the 2.7–2.9GHz band available for mobile broadband
- **EE & Three (UK)** – Development of three responses to regulatory consultations regarding Annual Licence Fees for 900MHz and 1800MHz spectrum
- **The GSM Association** – Development of a report on an indicative evaluation of making digital dividend spectrum available for mobile broadband in Egypt
- **BBC and Channel 4 (UK)** – Development of a report to investigate the merits of Administered Incentive Pricing (AIP) for broadcasting spectrum
- **The GSM Association** – Study into the economic benefits from making the 2.7-2.9GHz band available for mobile broadband use in Western Europe
- **GSM Association (Global)** – Study to assess the actual benefits that have occurred from use of digital dividend spectrum for mobile broadband services
- **GSM Association (Global)** – Development a series of case studies to investigate how regulators have approached clearing and then awarding the 700MHz/800MHz bands
- **Play (Poland)** – A study to identify measures of how efficiently mobile operators are using spectrum

[redacted]

- **BT (UK)** – Support to respond to the Independent Spectrum Broker's (ISB) report
- **Orange Group -(Global)** – Development of a spectrum auction price database
- **Provider of cellular solutions for the aviation industry (Asia)** – Detailed collation of the frequencies used for cellular networks across Asia
- **UMTS Forum (Global)** – Forecast of mobile spectrum demand between 2010-2020

### Spectrum projects for regulators and government bodies

- **ICASA (South Africa)** – Support to design an award process for 700MHz, 800MHz and 2600MHz spectrum
- **AKOS (Slovenia)** – Support to design an award process for a multiband auction
- **NITA (Denmark)** – Mobile spectrum demand forecast
- **NITA (Denmark)** – Support to design an award process for the 800MHz band
- **IDA (Singapore)** – Support to develop a strategy for the digital dividend
- **Ofcom (UK)** – Study to explore potential models for spectrum band management
- **NITA (Denmark)** – Support to design an award process for the 2.6GHz band
- **Ofcom (UK)** – Study to design a scheme to clear PMSE users from the 800MHz band
- **Ofcom (UK)** – Study to benchmark reasonable rates of return for a spectrum band manager
- **Ministry of Economic Affairs (Netherlands)** – Study on mechanisms to avoid winner's curse in broadcast radio spectrum awards
- **European Commission** – High profile study to assess the benefits of a coordinated European approach to the digital dividend
- **ARCEP (France)** – Study to quantify the economic benefits of various uses of the digital dividend in France
- **Ofcom (UK)** – Study to develop a methodology for deriving administered incentive pricing (AIP) for 69 spectrum bands used for PMSE
- **Ofcom (UK)** – Study to assess the administered incentive pricing (AIP) for business radio spectrum in VHF Band I
- **NITA (Denmark)** – Study to assess options regarding the re-farming of the 900MHz and 1800MHz bands from GSM
- **Ofcom (UK)** – High profile study to recommend an award process for the digital dividend
- **Ofcom (UK)** – Study to recommend an award process for the 2.6GHz band
- **Ofcom (UK)** – Study to understand the interference issues associated with the future use of L-Band (1452-1492MHz)
- **Ofcom (UK)** – Study to recommend an award process for L-Band (1452-1492MHz)
- **NITA (Denmark)** – Support to award a 2.1GHz licence
- **UK government** – Forecast of spectrum demand from commercial services between 2005 and 2015

### Other regulatory projects

- **European Commission** – Assessment of the competition impacts of zero-rating in broadband markets
- **Telstra (Australia) –** Assessment of the incremental costs of meeting the Universal Service Obligation (USO) for fixed voice services
- **Home Office (UK)** – Benchmarking of the cost of rural cell sites for an emergency services mobile network
- **Everything Everywhere, Telefónica, Three, Vodafone (UK)** – Analysis of the costs and benefits of a national roaming obligation proposed by the UK Government
- **Ooredoo (Oman)** – Independent assessment of the health of both the mobile and fixed markets and identifying regulatory actions for priority

- **Orange (Romania)** – Assistance with responding to the regulator's public consultation about its long run incremental costing (LRIC) model for mobile termination services
- **Orange (Switzerland)** – assistance with responding to the regulator's public consultation on costing methodologies for fixed wholesale broadband access services, including fibre-to-the-home
- **Ofcom (UK)** – Assessment of the various technical approaches to providing pre-call announcements for non-geographic call services
- **Ofcom (UK)** – Assessment of flow of funds for non-geographic call services
- **Ofcom (UK)** – Assessment of the costs of various delivery platforms for digital radio (e.g. DAB, internet based)
- **Vodafone (Romania)** – Development of a bottom-up LRIC model
- **Ofcom (UK)** – Study to forecast mobile base station costs in the UK

### Network strategy projects

- **Private Client (Southern Europe)** – Development of a detailed mobile network model to determine an operator's 5-year strategic plan
- **1&1 Drillisch (Germany)** – Support in negotiations regarding the wholesale price for MVNO services, included benchmarking and forensic investigation of host's cost base
- **Private Client (Southern Europe)** – 5-year network strategy for a mobile operator, based on a detailed site-level network model
- **Telstra (Australia) –** Lead the business case modelling team during cross-functional project to redefine Telstra's overall network strategy over a 5-10 year horizon
- **Telstra (Australia) –** Assessment of the case for deploying Network Function Virtualisation (NFV) across the mobile, fixed and broadcast networks
- **Telstra (Australia) –** Assessment of the business case to decommission the PSTN/copper network
- **Telstra (Australia) –** Development of business case for the deployment of LTE-B
- **Orange Group (Africa) –** Project to develop a pan-African RAN sharing strategy
- **OPTA (Netherlands)** – Evaluation of the business case for alternative operators to use fibre unbundling
- Department of Communications, Energy and Natural Resources (Ireland) – Expert advice regarding the development of NGNs
- **OPTA (Netherlands)** – Evaluation of the business case for alternative operators to use sub-loop unbundling
- **ComReg (Ireland)** – Investigation into the business case for alternative operators to use sub-loop unbundling
- **France Telecom (France)** – Assessment of the business case for the deployment of FTTH and FTTC
- **Vodafone and Orange (UK)** – Large project to firstly assess the business case for network sharing, and then to assist in the creation of the new joint venture

### Business strategy/planning projects

- **Cable Bahamas** – Development of a mobile network launch business plan
- **GSM Association (Global)** – Study to quantify the differences in the total cost of ownership for 2G and 3G embedded mobile devices
- **COLT** – Development of an historic and forward-looking profitability model
- **Putnam Investments (Europe)** – Primary consumer research to understand the impact of the introduction of mobile data on various European mobile operators

### Transaction support

- **Private Clients (East Asia)** – For two merging mobile operators, development of a submission to the competition authority for the merged entity to retain all of its existing spectrum

- **Private Client (Western Europe)** – Review of a business case model for the acquisition of another operator in the market
- **Private Client (Switzerland)** – Commercial due diligence of a start-up fixed operator

### Other tender and auction projects

- **Private Client (Europe)** – Bid strategy support for a renewable energy company ahead of an offshore windfarm tender process
- **Telstra (Australia)** – Support to develop an optimal negotiation strategy during a sports content rights tender process

### Languages

- English (mother tongue), French (basic), German (basic)

# Annex D Declarations made in accordance with the Federal Court's Harmonised Expert Witness Code of Conduct

1.1 We have read the Federal Court's Harmonised Expert Witness Code of Conduct and agree to be bound by it.

1.2 We have made all the inquires that we believe are desirable and appropriate (save for any matters identified explicitly in the report), and no matters of significance which we regard as relevant have, to our knowledge, been withheld.

1.3 Signed:

A.P. Wright

1.4 Date: 27 July 2022

1.5 Signed:

L.P. Sanders

1.6 Date: 27 July 2022

# Annex E Letter of Instruction

Aetha's letter of instruction is provided on the following pages.

Special Counsel Geoff Petersen
Contact Geoff Petersen
T [redacted]
[redacted]

Our ref GCP:1049539

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**27 July 2022**

By email: [redacted]

Lee Sanders
Managing Partner
Aetha Consulting Ltd

Andrew Wright
Partner
Aetha Consulting Ltd

[redacted]

Dear Mr Sanders and Mr Wright

**Application to the Australian Competition and Consumer Commission for Merger Authorisation**

1 We refer to our letter of engagement to you dated 29 April 2022. Defined terms in that letter have the same meaning in this letter.

2 As you are aware, Gilbert + Tobin act for Telstra. We are instructed to seek your expert opinion, in the form of a written report, in connection with the Authorisation Application and addressing certain matters raised in stakeholder submissions.

3 This letter sets out instructions for the preparation of your expert report.

**Background**

4 On 27 June 2022, the ACCC received a submission from Optus in relation to the Authorisation Application (**Optus Submission**). The Optus Submission was accompanied by a report from Analysys Mason.

5 The Optus Submission and Analysys Mason report make certain claims regarding the potential impact of the Proposed Transaction on the relative network capacity of Optus and the MOCN in the 17% Regional Coverage Zone. In particular, Optus claims that:

(a) "*The level of spectrum asymmetry will grant Telstra material network quality and cost advantages which cannot be matched by Optus, or any other potential new entrant network*" (paragraph 5.25); and

(b) "*An abundance of spectrum, particularly low band, improves the cost efficiencies of network deployment while access to a disproportionate amount of mid band spectrum means that Telstra is able to out perform any competition on a capacity basis without the need to invest in expensive spectral efficiency technology*" (paragraph 5.27).

## Instructions

6 Please prepare a report assessing the claims made in the Optus Submission regarding the potential impact of the Proposed Transaction on the relative network capacity of Optus and the MOCN in the 17% Regional Coverage Zone.

## Documents provided

7 In preparing your report, you may rely on the documents listed in **Schedule 1** (being the relevant agreements and data that we have provided, the Optus submission and the Analysys Mason report).

## Contents of your report

8 We ask that you prepare your report in accordance with the requirements of the Federal Court's Expert Evidence Practice Note (GPN-EXPT) (**Practice Note**), which includes the Harmonised Expert Witness Code of Conduct (**Code**). A copy of the Practice Note (including the Code) was enclosed with your letter of engagement.

9 Under the Code, your report must clearly state the following:

(i) your name and address;

(ii) an acknowledgement that you have read this code and agree to be bound by it;

(iii) your qualifications as an expert to prepare the report;

(iv) the assumptions and material facts on which each opinion expressed in the report is based (this letter of instructions may be annexed);

(v) the reasons for and any literature or other material utilised in support of each such opinion;

(vi) (if applicable) that a particular question, issue or matter falls outside your field of expertise;

(vii) any examinations, tests or other investigations on which you have relied, identifying the person who carried them out and that person's qualifications;

(viii) the extent to which any opinion which you have expressed involves the acceptance of another person's opinion, the identification of that other person and the opinion expressed by that other person;

(ix) a declaration that you have made all the inquiries which you believe are desirable and appropriate (save for any matter identified explicitly in the report), and that no matters of significance which you regard as relevant have, to your knowledge, been withheld from the court;

(x) any qualifications on an opinion expressed in the report without which the report is or may be incomplete or inaccurate;

(xi) whether any opinion expressed in the report is not a concluded opinion because of insufficient research or insufficient data or for any other reason; and

(xii) where the report is lengthy or complex, a brief summary of the report at the beginning of the report.

**Next steps**

10 We look forward to receipt of your report in due course.

Yours faithfully
**Gilbert + Tobin**

| | | |
|---|---|---|
| **Geoff Petersen** | **Simon Muys** | **Andrew Low** |
| Special Counsel | Partner | Partner |

**Schedule 1: Background documents**

| No. | Document description |
|---|---|
| **Agreements** | |
| 1. | Mobile Site Transition Agreement (Variation No 1 - 07.04.22) |
| 2. | MOCN Service Agreement (Variation No.1 - No site list - 07.04.22) |
| 3. | Spectrum Authorisation TPG and Telstra (Variation No 1 - 07.04.22) |
| 4. | Variation Agreement - MOCN arrangements (No attachments - 07.04.22) |
| 5. | Annexure A to Schedule 3 - Execution SA1 List |
| 6. | Annexure B to Schedule 3 - Execution Sites in Boundary SA1s List |
| Optus Submission | |
| 7. | Optus: Submission in response to ACCC market inquiry - Telstra and TPG application for merger authorisation for proposed spectrum sharing in regional Australia (June 2022) |
| 8. | Analysys Mason: Final report for Optus: The ACCC's consideration of the Telstra–TPG agreement (27 June 2022) |
| **Other documents and data** | |
| 9. | Spectrum area polygons |
| 10. | Frequency zone data |
| 11. | HCIS Polygons |
| 12. | Industry Spectrum Charts |
| 13. | MOCN Site List |
| 14. | Ookla market share data (national and for Regional Coverage Zone) |
| 15. | Telstra site build history |
| 16. | Data file provided by Telstra in response to Aetha data request |

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