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Economic Analysis of Dense Air and One New Zealand's Spectrum Acquisition

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Executive Summary

Dense Air and One New Zealand ("One NZ") have entered into an agreement where One NZ will gain access to 70 megahertz of mid-band spectrum (a 2x35 megahertz portion of the 2.6 GHz frequency band) until 2028 (when the management rights expire), with the option to seek renewal of management rights at the end of that period (the "Proposed Acquisition"). With the Proposed Acquisition, One NZ will have rights to manage 100 megahertz of the 2.6 GHz spectrum band. The New Zealand Commerce Commission ("the Commission") has expressed concern about the concentration of spectrum in the input market and potential anticompetitive outcomes in the output market as a result of the Proposed Acquisition, and is considering a counterfactual where 2degrees (a competing Mobile Network Operator ("MNO") operating in New Zealand) acquires the spectrum instead of One NZ.

In this report, we assess the competitive impact of this Proposed Acquisition. We believe that the relevant input market should be defined as all available spectrum that have been allocated for commercial wireless use in New Zealand ("NZ") because these bands all serve the same end market. For this reason, we find that 2degrees' claim that 2.3 GHz – 2.6 GHz band should be the relevant market is misleading. We also argue that the output market should be defined more broadly and that 4G fixed wireless services should be considered to be in the relevant market, with other fixed broadband services such as fibre and satellite. 2degrees' characterization of the 4G fixed wireless market as constituting a separate market is incorrect because it ignores the competitive pressures brought by these other services.

We find that the Proposed Acquisition is not likely to be unilaterally or vertically anticompetitive. Rather, the spectrum transfer resulting from the Proposed Acquisition is likely to be unilaterally and vertically procompetitive. Further, the counterfactual proposed by the Commission will create less benefit than the Proposed Acquisition. Overall, the Proposed Acquisition is likely to lead to greater competition, lower prices, higher quality services, and more innovation. We summarize the evidence that supports our three findings below.

- *Proposed Acquisition is Not Anticompetitive*

  First, based on international comparison, we find that NZ MNOs, in general, do not appear to be spectrum constrained. Thus, with its current capacity, 2degrees should be able to offer 4G Fixed Wireless Access ("FWA") and wholesale services with its current spectrum holdings and incremental network buildout just as one NZ currently

does. Hence, we see no reason for the Commission to take regulatory measures to subvert market outcomes (*i.e.*, for the Proposed Acquisition) for theoretical concerns regarding potential unilateral and/or vertical anticompetitive effects that are unfounded.

- *Proposed Acquisition is Procompetitive*

  Second, the Proposed Acquisition is procompetitive. It will close the gap between Spark and One NZ's spectrum holdings and make One NZ a better competitor where it can serve as an effective competitive constraint on Spark. In the mobile broadband marketplace, Spark underperforms One NZ on various service quality measures, but is able to charge higher prices. With spectrum holdings that match that of Spark's, One NZ will be able to provide even better quality services at lower prices relative to the status quo, which translates to increased pricing pressure on Spark which should lower prices and increase quality and innovation for NZ consumers.

- *The Counterfactual Proposed by the Commission Will Generate Less Procompetitive Impacts Relative to the Proposed Acquisition*

  Third, the counterfactual proposed by the Commission will generate less procompetitive impacts relative to the Proposed Acquisition, *i.e.*, the Proposed Acquisition will generate a greater degree of procompetitive impacts for NZ consumers compared to the counterfactual. It will be more efficient and cost-effective for One NZ to deploy the 2.6 GHz band than 2degrees. One NZ already has infrastructure in place that can effectively deploy the 2.6 GHz band as demonstrated by its use of the frequency band for 4G FWA, when Dense Air NZ loaned the 2.6 GHz band to One NZ (then Vodafone) during the COVID-19 pandemic. In contrast, 2degrees, will need to invest in new infrastructure to bring this spectrum online. Alternatively, they could invest in infrastructure for better utilization of existing bands, or obtain the IMSC spectrum and deploy infrastructure using that band. The larger investment by 2degrees required to bring the 2.6 GHz band into service compared to the investments needed by One NZ, suggest higher costs passed through to consumers under the Counterfactual proposed by the Commission.

I. Introduction

Dense Air, a small cell services provider, owns spectrum assets in New Zealand ("NZ") which it acquired for NZ$ 25.75 million (US$17.5 million) in 2018.[1] In April 2020, it temporarily loaned its 2.6 GHz spectrum to One New Zealand Group Limited ("One NZ") (formerly Vodafone New Zealand) for three months to address an increase in cellular data usage resulting from COVID-19 lockdown measures.[2] Subsequently, Dense Air and One NZ entered into an agreement where One NZ would gain access to 70 megahertz of mid-band spectrum (a 2x35 megahertz portion of the 2.6 GHz frequency band) until 2028 when the management rights expire, with the option to seek renewal of management rights at the end of that period (the "Proposed Acquisition").[3] With the Proposed Acquisition, One NZ would own 100 megahertz of the 2.6 GHz spectrum band.[4] There are three main mobile network operators ("MNO") in the NZ wireless industry: Spark New Zealand Limited ("Spark"), One NZ, and Two Degrees Mobile Limited ("2degrees"), and One NZ is the second largest wireless company in NZ.[5]

In November 2023, the NZ Commerce Commission ("the Commission") issued a Statement of Preliminary Issues ("Preliminary SOI") where it outlined its framework for assessing this

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1 In November 2018, Dense Air acquired 70 megahertz of 2.6 GHz spectrum management rights from Blue Reach and Cayman Wireless in NZ. *See,* Juha Saarinen, "Rich Lister Malcolm Dick Banks Huge Profit from Spectrum Sale," November 21, 2018, last accessed March 1, 2024, available at https://www.nzherald.co.nz/business/rich-lister-malcolm-dick-banks-huge-profit-from-spectrum-sale/RZKASMENETTCRJGJZUDGZBIT4Y/ . *See also*, Tom Leins, "How a Slough Company Quietly Secured 5G Spectrum in Major Markets Around the World," *Tele Geography*, November 19, 2019, accessed February 26, 2024, available at https://blog.telegeography.com/how-a-slough-company-quietly-secured-5g-spectrum-in-major-markets-around-the-world.

2 In 2002, Vodafone NZ enhanced 4G base stations nationwide and expanded spectrum to increase internet capacity, responding to a surge in data usage during COVID-19 lockdown measures. The company collaborated with Nokia to augment capacity at 265 4G cell sites with the additional spectrum leased from Dense Air in the 2.6 GHz band. *See*, "Vodafone NZ Adds Network Capacity to Cope with Data Surge," *Dense Air,* April 7, 2020, accessed February 26, 2024, available at https://denseair.net/vodafone-nz-adds-network-capacity-to-cope-with-data-surge/.

3 *See*, Joseph Waring, "One NZ to Acquire Dense Air Spectrum," *Mobile World Live*, November 3, 2023, last accessed February 26, 2024, available at https://www.mobileworldlive.com/operators/one-nz-to-acquire-dense-air-spectrum/#:~:text=One%20New%20Zealand%20moved%20to,to%20renew%20the%20management%20rights. Note that One NZ has argued that due to the lower power restriction on 5 megahertz of Dense Air's 2.6 GHz spectrum "only 2 x 30 MHz of Dense Air's spectrum is suitable for 5G." *See,* Commerce Commission New Zealand, "Statement of Issues – One NZ/Dense Air," February 2, 2024, at pp. 6-7, available at

acquisition.[6] It stated that its approach to analyzing the competitive impact of the proposed acquisition would be based on NZ's Mergers and Acquisitions Guidelines and would be assessed "using the substantial lessening of competition test."[7] It also stated that spectrum acquisitions by a provider could lessen competition through unilateral, vertical, and conglomerate effects.[8] For the unilateral effect, it would consider whether the consolidation of spectrum holdings by a single entity results in the ability to raise prices, diminish quality, reduce innovation, or negatively impact an aspect of service or competition (*i.e.* increase quality-adjusted prices) in pertinent downstream retail and/or wholesale telecommunications markets.[9] On the vertical effects, it would consider whether the acquisition in any way restricted the capacity of competitors to effectively compete with the acquiring entity in delivering wholesale and/or retail telecommunications services, or obstructed their ability to expand and exert a more substantial competitive influence, or increased the cost of spectrum or network capacity for rivals.[10]

On February 2024, the Commerce Commission issued a subsequent Statement of Issues ("SOI") highlighting the theories of harm it was continuing to investigate.[11] The Commerce Commission states that it is considering the counterfactual where 2degrees obtains Dense Air's spectrum, and are evaluating the comparative capacity of MNOs and their competitiveness in delivering retail and wholesale mobile as well as wireless broadband services in light of the Proposed Acquisition.[12] It is investigating whether the Proposed Acquisition will "inhibit the ability of 2degrees to compete," "the extent to which the

https://comcom.govt.nz/__data/assets/pdf_file/0021/342255/One-NZ-and-Dense-Air-Statement-of-Issues-2-February-2024.pdf ("Commerce Commission SOI February 2024").

4 Up until 2028, One NZ will own 100 megahertz, with the 70-megahertz from this Acquisition. However, after 2028, 20% of the 70 megahertz of acquired spectrum will be allocated to the Interim Māori Spectrum Commission. *See*, Commerce Commission SOI February 202, at pp. 6-7.

5 See, Christopher Hughes, "Estimated Mobile Phone Provider Market Share in New Zealand, in 2021, by Subscribers," *Statista*, May 10, 2023, accessed February 26, 2024, available at https://www.statista.com/statistics/996221/estimated-market-share-mobile-providers-by-subscribers-new-zealand/, ("Estimated Mobile Phone Provider Market Share in New Zealand"). *See also*, Submission of 2degrees Related to the Proposed Acquisition, at p.17.

6 *See*, Commerce Commission New Zealand, "Statement of Preliminary Issues – One NZ/Dense Air," November 15, 2023, available at https://comcom.govt.nz/__data/assets/pdf_file/0022/334147/One-NZ_Dense-Air-Statement-of-Preliminary-Issues-15-November-2023.pdf, ("Commerce Commission Preliminary SOI November 2023").

7 *See*, Commerce Commission Preliminary SOI November 2023, at p.2.

8 *See*, Commerce Commission Preliminary SOI November 2023, at p.4.

9 *See*, Commerce Commission Preliminary SOI November 2023, at p.4.

10 *See*, Commerce Commission Preliminary SOI November 2023, at p.4.

11 *See*, Commerce Commission SOI February 2024.

12 *See*, Commerce Commission SOI February 2024, at p. 1.

competitive constraint provided by 2degrees and One NZ on Spark might differ in the factual compared to the counterfactual," and whether consumers "would be likely to face higher prices, less choice, or lower quality for telecommunications services."[13] The primary theory of harm being analyzed is that the Proposed Acquisition "would increase the disparity between One NZ's holdings and those of 2degrees and could accordingly change the relative capacities of the three MNOs" and this will adversely affect the competitiveness in the mobile telecommunications market and the Fixed Wireless Access ("FWA") services market, and harm consumers.

This report responds to the concerns stated by the Commerce Commission and finds that there is no likelihood of anticompetitive effects from the Proposed Acquisition, and in fact, consenting to this Proposed Acquisition will beneficial to the NZ consumers. The report is structured as follows. In Section II, we provide a brief primer on spectrum. In Section III, we provide relevant industry background on the competitive landscape of the NZ telecommunications industry, with a focus on the mobile and fixed wireless sector. In Section IV, we assess the competitiveness of the Proposed Acquisition based on findings from economic theory and empirical evidence from the NZ telecommunications industry. In Section V, we provide conclusions.

II. General Background on Spectrum as an Input

Spectrum, in the context of telecommunications, refers to the range of electromagnetic frequencies used for wireless communication. The allocation of spectrum allows for the provision of various services essential for modern communication. For terrestrial mobile uses, it enables voice calls, text messaging, and data transfer over cellular networks. Different frequency bands are allocated for 2G, 3G, 4G, and 5G technologies to support evolving mobile communication standards. Spectrum is also allocated for Wi-Fi services, enabling wireless local area networking (WLAN) in homes, businesses, and public spaces. It can also be used for providing high-speed internet access without the need for physical cables, *i.e.* in the provision of FWA. Both broadcast television and radio utilize specific spectrum bands for transmitting audio and video content to a wide audience. Certain spectrum bands are designated for satellite communication services, including satellite TV broadcasting, satellite phones, and

[13] *See*, Commerce Commission SOI February 2024, at p. 2.

data transmission. Other uses include Internet-of-Things ("IoT"), aeronautical and maritime communications, and other government and defense uses such as radar technology.

A. Spectrum as an Input to Communication Services

1. Terrestrial Mobile Wireless Network

Providing a wireless service requires radio spectrum.[14] Radio spectrum can be distinguished by frequency: lower frequencies generally have greater geographic reach but lower data carrying capacity overall, and higher frequencies tend to have lower geographic reach but more bandwidth—*i.e.* higher data carrying capacity.[15] There is also a fundamental relationship between the cost of deploying a mobile network and the propagation characteristics of a frequency band. For example, all else equal, deploying spectrum in the 2.5 GHz band would require many more towers than the 700 MHz band, and thus would be significantly more expensive to deploy when covering a certain amount of area.[16]

The mobile architecture allows the reuse of frequencies.[17] Each cell, which has a fixed amount of capacity, covers a small geographic area, and any added cells that fill in the geography represent added capacity.[18] Engineers remind us that there are several ways to avoid capacity constraints on wireless networks.[19] One very important implication of networks built on cellular architecture, as are all terrestrial mobile broadband networks today, is that wireless carriers such as One NZ or 2degrees can increase the capacity of a network in three complementary ways: increasing spectral efficiency, deploying more spectrum, and building

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[14] The radio spectrum covers the range of electromagnetic spectrum that is defined from 1 Hz to 3000 GHz. *See*, U.S. Department of Transportation, "What is Radio Spectrum?" accessed February 27, 2024, available at https://www.transportation.gov/pnt/what-radio-spectrum.

[15] *See,* Jon Gold, "How 5G Frequency Affects Range and Speed," *Network World*, July 23, 2020, available at https://www.networkworld.com/article/968979/how-5g-frequency-affects-range-and-speed.html.

[16] *See,* Zoraida Frias, Luis Mendo and Edward J. Ouchton, "How Does Spectrum Affect Mobile Network Deployments? Empirical Analysis Using Crowdsourced Big Data," *IEEEAccess*, Vol. 8, October 29, 2020, at pp. 190812-190813, available at https://ieeexplore.ieee.org/document/9229062 ("How Does Spectrum Affect Mobile Network Deployments?").

[17] *See*, Inside Towers, "The Fundamentals of Cellular System Design," January 14, 2020, available at https://insidetowers.com/cell-tower-news-the-fundamentals-of-cellular-system-design/, ("The Fundamentals of Cellular System Design").

[18] *See*, The Fundamentals of Cellular System Design.

[19] See, Richard N Clark, "Expanding Mobile Wireless Capacity: The Challenges Presented by Technology and Economics," *Telecommunications Policy* 38(8-9) (September 2014): 693-708, at pp. 694-695, available at https://www.sciencedirect.com/science/article/pii/S0308596113001900 ("Expanding Mobile Wireless Capacity").

more cell sites.[20] Note that each dimension experiences diminishing marginal returns as it is incrementally invested in. For example, a service provider can hold spectrum deployment constant and still improve network capacity by adding more sectors for denser spectrum reuse or more cell sites, but doing so becomes increasingly expensive per unit of capacity added. Optimally, each firm's network should be designed such that the willingness to pay of improving overall capacity by investing in each of these dimensions is equal.

a. Increase Spectral Efficiency

Increasing spectral efficiency allows the same amount of spectrum and same cell sites to be used more efficiently and to serve more connections, *i.e.* an increase in spectral efficiency implies that the same bandwidth can carry more data.[21] It is usually expressed as "bits per second per hertz," or bits/s/Hz, *i.e.* the "net data rate in bits per second ("bps") divided by the bandwidth in hertz."[22] 5G has increased the efficiency of spectrum use over previous technologies such as 4G.[23] New and improved technologies, such as Advanced Antenna Systems ("AAS") equipped with beamforming and MIMO ("Multiple Input, Multiple Output") techniques, have also increased the usability of mid-band spectrum, and have improved capacity and spectral efficiency of the radios.[24] However, spectral efficiency cannot be increased beyond a certain limit because there is a "hard limit to how much data can be transmitted in a given bandwidth."[25] Therefore, additional solutions are needed to increase capacity of wireless networks.

b. Densifying the Network by Building More Cell Sites

Creating more cell sites (thereby reducing the coverage area of existing cells) is a second way to increase the capacity of a wireless network because it further increases the reuse of

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[20] *See,* Expanding Mobile Wireless Capacity, at p. 694.

[21] *See,* "Spectral Efficiency," *Techplayon*, accessed February 16, 2024, available at https://www.techplayon.com/spectral-efficiency-5g-nr-and-4g-lte/ ("Spectral Efficiency").

[22] *See,* Spectral Efficiency.

[23] *See,* "Spectral Efficiency: 5G-NR and 4G-LTE Compared," *5G Networks*, February 8, 2021, available at https://www.5g-networks.net/5g-technology/spectral-efficiency-5g-nr-and-4g-lte-compared/.

[24] *See,* Noman M. Alam, Mark Racek, and Kumar Balachandran, "Mid-Band Spectrum – Laying a strong foundation for 5G," Ericsson, July 4, 2022, available at https://www.ericsson.com/en/blog/6/2022/mid-band-spectrum-in-the-us-a-strong-foundation-for-5g, ("Mid-Band spectrum – Laying a strong foundation for 5G").

[25] *See,* Grigol Basilashvili, "Study of Spectral Efficiency for LTE Network," *American Scientific Research Journal for Engineering, Technology, and Sciences* 29(1) (March 2017):21-32, available at https://www.researchgate.net/publication/323534897_Study_of_Spectral_Efficiency_for_LTE_Network.

spectrum in the network.[26] Increasing the number of cell sites increases the capacity of a given network by dividing or splitting cells to reduce cell size. This increases the number of cells serving a given area, with each cell continuing to deploy the full set of frequencies available for the market area. This is achieved by "deploying more radio towers/antennas and shrinking the reach of each tower by reducing the radiated power of its radio transmissions."[27] This allows for the reuse of existing spectrum, thereby increasing the amount of traffic carried by the deployed spectrum increases.[28] Investments in additional cell sites include capital expenditures, such as the cost of the land, the tower, radios, and backhaul, and operating expenditures, such as electricity, maintenance, security, etc. [29]

c. Deploying Additional Spectrum

As discussed earlier, if the network is spectrum constrained, technology solutions are necessary but not necessarily sufficient to meet growing traffic demands. Amongst all inputs, spectrum holdings are important assets that enable wireless operators to provide wireless communication services, such as wireless broadband, voice, IoT, Machine-to-Machine ("M2M"), and other services.[30] The holdings represent the specific radio frequencies that carriers are licensed to use to deploy terrestrial wireless services. These holdings are critical for the capacity, coverage, and quality of service offered by carriers and play a significant role in shaping the wireless communication landscape in the country.

In general, to meet the growing demands of wireless networks, additional frequencies will have to be part of the solution, although how much more spectrum is needed will vary by country, existing provider holdings in the country, traffic load on the networks, tower

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[26] See, Federal Communications Commission (FCC), "Mobile Broadband: The Benefits of Additional Spectrum," October 2010, at p. 12, available at https://transition.fcc.gov/national-broadband-plan/mobile-broadband-paper.pdf.

[27] See, Expanding Mobile Wireless Capacity, at p. 695.

[28] See, Expanding Mobile Wireless Capacity, at p. 695.

[29] See, Expanding Mobile Wireless Capacity, at p. 695.

[30] *See,* Cisco, "Cisco Annual Internet Report (2018-2023)," 2020, accessed February 24, 2024, available at https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.pdf. *See also,* ITU and The World Bank, "Spectrum management: Key applications and regulatory considerations driving the future use of spectrum," September 13, 2020, accessed February 20, 2024, available at https://digitalregulation.org/spectrum-management-key-applications-and-regulatory-considerations-driving-the-future-use-of-spectrum/. *See also,* Edward Parker, Spencer Pfeifer, and Timothy M. Bonds, "America's 5G Era: Strengthening Current and Future U.S. Technical Competitiveness in 5G," *RAND Corporation*, June 2022, at p. 4, available at https://www.rand.org/content/dam/rand/pubs/perspectives/PEA400/PEA435-3/RAND_PEA435-3.pdf, ("America's 5G Era").

infrastructure, spectral efficiency, expected spectrum availability, and the expected increase in demand.

2. Fixed Wireless Access (FWA)

FWA refers to the use of wireless communication for providing high-speed internet access to fixed locations, such as homes or businesses.[31] It serves as an alternative to traditional wired broadband solutions like coaxial cables, fibre optic cables, or DSL for the last mile. Fixed wireless services use 4G and 5G radio spectrum to provide connectivity between two points, such as a mobile network cell and a FWA device.[32] FWA has been recognized as a crucial technology in bridging the digital divide and providing reliable and high-speed internet connectivity to areas where traditional wired infrastructure may be challenging to implement.[33] Most service providers worldwide are offering FWA services.[34] According to Ericsson, the number of FWA connections exceeded 60 million in 2020 and are expected to exceed 180 million by 2026 – reflecting an annual growth rate of about 20.09%.[35] In NZ, as of 2018, fixed wireless was the third most common type of internet connection in NZ, following copper wire and fibre optic.[36]

In most European and Asian countries, FWA is offered on lower mid-range spectrum such as 1.8 GHz, 2.1 GHz, 2.3 GHz and the C-Band (3 GHz).[37] In NZ, an additional 80 Megahertz of 3.5

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[31] Also called wireless broadband. We use both terms interchangeably in this report.

[32] *See,* Nokia, "Fixed Wireless Access Explained," June 28, 2023, accessed February 26, 2024, available at https://www.nokia.com/about-us/newsroom/articles/fixed-wireless-access-explained/, ("Fixed Wireless Access Explained").

[33] *See,* Fixed Wireless Access Explained.

[34] *See,* Linda Hardesty, "FWA is Hot: 72% of Global Service Providers are Offering FWA, says Ericsson," *Fierce Wireless*, June 16, 2021, accessed February 26, 2024, available at https://www.fiercewireless.com/wireless/fwa-hot-72-global-service-providers-are-offering-fwa-says-ericsson, ("FWA is Hot: 72% of Global Service Providers are Offering FWA, Says Ericsson"). ("Ericsson looked at the retail packages offered by service providers worldwide and found that out of the 311 service providers studied, 224 had an FWA offering, which represents an average of 72% globally.")

[35] *See,* FWA is Hot: 72% of Global Service Providers are Offering FWA, Says Ericsson. ("[Ericsson] estimates that there were more than 60 million FWA connections by the end of 2020. This number is forecast to grow more than threefold through 2026, exceeding the 180 million connections threshold."). Note that annual growth rate = $\left(\frac{180\ million}{60\ million}\right)^{\frac{1}{6}} - 1$.

[36] *See,* Christopher Hughes, "Number of Internet Connections in New Zealand in Financial Year 2018, by Connection Type," *Statista,* January 3, 2023, accessed February 26, 2024, available at https://www.statista.com/statistics/995503/number-internet-connections-by-type-new-zealand/.

[37] *See,* Michael D. Breitenstein, Heinz T, Bernold, Rüdiger Schict, and Ernesto Wandeler, "The Secret to Fixed Wireless Access? Location, Location, Location," *Boston Consulting Group,* September 30, 2022, accessed February 26, 2024, available at https://www.bcg.com/publications/2022/secret-to-fixed-wireless-access, ("The Secret to Fixed Wireless Access? Location, Location, Location").

GHz spectrum was allocated to each of the MNOs in 2023 "for accelerated 5G deployments and investment in rural connectivity."[38] This spectrum is also well suited for deploying FWA and enables a large amount of FWA capacity for the NZ MNOs in the status quo.[39] In the United States ("U.S."), 5G services for FWA are also offered on the millimeter wave spectrum in addition to the usual mid-band spectrum.[40] According to some reports, mid-band spectrum in the 2 GHz to 6 GHz range is considered ideal for 5G FWA as it allows for a good balance between footprint and bandwidth – allowing for better data transfer and connection speeds.[41] Thus, all the frequencies within the mid-band range of 1.8 GHz to 3.7 GHz appear to be equally suitable to the deployment of FWA.

3. Satellite

Increasingly, satellite communications have been playing an important role in providing customers with internet access, especially in areas that cannot rely on terrestrial infrastructure.[42] It allows end-users to have connectivity in remote and underserved parts of the world and can be deployed fairly quickly.[43] The satellite-to-device market is projected to grow rapidly in the next few years. As of 2023, this market had 25 million subscribers and by 2030, it is projected to have about 390 million, reflecting a growth rate of about 48.06% per year.[44] Furthermore, according to forecasts, the worldwide consumer segment of the 5G satellite communication market will grow from around US$1.1 billion in 2022 to approximately US$13.6 billion in 2032.[45]

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[38] *See,* Radio Spectrum Management, "The New Zealand Spectrum Outlook 2023 – 2027: A Forward Looking View of Radio Spectrum Management," at p. 8, September 2023, available at https://www.rsm.govt.nz/assets/Uploads/documents/annual/new-zealand-spectrum-outlook-2023-to-2027.pdf.

[39] *See,* Alpha, "Fixed Wireless Access is a Prime Use Case for CBRS," December 2019, available at https://alphawireless.com/fixed-wireless-access-is-a-prime-use-case-for-cbrs/. Note that the CBRS band is the U.S. is the 3.5 GHz band.

[40] *See,* The Secret to Fixed Wireless Access? Location, Location, Location.

[41] *See,* Fixed Wireless Access Explained.

[42] *See,* "Satellite Communication Systems Bridging the Digital Divide," *Utilities One,* October 28, 2023, accessed February 26, 2024, available at https://utilitiesone.com/satellite-communication-systems-bridging-the-digital-divide, ("Satellite Communication Systems Bridging the Digital Divide").

[43] *See,* Satellite Communication Systems Bridging the Digital Divide.

[44] *See,* Statista, "Subscribers in the direct satellite-to-device market worldwide from 2020 to 2030," February 26, 2023, accessed February 26, 2024, available at https://www.statista.com/statistics/1362432/direct-satellite-to-device-market-subscribers-worldwide/. To calculate the annualized growth rate, we divide 390 by 35, raise it to 1/7, and then subtract 1.

[45] *See,* Petroc Taylor, "5G satellite communication market worldwide in 2022 with a forecast for 2032, by end user," *Statista,* May 12, 2023, accessed February 26, 2024, available at https://www.statista.com/statistics/1384234/global-5g-satellite-communication-market/.

There are several spectrum bands currently in use for satellite communications. The L Band (1.518 GHz – 1.675 GHz), S Band (1.97 – 2.69 GHz) and Q/V Band (37.5-51.4 GHz) are used for mobile satellite services and the C Band (3.4 GHz – 7.025 GHz), X Band (7.25 – 8.44 GHz), Ku Band (10.7 GHz – 14.5 GHz), and Ka Band (17.3 GHz – 30 GHz) are used for fixed satellite services.[46]

4. Other Uses of Spectrum

There are various other uses cases for radio spectrum beyond providing telecommunications services such as calling, messaging, and data transmission over cellular networks. Notably, spectrum is widely used for broadcasting – *i.e.*, transmitting audio and video signals in only one direction for television and radio. For instance, the FM radio band (87.5 MHz-108 MHz) is used for broadcasting radio services and individual channels (subdivisions of the band) represent separate broadcast stations.[47] Terrestrial TV broadcasts, operate at low radio frequencies typically below 700 MHz.[48]

Moreover, spectrum is also used for telemetry. For instance, in the U.S., spectrum in the 608-614 MHz, 1395-1400 MHz, and 1427-1432 MHz bands are used for WMTS (Wireless Medical Telemetry Service).[49] This technology allows for remote monitoring of a patient's health as medical devices can transmit data using radio spectrum to a radio receiver.[50] This allows, for instance, a nurse to monitor a patient after surgery using a wireless cardiac monitor.[51] Licensed spectrum is also crucial for aviation systems and air traffic control, maritime communication and navigation, radio astronomy, and non-commercial organizations such as emergency services, military, and national security systems.[52]

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[46] "Satellite Frequency Allocation and the Band Spectrum," *Cadence PCB Solutions,* last accessed February 28, 2024, https://resources.pcb.cadence.com/blog/2023-satellite-frequency-allocation-and-the-band-spectrum.

[47] *See,* "Introducing Radio Spectrum," GSMA, February 2017, accessed February 26, 2024, available at https://www.gsma.com/spectrum/wp-content/uploads/2017/04/Introducing-Radio-Spectrum.pdf, ("Introducing Radio Spectrum").

[48] *See,* Introducing Radio Spectrum.

[49] *See,* Federal Communications Commission (FCC), "Wireless Medical Telemetry Service (WMTS)," accessed February 26, 2024, available at https://www.fcc.gov/wireless/bureau-divisions/mobility-division/wireless-medical-telemetry-service-wmts, ("Wireless Medical Telemetry Service (WMTS)").

[50] *See,* Wireless Medical Telemetry Service (WMTS).

[51] *See,* Wireless Medical Telemetry Service (WMTS).

[52] Unlicensed spectrum frequency bands also have several use cases such as Wi-Fi, Bluetooth, car key fobs and garage door openers. *See*, Introducing Radio Spectrum.

B. Deeper Dive into Spectrum

In modern wireless broadband networks, there is a trade-off between spectrum and capital investments when increasing the capacity of a network. As discussed below, the type of frequency determines the extent of this trade-off. Spectrum is divided into different frequency bands. When referring to a spectrum band on the map of radio frequencies, its location is identified by the frequencies covered by that band.[53] Different frequencies have different technical characteristics, which can confer different advantages in designing a wireless network.

As briefly mentioned earlier, there are three broad segments that radio frequencies for wireless use are segregated into. In general, sub-1 GHz frequencies are considered as low-band, between 1 – 6 GHz as mid-band, and mmW as high-band. Thus in the body of the Report, when discussing the bands we will use the terms "low-band" and "the sub-1 GHz bands" interchangeably, the terms "mid-band" and "1-6 GHz frequencies" interchangeably, and "high-band" and "mmW frequencies" interchangeably.

Lower frequencies tend to travel farther with the same energy. This allows the maximum size of a cell site to be larger when deploying lower frequencies than when deploying higher frequencies.[54] This is relevant when initially building a network. An initial network build must first achieve a coverage layer—a footprint of cell sites that cover the geographic market being served. Thus, lower frequency bands, with their relatively better coverage and propagation characteristics and good in-building penetration, are suitable for covering large geographic areas, including rural and suburban regions.[55] Figure 1 shows the coverage radii of some

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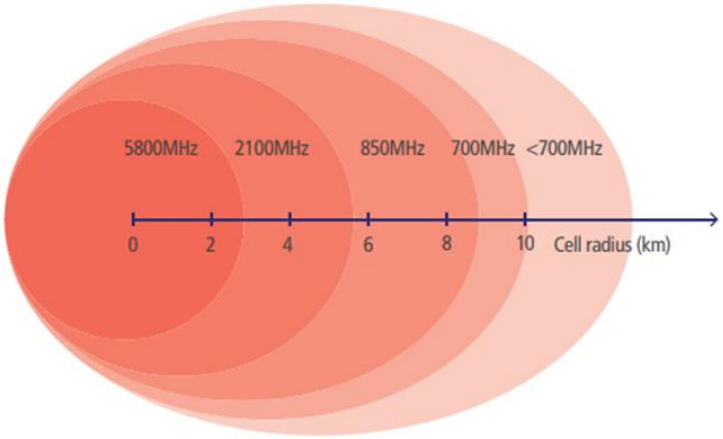
[53] *See,* National Telecommunications and Information Administration, "Federal Spectrum Use Summary: 30 MHz – 3000 GHz," June 21, 2010, accessed February 26, 2024, available at https://www.ntia.doc.gov/files/ntia/publications/spectrum_use_summary_master-07142014.pdf. *See also,* Federal Communications Commission (FCC), "Radio Spectrum Allocation," accessed February 16, 2024, available at https://www.fcc.gov/engineering-technology/policy-and-rules-division/general/radio-spectrum-allocation.

[54] See, Commerce Spectrum Management Advisory Committee, "Identifying Key Characteristics of Bands for Commercial Deployments and Applications Subcommittee Final Report and Recommendations," *NTIA*, November 17, 2017, at pp. 7, 11, available at https://www.ntia.doc.gov/files/ntia/publications/key_characteristics_sub-committee_final_report_nov_17_2017.pdf, ("Key Characteristics of Bands").

[55] *See,* GSMA, "5G Spectrum," GSMA Public Policy Position, June 2022, at pp. 4-5, available at https://www.gsma.com/spectrum/wp-content/uploads/2022/06/5G-Spectrum-Positions.pdf, ("GSMA 5G Spectrum"). *See also,* Gautam Talagery, Michael Carey, and Noman M. Alam, "Case study: Spectrum Simplified," Ericsson, 2023, accessed February 16, 2024, at p. 7, available at https://www.ericsson.com/4a1b1a/assets/local/reports-papers/further-insights/doc/ericsson-utilities-spectrum-simplified.pdf, ("Ericsson: Spectrum Simplified").

selected bands of spectrum.[56] For instance, we observe that the radii varies from 10 km for the 700 MHz band to about 5 km for the 2.1 GHz band.[57]

FIGURE 1: PROPAGATION CHARACTERISTICS OF LOW, MID, AND HIGH-BANDS



Source: GSMA, "The 2.6GHz Spectrum Band: An Opportunity for Global Mobile Broadband," last accessed March 1, 2024, available at https://www.gsma.com/spectrum/wp-content/uploads/2012/07/Spectrum-The-2-6GHz-band-Opportunity-for-global-mobile-broadband-English.pdf.

Where added capacity is needed, typically in areas over some threshold of population density, cells can be divided so that each cell's network capacity is deployed to cover a smaller geographic area and the assigned frequencies are reused more intensively. Lower frequencies are an advantage in areas of low demand, such as areas of low population density, where coverage is the main goal. In general, all low-bands are considered generally substitutable for one another in terms of coverage and capacity characteristics.[58]

Thus, low-band frequencies require fewer towers to cover a given area compared to mid and high-band frequencies, and are thus cheaper to deploy, and are essential for deploying a coverage layer.[59] In higher density areas, however, this advantage disappears. In such areas with large capacity demands, mid-band, such as the 2.4 GHz and 3.5 GHz, may be more

[56] Figure 1 represents typical maximum coverage ratios based on good terrain conditions. Actual maximum coverage will vary in practice.

[57] *See,* Figure 1.

[58] See, "Allocation Limits Advice for 850 MHz Expansion Band and 900 MHz Band Spectrum Allocation," *OPTUS*, December 2020, accessed February 27, 2024, at p. 3, available at https://www.accc.gov.au/system/files/Optus_33.pdf.

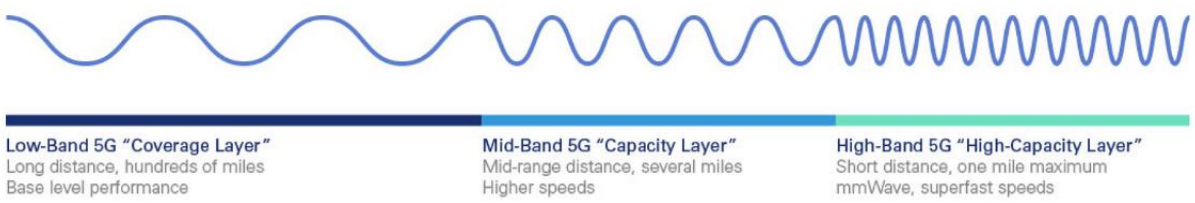
[59] *See,* David Sosa and Greg Rafert, "The Economic Impacts of Reallocating Mid-Band Spectrum to 5G in the United States," *CTIA*, February 2019, at pp. 2, 10, available at https://api.ctia.org/wp-content/uploads/2019/02/The-Economic-Impacts-of-Reallocating-Mid-Band-Spectrum-to-5G-1.pdf. *See also*, Commerce Spectrum Management Advisory Committee, "Key Characteristics of Bands," at p. 7.

suitable.[60] Frequencies in the 1-6 GHz range balance coverage and capacity, making that range of frequencies ideal for serving urban and suburban areas with high data traffic.[61] Similar to the low-band frequencies, the frequencies within the mid-band range are also generally comparable in terms of their coverage and capacity characteristics, although the higher mid-bands in the 3 GHz range are often considered comparably more ideal for 5G than the lower mid-bands in the 2 GHz range.[62] It is also worth noting that while these bands are seen as ideal for 5G, low-band spectrum can also be deployed successfully for 5G services.[63]

High-band or mmW frequencies offer high data capacity but limited coverage, and they are generally used for dense urban areas and to provide super-fast speeds in 5G networks.[64] mmW 5G antennas generally have a maximum range of one mile, although achieving this distance in reality is challenging due to the high susceptibility of signals to absorption by structures such as glass and walls.[65]

Figure 2 shows the propagation characteristics of the three types of bands.

FIGURE 2: PROPAGATION CHARACTERISTICS OF LOW, MID, AND HIGH-BANDS



Source: Westbase, "What Is Low, Mid, and High-Band? The 5G Spectrum Layers Explained," May 27, 2022, available at https://www.westbase.io/what-is-low-mid-and-high-band-the-5g-spectrum-layers-explained/

[60] See, Key Characteristics of Bands, at p. 4.

[61] *See,* Spectrum Simplified, at p. 7. *See also*, "What Is Low, Mid, and High-Band? The 5G Spectrum Layers Explained," *Westbase.io,* May 27, 2022, accessed February 26, 2024, available at https://www.westbase.io/what-is-low-mid-and-high-band-the-5g-spectrum-layers-explained/, ("What Is Low, Mid, and High-Band? The 5G Spectrum Layers Explained").

[62] *See,* Nokia, " 5G Spectrum Explained – Low, Mid and High-band," accessed February 27, 2024, available at https://www.nokia.com/thought-leadership/articles/spectrum-bands-5g-world/.

[63] *See,* "What is the difference between 600 MHz and 700 MHz coverage today?" *T-Mobile,* accessed February 26, 2024, available at https://www.t-mobile.com/devices/extended-range-compatible-devices#:~:text=While%20both%20600%20MHz%20and,markets%20for%20LTE%2Dcompatible%20devices.

[64] *See,* Ericsson: Spectrum Simplified, at p. 7.

[65] *See,* What Is Low, Mid, and High-Band? The 5G Spectrum Layers Explained.

Thus, to some extent, all spectrum bands are substitutable for one another, and the degree of substitutability between spectrum bands depends on their unique propagation characteristics, including factors such as maximum propagation distance, penetration through obstacles, atmospheric effects, and regulatory considerations.[66] Understanding these characteristics is crucial for selecting the most appropriate frequency bands for specific communication needs and applications.

C. Technological Developments Make It Feasible to Use Multiple Spectrum Bands for 5G

In practice, most network operators use a mix of low- and mid-band frequencies, with one of the promises of 5G being the ability to integrate high-band frequencies into consumer oriented mobile networks.[67] To understand how these spectrum bands have been used by various countries, we present a comparison of low and mid-band spectrum deployed in NZ, U.S., Norway and Australia in Table 1.[68] We observe that both 4G/LTE and 5G have been deployed on different spectrum bands in different countries.

[66]

[67] *See,* Nokia, "5G Spectrum Bands Explained," 2021, accessed February 26, 2024, available at https://www.nokia.com/networks/insights/spectrum-bands-5g-world/, ("5G Spectrum Bands Explained").

[68] Norway is the most comparable to NZ in terms of population density. We select Australia for its geographical proximity and U.S. as a leader in the mobile telecommunications space. *See,* Appendix Table A 1 for general statistics on these countries.

TABLE 1: CURRENT 4G LTE AND 5G BANDS IN USE (2024)

Country	**LTE Bands** [1]	**5G Bands** [2]
New Zealand	700 MHz 900 MHz 1.8 GHz 2.1 GHz 2.3 GHz 2.6 GHz	3.5 GHz
Australia	700 MHz 850 MHz 900 MHz 1.8 GHz 2.1 GHz 2.3 GHz 2.6 GHz	700 MHz 850 MHz 1.8 GHz 2.1 GHz 2.3 GHz 3.5 GHz
Norway	800 MHz 1.8 GHz 2.6 GHz	3.5 GHz
United States	600 MHz 700 MHz 850 MHz 1.7/2.1 GHz 1.9 GHz 2.3 GHz 2.5 GHz	600 MHz 850 MHz 1.8/1.9 GHz 2.1 GHz 2.5 GHz 2.6 GHz 3.45 GHz 3.7 GHz

Sources and Notes:

[1]: GSA, "Evolution to LTE Report: 4G Market and Technology Update," October 13, 2015, available at https://gsacom.com/content/uploads/2015/10/151013-Evolution_to_LTE_report.pdf. The NZ band data was extracted by Melbury Group from the Radio Spectrum Management database available at https://www.rsm.govt.nz/.

[2]: Victor Hristov, "5G bands cheat sheet: Verizon vs AT&T vs Sprint vs T-Mobile vs World," *Phone Arena,* November 16, 2023, available at https://www.phonearena.com/news/5G-bands-explained-Verizon-vs-AT-T-vs-Sprint-vs-T-Mobile-vs-World_id116781; Alex Choros, "Australian Phone Networks and Frequencies Explained," *WhistleOut,* October 6, 2023, available at https://www.whistleout.com.au/MobilePhones/Guides/Will-my-phone-work-in-Australia-carrier-network-frequencies#:~:text=B1%2C%20B3%2C%20B5%2C%20B7,n5%2C%20n28%2C%20and%20n40; "Network Coverage in Norway," *GSMArena*, available at https://www.gsmarena.com/network-bands.php3?sCountry=Norway; Bevin Fletcher, "Ericsson helps Telia turn on 5G in Norway," *Fierce Wireless,* May 13, 2020, available at https://www.fiercewireless.com/5g/ericsson-helps-telia-turn-5g-norway; "Network Coverage in New Zealand," *GSMArena*, available at https://www.gsmarena.com/network-bands.php3?sCountry=New+Zealand. *See also,* Power Signals, "Cellular Frequency Bands," available at https://powerfulsignal.com/cellular-frequency-bands/.

With the advent of 5G, for the first time, carriers can utilize low, medium, and high frequencies in the same integrated, optimized network. In particular, with this "multi-layered" network, 5G is able to utilize the mmW spectrum, which has extremely short coverage capabilities and was previously not viable for use, along with mid- and low-band spectrum.[69] New technologies such as 5G carrier aggregation are allowing operators to combine multiple 5G channels (or carriers) where they combine various low and mid-band spectrum to deliver greater speed and performance.[70] Other technologies such as dynamic spectrum sharing ("DSS") have further increased the fungibility of spectrum resources and how spectrum can be used to service different generations (4G/LTE and 5G) of cellular service.[71] DSS is an antenna technology that allows wireless service providers to use their existing spectrum assets for both 5G and 4G simultaneously by dynamically adjusting the amount of spectrum resources attributed to each standard. In doing so, it allows the spectrum resource to be used more efficiently than if a band of spectrum has to be fully dedicated to 4G or 5G.

Thus, while mid-band spectrum is important for 5G, there is no one particular band that is a critical input for 5G, which, with the advances in technology, can be delivered using multiple bands. In particular, within the 2 GHz bands such as 2.1 – 2.6 GHz, the propagation characteristics are very similar. Mid-band's use in 5G deployment or FWA deployment is dictated by regulatory band plans and existing incumbent use amongst other things, rather than a specific frequency band being more technically superior for deploying 5G or FWA. Over time, additional bands will be deployed for 5G in NZ and Norway and a future Figure 1 will show a portfolio of bands in those countries.

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69 *See,* "5G's Data Science Challenge," *OmniSci*, 2021, at p. 4, accessed February 26, 2024, available at https://www2.omnisci.com/resources/whitepaper/5g-data-science-challenge/lp.

70 *See,* "T-Mobile Revs Up 5G with Four-Carrier Aggregation," *T-Mobile,* July 25, 2023, accessed February 27, 2024, available at https://www.t-mobile.com/news/network/t-mobile-revs-up-5g-with-four-carrier-aggregation.

71 *See,* Celona, "Dynamic Spectrum Sharing: How It Works & Why It Matters," accessed February 26, 2024, available at https://www.celona.io/5g-lan/dynamic-spectrum-sharing-how-it-works-why-it-matters#:~:text=Dynamic%20spectrum%20sharing%20refers%20to,bandwidth%20based%20on%20user%20demand.

III. NZ Telecommunications Industry Background

This section provides a brief background of the NZ wireless and wireline industry including market shares, market structure, coverage, prices and spectrum ownership by various MNOs.

A. Terrestrial Mobile Wireless Services

1. Structure of the Wireless Output Marketplace

a. MNOs

As discussed earlier, there are three wireless MNOs in NZ - Spark, One NZ, and 2degrees. MNOs own the network infrastructure (and often lease towers from third parties) and act as both wholesale and retail suppliers of wireless services.[72] In terms of subscriber share, Spark and One NZ are comparable and together have over 75% market share. In terms of revenues, Spark appears to have the largest market share (Table 2).[73]

TABLE 2: SUBSCRIBER SHARE AND REVENUE SHARE FOR SPARK, ONE NZ, AND 2DEGREES

	Subscriber Share		*Mobile Revenue Share*	
	2016 [1]	2022 [2]	2016 [3]	2022 [4]
Spark	39.5%	40.5%	35.9%	44.0%
One NZ	38.0%	37.2%	45.5%	34.2%
2 Degrees	22.5%	22.4%	18.7%	21.8%

Sources and Notes:
There are approximately 6.4 million total subscribers in 2016 and 2022.
Landy Fevre, "New Zealand Telecommunications Market Report 2023-2030," *Idem Est Productions Pty Ltd*., July 2023, at pp. 33, 38.

[72] *See,* Estimated Mobile Phone Provider Market Share in New Zealand.

[73] For a time-series and the number of subscribers and revenues, *see* Appendix Table A 2.

b. MVNOs

Several mobile virtual network operators ("MVNOs") also operate in NZ's wireless output market, including Trustpower, Compass, Kogan Mobile, Megatel, MyRepublic, and Warehouse Mobile.[74] MVNOs provide mobile services to retail consumers; however, they do not own the infrastructure for providing said services.[75] They rely on agreements with MNOs to get access to the spectrum and infrastructure required to provide mobile services.

In NZ, MVNOs play a limited role in the market, and in 2022, MVNOs served around 1.4% of NZ's mobile subscribers.[76] Alongside MVNOs, Spark and 2degrees also offer sub-brands called Skinny, and Orcon and Slingshot, respectively.[77] While competition amongst MNOs to host MVNOs is limited, it is on the increase as evidenced by new deals between Trustpower and Spark, and Kogan Mobile and One NZ.[78] See Appendix Table A 3 for a complete list of MNOs that each MVNO contracts with to provide retail mobile services.

2. 5G Coverage in NZ

For all three MNOs, 5G average mobile population coverage reached 18% due to densification in urban areas, while geographic coverage averaged less than 1%.[79] The Commerce Commission expects 5G coverage to continue to increase following the 3.5 GHz spectrum auction and given Spark's goal of "extending 5G coverage to 90% of the population by the end of 2023."[80] Average 4G population coverage remained steady across all three MNOs at 98%. Average 4G land coverage also increased to 50%.[81] 2degrees launched its 5G network in 2022

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[74] *See,* Commerce Commission New Zealand, "2022 Telecommunications Monitoring Report," accessed February 23, 2024, at p. 117, available at https://comcom.govt.nz/__data/assets/pdf_file/0028/318907/2022-Annual-Telecommunications-Monitoring-Report-15-June-2023.pdf ("2022 Telecommunications Monitoring Report").

[75] MVNOs can exist in the form of licensed resellers or "full" MVNOs, in which they play a greater role in developing the mobile network infrastructure. *See,* Stephen Gale, Jill Walker, Elisabeth Welson and John Crawford, "Mobile Market Study – Findings," 26 September 2019, accessed February 26, 2023, at p. 26. available at https://comcom.govt.nz/__data/assets/pdf_file/0022/177331/Mobile-Market-Study-Findings-report-26-September-2019.PDF, ("Mobile Market Study – Findings").

[76] *See,* Landy Fevre, "New Zealand Telecommunications Market Report 2023-2030," *Idem Est Productions Pty Ltd*., July 2023, at p. 34, ("New Zealand Telecommunications Market Report 2023-2030"). In 2022, the number of MVNO subscribers dropped by 27% due to the merger between Vocus (previously the largest MVNO) and 2degrees.

[77] *See,* 2022 Telecommunications Monitoring Report, at p. 30.

[78] *See,* Mobile Market Study – Findings, at p. 29.

[79] See, 2022 Telecommunications Monitoring Report, at p 111.

[80] *See,* 2022 Telecommunications Monitoring Report, at pp. 110-13.

[81] *See,* 2022 Telecommunications Monitoring Report, at p. 113.

and Spark and One NZ continued to improve coverage. Table 3 below reports the mobile service coverage in NZ by mobile technology generation and

Figure 3 shows this for each MNO. Overall, less than 20% of the population has 5G coverage. From

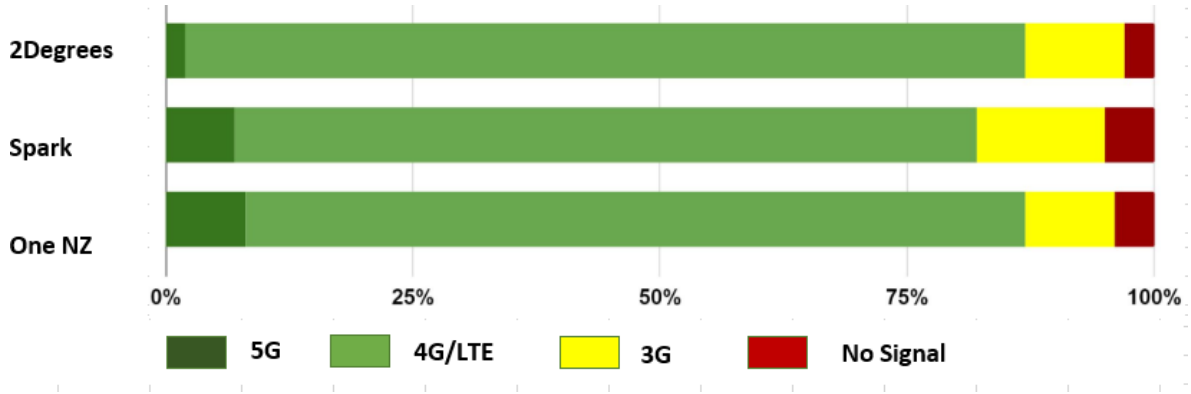
Figure 3, we find that One NZ and Spark have better 5G coverage than 2degrees, although 4G/LTE coverage appears to be better for One NZ and 2degrees

TABLE 3: AVERAGE REPORTED MOBILE COVERAGE BY SERVICE TYPE, 2023

	Land Mass [1]	Population [2]
3G	49.1%	98.5%
4G	49.8%	97.4%
5G	0.4%	17.5%

Sources and Notes:
2022 Telecommunications Monitoring Report, at p. 112.
Numbers in the table have been approximated from charts.

FIGURE 3: REPORTED MOBILE POPULATION COVERAGE BY BEST AVAILABLE TECHNOLOGY AND BY PROVIDER, 2023



Sources and Notes:
Note that the report separates out 5G-SA (Standalone) and 5G-NSA (Non-Standalone). We show a combined category as there was no 5G SA on the chart. Additionally, we have labelled 4G as 4G/LTE as these are often used interchangeably. The original chart does not show any 2G coverage.
M2Catalyst Global Mobile Insights Report, January – June 2023, Chart 5, available at https://www.m2catalyst.com/_files/ugd/6ef073_8a85dcaa289d420894483961fa539cd5.pdf.

3. Spectrum Landscape for NZ MNOs

In most circumstances, MNOs acquire spectrum via auctions from the NZ government. The Radio Spectrum Management Group under the Ministry of Business, Innovation and

Employment ("MBIE") manages the auction and allocation processes, and awarded spectrum management rights are usually extended for a 20-year period, following which a renewal is possible.[82] However, spectrum can also be acquired via sales among license-holders and occasionally, through direct allocation.[83] Additionally, spectrum is allocated to the Interim Māori Spectrum Commission ("IMSC"), which represents and manages spectrum for Māori. In February 2022, the government of NZ and the IMSC agreed that 20% of all future spectrum allocations will be licensed to the IMSC.[84]

In May 2020, the NZ government had allocated short-term rights to the critical 5G spectrum band, 3.5 GHz, at fixed cost instead of an auction. At the time, Spark and 2degrees had acquired 60 megahertz each and Dense Air had acquired 40 megahertz.[85] These rights were due to expire in October 2022, however, at that time, the government chose to provide long-term rights to 80 megahertz each of the 3.5 GHz band to each MNO via direct allocation.[86] Additionally, 100 megahertz was allocated to the IMSC.[87] The direct allocation was offered in exchange for a commitment to enhanced rural connectivity.[88] Specifically, each operator will contribute NZ$24 million to the government's Rural Connectivity Group between 2023 and 2025.[89] These funds are intended to improve rural mobile coverage and connectivity on state highways.[90]

As seen in Table 4, most spectrum owned by the MNOs is frequency division duplex ("FDD") spectrum,[91] with the exception of the 2.3 GHz and 3.5 GHz bands.[92] The 2022 Telecommunications Monitoring Report notes that NZ's spectrum allocation decisions "have

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82 *See*, ZCG, "Radio Spectrum Allocations in New Zealand," Ministry of Business Innovation and Employment, accessed February 26, 2024, available at https://zcg.com.au/wp-content/uploads/2019/09/MBIE-Radio-Spectrum-Allocation-New-Zealand-Chart.pdf for the spectrum allocation chart in New Zealand.

83 *See*, Commerce Commission Preliminary SOI November 2023, at p. 6.

84 *See*, Commerce Commission Preliminary SOI November 2023, at pp. 6-7.

85 *See*, New Zealand Telecommunications Market Report 2023-2030, at pp. 41-42.

86 *See*, New Zealand Telecommunications Market Report 2023-2030, at p. 43.

87 *See*, New Zealand Telecommunications Market Report 2023-2030, at pp. 43.

88 *See*, 2022 Telecommunications Monitoring Report, at p. 114.

89 *See*, New Zealand Telecommunications Market Report 2023-2030, at pp. 43.

90 *See*, New Zealand Telecommunications Market Report 2023-2030, at p. 43.

91 In FDD, the available frequency band is divided into two separate frequency bands: one for transmitting (uplink) and another for receiving (downlink). The uplink and downlink frequencies operate simultaneously but on different frequency channels, allowing for two-way communication. *See,* Qualcomm, "FDD/TDD Comparison Key Messages," accessed February 27, 2024, available at https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/FDD_TDD_Key_Messages_09_11_08_Final.pdf.

92 We understand that Dense Air NZ had used the 2.6 GHz spectrum as TDD previously. However, the MNOs currently use their 2.6 GHz as FDD.

supported the entry and expansion of 2degrees."[93] Overall, the three MNOs hold well-distributed spectrum portfolios. Spark owns several mid-band licenses, while One NZ has well rounded low-band and mid-band frequencies. While it has a smaller portfolio than the rest, 2degrees also holds several low (sub-1 GHz) and mid-band (1 – 6 GHz) spectrum. Note that in terms of mid-band holdings, 2degrees appears to be well positioned with 150 megahertz for its 1.4 million customers (with the option to lease 2.1 GHz and 2.3 GHz from the IMSC if 2degrees deems it helpful), compared to One NZ, which has 200 megahertz and 2.4 million customers..[94]

TABLE 4: SPECTRUM HOLDINGS IN NZ (IN MEGAHERTZ)

	Sub 1-GHz Spectrum Band Holdings (Megahertz)		1-6 GHz Spectrum Holdings (Megahertz)							
Band	700 MHz (FDD)	800-900 MHz (FDD)	1.8 GHz (FDD)	2.1 GHz (FDD)	2.3 GHz (TDD)	2.6 GHz (FDD)	3.5 GHz (TDD)	Sub-1 GHz Spectrum Holdings	1-6 GHz Spectrum Holdings	Total Spectrum Holdings
Spark	40	30	40	30	70	40	80	70	260	**330**
One NZ	30	30	50	40		30	80	60	200	**260**
2degrees	20	20	40	30			80	40	150	**190**
Other Users			20	20	25	115	160		340	**340**
Total Megahertz	90	80	150	120	95	185	400	170	950	**1120**

Sources and Notes:
Commerce Commission SOI February 2024, Table 2 at p. 7

Compared to the U.S., which has a population of around 332 million, in NZ, which has a population of around 5 million, MNOs should not be capacity constrained.[95] For instance, the total sub-1 GHz – 4 GHz spectrum inventory in the U.S. is 1193 megahertz (204 sub-1 GHz spectrum and 989 1-4 GHz spectrum), compared to NZ's 780 megahertz (170 sub-1 GHz spectrum and 640 1-4 GHz spectrum).[96] To put things in context, NZ's population is 1.5% of that of the U.S., and it has 65% of the spectrum available in the U.S. In Table 5 below, we estimate a capacity metric.[97]

[93] *See*, 2022 Telecommunications Monitoring Report, at p. 119.

[94] *See,* **Error! Reference source not found.**. *See also,* New Zealand Telecommunications Market Report 2023-2030, at p. 32.

[95] *See,* Appendix Table A 1.

[96] We add 70 megahertz of the 3.5 GHz spectrum (Priority Access Licenses) to the amount reported for the spectrum screen. In the U.S., this is shared spectrum and is not included in the spectrum screen. For the exclusive use spectrum see, Federal Communications Commission (FCC), "2022 Communications Marketplace Report," December 30, 2022, Table II.B.9, pp. 66, 70, available at https://docs.fcc.gov/public/attachments/FCC-22-103A1.pdf.

[97] Our metric for capacity is the amount of spectrum holdings (megahertz) multiplied by the macro site count (tower) for each provider.

TABLE 5: CAPACITY PER SUBSCRIBER BY MNOS IN U.S. AND NZ

		United States			*New Zealand*		
		AT&T	T-Mobile	Verizon	Spark	One NZ	2degrees
Spectrum				(Megahertz)			
Sub-1 GHz Spectrum Holdings	[1]	53.2	54.8	47.3	70	60	40
1 - 6 GHz Spectrum Holdings	[2]	211.4	302	231.7	260	200	150
Total Spectrum Holdings	[3]	264.6	356.8	279	330	260	190
Sites and Subscriber Counts							
Macro Sites (approximation)	[4]	73,700	79,000	68,000	1,616	1,759	1,448
Subscribers (millions)	[5]	217.4	113.6	115.0	2.6	2.4	1.4
Capacity/Subscriber	[6]	0.09	0.25	0.16	0.20	0.19	0.19

Sources and Notes:
[1], [2]: Federal Communications Commission (FCC), "2022 Communications Marketplace Report," December 30, 2022, Fig. II.B.13, accessed February 27, 2024, available at https://docs.fcc.gov/public/attachments/FCC-22-103A1.pdf; Submission of 2degrees Related to the Proposed Acquisition.
[3]: [1] + [2]
[4]: According to various analyst sources Verizon, AT&T and T-Mobile had approximately 68,000 macro sites (towers) (2021 estimate), 73,700 towers (2021 estimate) and 79,000 macro sites (2023 estimate), respectively. For tower data, *see* Bevin Fletcher, "Verizon Readies for C-band Deployments with Crown Castle, SBA Deals," Fierce Wireless, April 12, 2021, accessed February 27, 2024, available at https://www.fiercewireless.com/operators/verizon-readies-for-c-band-deployments-crown-castle-sba-deals; Steel in the Air, "AT&T Forecasts 6,700 New Macrocells from 2017-2022," June 9, 2016, accessed February 27, 2024, https://www.steelintheair.com/blog/att-forecasts-6700-new-macrocells-from-2017-2022; Steel in the Air, "T-Mobile Cell Tower Lease Rates in 2023," accessed February 27, 2024, https://www.steelintheair.com/t-mobile-cell-tower-lease. For the NZ site data we approximate the number of sites for each MNO by taking the largest number of sites licensed for each MNOs spectrum deployment. We understand that this is not an exact count but given that many sites collocate multiple bands, we believe that our approximation is not too far off. This data was extracted by Melbury Group from the Radio Spectrum Management database available at https://www.rsm.govt.nz/.
[5]: AT&T 2022 Annual Report, at p. 10, available at https://investors.att.com/~/media/Files/A/ATT-IR-V2/financial-reports/annual-reports/2022/2022-complete-annual-report.pdf; T-Mobile 2022 Annual Report, p. 5, available at https://s29.q4cdn.com/310188824/files/doc_financials/2022/ar/TMUS-2022-annual-report-final.pdf; Verizon 2022 Annual Report, p. 5, available at https://www.verizon.com/about/sites/default/files/2022-Annual-Report-on-Form-10K.pdf; New Zealand Telecommunications Market Report 2023-2030, at p. 32.
[6]: ([4] x [5]) / [3]

When comparing MNOs, from Table 5, we find that U.S. providers hold similar spectrum holding as their NZ counterparts. Currently T-Mobile has the highest spectrum holdings (357 average megahertz), followed by Verizon (279 average megahertz) and AT&T (265 average megahertz). Our capacity per subscriber per site estimate shows that NZ MNOs generally have comparable capacity per subscriber and 2degrees is not that dissimilar to, say, One NZ. Additionally, we also find that on average, the NZ MNOS have more capacity per subscriber

per site than both AT&T and Verizon.[98] Note that NZ has a lower population density than the U.S., nationally and locally. For example, nationally, NZ has a population density of 19 people per square kilometer, while the U.S. has a population density of about 36 people per square kilometer.[99] Locally, the U.S. MNOs are able to provide services to much denser urban areas, primarily due to densification and infrastructure build out. For example, New York County has a population density of about 29,000 people per square kilometer while Urban Auckland has a population density of about 2,400 people per square kilometer.[100] This is more than an order of magnitude difference in density while spectrum holdings for MNOs are quite comparable.

4. Comments on the Mobile Broadband Marketplace

Generally, the current structure of the NZ mobile services market can be described as having a dominant firm (Spark), a second place firm (One NZ), and a third place firm (2degrees) in terms of revenue shares and spectrum holdings. In the context of the Proposed Acquisition and the factual and counterfactual scenario, the change in market structure that is being considered is to either allow One NZ to more effectively compete with Spark (*i.e.*, the factual), or leave Spark the dominant firm, but provide 2degrees spectrum parity with One NZ (*i.e.*, the counterfactual). Which market structure is ultimately more procompetitive is an empirical question, and given the current state of the market, we believe that the factual world will be more procompetitive. We discuss the evidence to support our opinion in Section IV.C.

In terms of NZ's spectrum landscape in terrestrial wireless, we find that NZ MNOs, including 2degrees, have more capacity per subscriber compared to their largest U.S. counterparts (AT&T and Verizon) and, thus, it does not appear that 2degrees suffers from any more spectrum constraints than other MNOs locally or globally. For instance, if a provider such as AT&T with more than 200 million customers can deploy the latest functionalities in 5G with 265-megahertz holdings on average, there is little reason to believe that a provider such as 2degrees, with 2 times more capacity per subscriber per site nationally, is spectrum

[98] For example, Spark has 9 times the capacity per subscriber as AT&T, and 2degrees has three times the capacity per subscriber when compared to T-Mobile.

[99] "Population Density (People per sq.km of Land Area) – New Zealand, United States," *The World Bank*, last accessed March 1, 2024, available at https://data.worldbank.org/indicator/EN.POP.DNST?locations=NZ-US.

[100] 74,781.6 people per square mile divided by 2.58 to scale to per square kilometre.
"Quick Facts: New York County, New York; United States," *United States Census Bureau*, last accessed March 1, 2024, available at https://www.census.gov/quickfacts/table/PST045216/36061,00.
"Flashback Saturday – Shedding Light on Auckland's Population Density," *Greater Auckland*, February 1, 2020, last accessed March 1, 2024, available at https://www.greaterauckland.org.nz/2020/02/01/flashback-saturday-shedding-light-on-aucklands-population-density/.

constrained.[101] Additionally, in the U.S., T-Mobile's deployment and marketing of FWA services is an example of excess spectrum holdings.[102] This is because the provision of fixed broadband services over the wireless network that coexists with mobile uses is only possible if a carrier has an excess of spectrum after serving its wireless customers.[103] 2degrees has similar capacity per subscriber compared to One NZ and Spark who provide FWA services. Thus, considering existing capacity, it would appear that 2degrees should also be able deploy FWA with its current spectrum holdings.

B. Terrestrial Fixed Services

All three mobile wireless MNOs serve both the wireline and wireless fixed telecommunications services market as well.

1. Fixed Wireline Services

The NZ government, in partnership with private investors, established the Ultra-Fast Broadband ("UFB") initiative to fund Fibre to the Premises ("FTTP") for households and businesses.[104] Initially rolled out in 2012, the program sought to expand broadband access to replace traditional copper lines and older broadband technologies like ADSL and VDSL.[105] The program focused on delivering fibre to schools, hospitals, private health facilities, and businesses by 2015; and focused on expanding fibre access to 75% of the population by 2019.[106] As of 2022, it is estimated that FTTP was deployed to 1.8 million households and businesses in the country, spanning 412 cities and towns.[107] In sum, 87% of NZ's population

[101] *See,* Petroc Taylor, "AT&T Wireless Subscribers and Connections from 1st Quarter 2017 to 1st Quarter 2023," Statista, July 10, 2023, accessed February 26, 2024, available at https://www.statista.com/statistics/1125140/total-mobility-subscribers-connections/.

[102] *See*, Monica Alleven, "T-Mobile's FWA Retains Air of Mystery," *Fierce Wireless*, April 5, 2023, accessed February 27, 2024, https://www.fiercewireless.com/wireless/t-mobiles-fwa-retains-air-mystery, ("T-Mobile's FWA Retains Air of Mystery").

[103] T-Mobile is deploying mid-band assets such as 2.5 GHz, PCS at 1.9 GHz, and more recently, AWS spectrum. *See,* T-Mobile's FWA Retains Air of Mystery.

[104] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 55. *See also*, Sean Mosby and Jerome Purre, "Toward Universal Broadband Access in New Zealand," November 2010, accessed February 24, 2024, available at https://www.itu.int/ITU-D/treg/Documentation/ITU_UAB_NZ_2010.pdf.

[105] *See,* "Fibre," *TCF NZ Telecommunications Forum Inc.*, accessed February 26, 2024, https://www.tcf.org.nz/broadband/fibre ("Fibre TCF NZ").

[106] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 55.

[107] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 55.

has fibre broadband availability.[108] The broadband market is also experiencing growth as a result of the UFB project occurring jointly with new home buildouts in urban redevelopments.[109] The UFB program is a public-private partnership with four companies to build out fibre.[110] As a result of the UFB program, fibre networks in NZ are largely owned by Chorus and three smaller "local fibre companies" which provide wholesale services.[111] Thus, retail service providers pay a fee to access and deploy their own equipment on the UFB to reach their subscribers.[112]

As of 2022, Spark was the largest wireline broadband provider followed by One NZ. Since 2016, 2degrees had drastically increased its broadband share of subscribers after officially acquiring Vocus in June 2022.[113] Table 6 below shows Spark and One NZ losing market share to smaller players like 2degrees and Trustpower. Overall, the fixed broadband market is experiencing little growth, reaching just over 1.6 million in subscribers compared to slightly

[108] *See,* Measure as of the end of 2022. *See,* Fibre TCF NZ; "Govt Completes Delivery of Ultra-Fast Broadband Programme," *Beehive.govt.nz*, December 14, 2022, accessed February 26, 2024, available at https://www.beehive.govt.nz/release/govt-completes-delivery-ultra-fast-broadband-programme.

[109] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 50.

[110] The caveat of the government program is that companies who build the network cannot be retailers on the network. Crown Infrastructure manages the partnership between four companies. Crown Infrastructure manages the partnership between four companies: Chorus, Tuatahi First Fibre, Northpower Fibre, and Enable Networks. Note Crown Infrastructure is a Crown-owned company operated by NZ's state sector to manage the government's investment in UFB. *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 55; The Treasury of New Zealand, "Portfolio of Companies and Entities," accessed February 26, 2024, available at https://www.treasury.govt.nz/information-and-services/commercial-portfolio-and-advice/commercial-portfolio; Ministry of Business Innovation and Employment of New Zealand, "Broadband and Mobile Programmes," accessed February 26, 2024, available at https://www.mbie.govt.nz/science-and-technology/it-communications-and-broadband/digital-connectivity-programmes/broadband-and-mobile-programmes/. To participate in the project, Chorus was split from the incumbent telco Spark in 2011. Thus, Spark serves as a retail company while Chorus operates separately as an infrastructure company. *See,* Bill Bennett, "Mercury NZ Rising in Retail Broadband, Mobile," *Scoop*, May 8, 2022, accessed February 26, 2024, available at https://www.scoop.co.nz/stories/HL2205/S00014/mercury-nz-rising-in-retail-broadband-mobile.htm; New Zealand Telecommunications Market Report 2023-2030, at p. 28. *See also*, Sarah Putt, "Fibre Network Unbundling, the New Zealand Way," *Computer World*, June 24, 2020, available at https://www.computerworld.com/article/3563927/fibre-network-unbundling-the-new-zealand-way.html ("Fibre Network Unbundling, the New Zealand Way").

[111] Operating the largest fixed network in New Zeland, Chorus provides a mix of fibre and copper technologies, with over 52,000 kilometers of fibre. New Zealand Telecommunications Market Report 2023-2030, at p. 29.

[112] *See*, Fibre Network Unbundling, the New Zealand Way.

[113] *See*, Rob O'Neill, "2degrees Reveals its First Board since $1.7B Merger with Vocus NZ," *Reseller News,* August 08, 2022, accessed February 26, 2024, available at https://www.reseller.co.nz/article/700527/2degrees-announces-its-first-board-since-1-7-billion-merger-vocus-nz/; New Zealand Telecommunications Market Report 2023-2030, at p. 50.

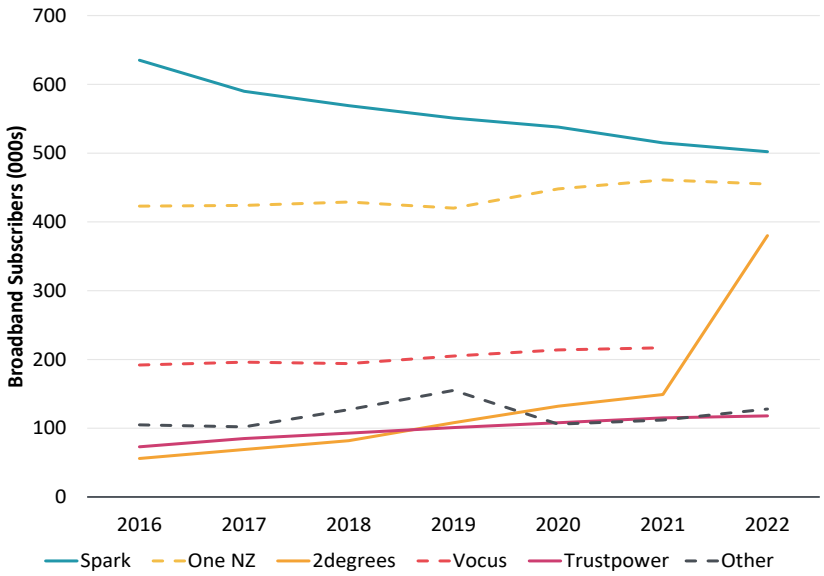
less than 1.5 million in 2016.[114] Figure 4 shows the historical trend, with 2degrees capturing greater market share.

TABLE 6: NZ FIXED BROADBAND SUBSCRIBERS SHARE COMPARISON

	2016	2022
Spark	43%	32%
One NZ	28%	29%
Vocus	13%	
Trustpower	5%	7%
2degrees	4%	24%
Other	7%	8%

Sources and Notes:
New Zealand Telecommunications Market Report 2023-2030, at p. 51. Note, Trustpower was acquired by Mercury in June 2023.[115] 2degrees acquired Vocus in June 2022.[116]

FIGURE 4: HISTORICAL FIXED BROADBAND SUBSCRIBERS (2016-2022)



Sources and Notes:
New Zealand Telecommunications Market Report 2023-2030.

[114] *See*, New Zealand Telecommunications Market Report 2023-2030, at p. 50.

[115] *See*, Mercury, "Trustpower is Now Mercury," February 26, 2024, available at https://ask.mercury.co.nz/app/answers/detail/a_id/3177/~/trustpower-is-now-mercury.

[116] *See*, Rob O'Neill, "2degrees Reveals its First Board since $1.7B Merger with Vocus NZ," *Reseller News,* August 08, 2022, accessed February 26, 2024, available at https://www.reseller.co.nz/article/700527/2degrees-announces-its-first-board-since-1-7-billion-merger-vocus-nz/

2. Satellite

According to the Commission, Starlink's constellation provides coverage to almost all parts of NZ and "[s]atellite has been the fastest-growing technology following the entry of Starlink, with connections increasing from 1,900 to 12,000 over the past year – the fourth-highest level of satellite connections per capita in the OECD."[117] More specifically, this new mode of fixed broadband provision is referred to as Lower Earth Orbit Satellite. Low Earth Orbit ("LEO") satellites operate between 500–1,500 km above the Earth's surface. In contrast to more traditional geostationary satellites, LEO satellites are not geostationary and continuously orbit the earth. Satellite based broadband services are best suited for remote geographies where it competes with wireless broadband and copper.[118]

3. Fixed Wireless Access (FWA)

In NZ, fixed wireline broadband household penetration declined slightly from 2016 – 2022.[119] In part, this was driven by low-usage subscribers being migrated to fixed wireless access.[120] The drop in Spark's fixed wireline broadband subscriber market share from 2016 to 2022, as seen in Figure 4, came as a result of customers being migrated on to its fixed wireless product, i.e. FWA services; with an estimated 20% of broadband customers being migrated to fixed wireless.[121] This strategy allowed Spark to bypass UFB access to decrease its input costs for "low-end broadband users."[122] Rather than using fibre or cables for fixed broadband services, radio frequencies are used to transmit data and support broadband internet access.[123]

In addition to the fibre-focused UFB program, the NZ government is also investing in the subsidization of fixed wireless services. The NZ government's Rural Broadband Initiative (RBI) aims to expand broadband and mobile services to homes and businesses outside of areas

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[117] 2022 Telecommunications Monitoring Report, at p. 8.

[118] 2022 Telecommunications Monitoring Report, at p. 74.

[119] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 50.

[120] *See,* New Zealand Telecommunications Market Report 2023-2030, at p. 50.

[121] See, New Zealand Telecommunications Market Report 2023-2030, at p. 51; Spark New Zealand, "Fixed Wireless Access (FWA) Product Overview," accessed February 26, 2022, available at https://investors.sparknz.co.nz/FormBuilder/_Resource/_module/gXbeer80tkeL4nEaF-kwFA/doc/Spark-NZ-FWA-Presentation.pdf. Spark lost a total of over 133,000 subscribers between 2016 to 2020 but reached 200,000 wireless broadband subscribers at the end of 2022. *See also*, New Zealand Telecommunications Market Report 2023-2030, at p. 50.

[122] *See,* New Zealand Telecommunications Market Report 2023-2030," at p. 51.

[123] See, "What is Fixed Access (FWA) Technology," *Verizon*, accessed February 26, 2024, available at https://www.verizon.com/about/blog/fixed-wireless-access; https://www.tcf.org.nz/.

covered by UFB fibre.[124] By 2023, the second phase of this program aimed to build 400 additional towers to extend high-speed wireless broadband availability to 99.8% of NZ's population.[125] This is being rolled out by the Rural Connectivity Group, a joint venture between Crown Infrastructure and the country's three main MNOs: 2degrees, One NZ, and Spark.[126]

4. Comments on Overall Structure on the Fixed Broadband Marketplace and Intermodal Competition

The fixed broadband marketplace in NZ is different from other countries given the large subsidization, large fibre deployment, regulations, and subsidization of FWA. In general, FWA is predominantly adopted in regions where establishing fixed-line infrastructure and deploying fibre, such as Fibre-to-the-Home ("FTTH") or Fibre-to-the-Building ("FTTB"), has proven to be economically unviable, slow, or challenging, given the shorter term profit calculus of companies.[127] While fibre is often ideal for providing the fastest and most reliable internet access, a substantial average revenue per user ("ARPU") and population density are necessary for a viable business case. Therefore, in areas where fibre is prohibitively expensive to deploy, FWA often emerges as the next-best alternative.[128] However, in NZ with fibre available to a large part of the population, FWA appears to be a service that competes with a fixed wired broadband service.

Intermodal competition in the fixed broadband market refers to competition between different types or modes of broadband technologies and infrastructure that can deliver high-speed internet access to consumers – such a fixed wired broadband services and FWA broadband services. From a consumer's perspective, they are primarily choosing a speed-price-data quota bundle, rather than the specific mode of technology. Hence, along these dimensions (speed-price-data quota) any fixed broadband services that is available to the

[124] *See,* "Fixed Wireless," *TCF NZ Telecommunications Forum Inc*., accessed February 26, 2024, available at https://www.tcf.org.nz/broadband/fixed-wireless ("Fixed Wireless TCF NZ").

[125] See, Fixed Wireless TCF NZ.

[126] *See,* Fixed Wireless TCF NZ; "The Rural Connecticity Group," *Broadband Map NZ*, accessed February 26, 2024, available at https://www.thercg.co.nz/.

[127] *See,* "What is 5G Fixed Wireless Access (FWA)?" *Meta Switch*, accessed February 27, 2024, available at https://www.metaswitch.com/knowledge-center/reference/what-is-5g-fixed-wireless-access-fwa#:~:text=Fixed%20Wireless%20Access%20(FWA)%20enables,expensive%20to%20lay%20and%20maintain.

[128] *See,* Michael Kletchko, "Fixed Wireless Access Delivering Broadband When Fiber Isn't Available," *Telecom Ramblings*, December 4, 2020, accessed February 27, 2024, available at https://www.telecomramblings.com/2020/12/fixed-wireless-access-delivering-broadband-when-fiber-isnt-available/.

consumer are substitutes. For example, if an FWA broadband provider increases prices, customers could switch to a wired service that offers lower prices and/or better or worse quality. Given that there are alternatives to FWA the inherent market forces coupled with declining prices for data should put downward pressure on prices without the need for regulatory intervention, such as allocating more spectrum to a specific MNO. Note that the Commission also considered FWA as in competition and substitutable with rural broadband and copper in their decision to allow Spark to acquire 70 MHz of 2.3 GHz spectrum in 2016.[129]

IV. Assessing the Competitive Impact of the Proposed Acquisition

The Proposed Acquisition (*i.e.*, the factual) will increase One NZ's spectrum holdings to be on par with current market leader Spark. This has raised concerns about heightened concentration in the input market and potential anticompetitive outcomes in the output market. Mergers and acquisitions of firms within a relevant market have the potential to generate both anticompetitive and procompetitive impacts on the market. We understand The Commission is currently considering a counterfactual where 2degrees purchases Dense Air NZ's spectrum management rights (*i.e.*, the counterfactual). We refer to this counterfactual for the purposes of our analysis, although we understand that Dense Air disagrees that this is a likely counterfactual.

To clear the Proposed Acquisition, the Commission states that it must be satisfied that an acquisition will not have, or would not be likely to have, the effect of substantially lessening competition in a NZ market. In particular, in evaluating the Proposed Acquisition, the Commission considers the relationship between concentration in an input market and its impact on competition in the output market in the factual and counterfactual. Such linkages between the input and output markets are a well-documented concept in economics and industrial organization. For example, exclusive dealing arrangements, and other practices in the input market, can affect competition in the output market through foreclosure and

[129] *See,* "Spark New Zealand Trading Limited and Craig Wireless New Zealand Spectrum Operations Limited and Woosh Wireless Holdings Limited [2016] NZCC 7" ISSN 1178-2560, Decision Series, Project no. 11.04/15746, *Commerce Commission New Zealand*, March 23, 2016, at ¶ 82.

incentives to raise input prices.[130] This linkage is well accepted when it comes to radio spectrum and is the basis for spectrum screens in the U.S.[131]

In this section, we analyze through economic principles both the pro and anticompetitive implications of both the factual and counterfactual world. We find evidence that the proposed acquisition will more likely be procompetitive than the counterfactual. This section is organized in the following way. In Section IV.A, we describe issues raised by the Statement of Issues and a summary of conclusions. In Section IV.B. we explain how relevant markets should be determined in competition analysis and what we believe the relevant markets should be in the current context. In Section IV.C., we discuss that given the spectrum landscape, this Proposed Acquisition will not harm competition in the output market, but will likely be procompetitive.

A. Issues Raised in the SOI and Summary of Conclusions

In its Statement of Issues, the Commission has identified a set of issues that it is continuing to investigate. We have summarized these issues at a high-level into two categories:

A. Definition of the relevant markets for assessing the competitive effects of the proposed acquisition.[132]

B. Given that spectrum is a critical input for providing wireless services, the relative capacities of MNOs and the implications for provision of services and ability to compete,[133] in particular in the provision of:

    1. retail mobile services[134]

    2. retail wireless broadband (*i.e.*, FWA)[135]

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130 *See,* Oliver Hart, Jean Tirole, Dennis W. Carlton, and Oliver E. Williamson, "Vertical Integration and Market Foreclosure," *Brookings Papers on Economic Activity,* Microeconomics 1990 (1990): 205–86, available at https://doi.org/10.2307/2534783.

131 FCC, "In the Matter of Policies Regarding Mobile Spectrum Holdings," WT Docket No. 12-269, Adopted May 15, 2014, ¶ 41, available at https://docs.fcc.gov/public/attachments/FCC-14-63A1.docx.

132 Commerce Commission SOI February 2024, ¶ 6.

133 Commerce Commission SOI February 2024, ¶ 7, 8, 9, 11.

134 Commerce Commission SOI February 2024, ¶ 183.

135 Commerce Commission SOI February 2024, ¶ 194.

3. wholesale services for mobile and wireless broadband services[136]

We conclude the following on these issues:

A. The Commission's current approach to market definition is consistent with economic principals and the characteristics of the NZ wireless telecommunications market. However, we believe that mobile services provided by MVNOs should also be included in the assessment of the output market.[137] This is because relevant markets should be determined based upon the consideration of the end consumer's choice set and substitutability within that choice set. In particular, we believe there is no economically consistent reason that wireless broadband services should be a separate retail market for competition assessment.

B. Compared to the U.S., NZ MNOs are, in general, not spectrum constrained. In addition, at a high-level, 2degrees is no more spectrum constrained than both Spark and One NZ given status quo spectrum holdings. This holds true both in the factual and the counterfactual, which implies that the Proposed Acquisition does not hinder 2degrees' ability to continue competing in any relevant market.

   In fact, we find evidence that the deployment of Dense Air NZ's 2.6 GHz spectrum will be more cost-effective and bring about higher service quality when deployed by One NZ, compared to the counterfactual of the band being deployed by 2degrees. This implies that in the factual One NZ can apply legitimate competitive pressures on Spark (the highest ARPU MNO) to bring prices down for consumers. We find evidence that in the counterfactual, deployment costs for 2.6 GHz will be higher, which will limit 2degrees' ability to apply effective competitive pressure on Spark.

In the following sections, we discuss our reasoning and supporting evidence for the conclusions on each issue.

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136 Commerce Commission SOI February 2024, ¶ 200.

137 Note that in NZ, MVNOs play a limited role in the market, and in 2022, MVNOs served around 1.4% of New Zealand's mobile subscribers. *See*, Landy Fevre, "New Zealand Telecommunications Market Report 2023-2030," Idem Est Productions Pty Ltd., July 2023, at p. 34, ("New Zealand Telecommunications Market Report 2023-2030"). In 2022, the number of MVNO subscribers dropped by 27% due to the merger between Vocus (previously the largest MVNO) and 2degrees.

B. Relevant Market Definitions

1. Relevant Markets Should Be Defined in Terms of the Uses of Spectrum and the Choices Available to the Consumer

Relevant markets and market definitions need to ultimately be assessed by the substitutability across related products in the input market and the ultimate output market. This is because the Commission is ultimately focused on the promotion of competition in markets for the long-term benefit of consumers in NZ.[138] Such analysis results in the relevant input market to necessarily include spectrum bands other than the 2.6 GHz spectrum at issue with the Proposed Acquisition, which reveals the misleading nature of 2degrees' claims which insinuate that the 2.3 GHz – 2.6 GHz band should be considered in isolation for analysis.[139] This also suggests that the output market should be considered more broadly than 2degrees' proposed separate 4G FWA market.

We largely agree with the Commission's consideration that the competition issues that may arise from the Proposed Acquisition are best assessed and isolated by defining markets for the:[140]

- National acquisition of spectrum management rights;
- National retail supply of mobile services by MNOs;[141]
- Retail supply of broadband services in (including wireless broadband services) fibre areas;
- Retail supply of broadband services (including wireless broadband services) in non-fibre areas; and
- National wholesale supply to telecommunications services by MNOs, including mobile services, wireless broadband services and fixed-line broadband services.

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138 Commerce Act 1986, 1A Purpose, accessed March 1, 2024, available at https://www.legislation.govt.nz/act/public/1986/0005/latest/DLM87623.html.

139 Submission of 2degrees Related to the Proposed Acquisition, ¶ 3.6.

140 *See*, Commerce Commission SOI February 2024, at p.10.

141 A minor disagreement here is that we also believe that MVNO supply of mobile services should be included in this market definition. We explain why in the subsection below.

Below we provide an exposition as to how we believe the relevant market should be determined, and what we believe the market definitions should be.

a. The Fixed Wireless Broadband Market

As discussed above in Section III and in the 2022 Telecommunications Monitoring Report,[142] in the output market, consumers can make a choice between FWA, fibre, satellite, and other legacy fixed wireline technologies (*e.g.*, ADSL, copper). In NZ, each technology is widely adopted with a well-balanced distribution of subscriber share,[143] which suggests that each technology is applying competitive pressures on the other technologies.

Additionally, the Commission has been considering the fibre vs. non-fibre geographical market for fixed wireless broadband as another dimension of relevant market definition.[144] In the context of the output market, we believe this is reasonable as the end consumer's choice set, by definition, varies in these geographies. In the context of the input market, note that in non-fibre geographies (*i.e.*, 13% of the population),[145] low-band spectrum is better suited,[146] and is the primary method of FWA delivery in these geographies.[147] Consequently, in these geographies, low-band spectrum should be part of the input market definition.

Furthermore, these geographies will still have new up and coming technologies to choose from going forward, like LEO satellite broadband.[148] Given this, these competitive pressures in the output market will limit the FWA provider from exercising market power, and have minimal impact on consumers, regardless of conclusions about the input market. In the output market, even if we were to incorrectly define an overly narrow market around just 4G FWA broadband (implying that consumers in NZ only have access to 4G FWA technology for home broadband, which is clearly untrue), 4G FWA can be deployed by a multitude of ways.[149] This implies that the input market should necessarily include a portfolio of spectrum bands.

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[142] *See*, 2022 Telecommunications Monitoring Report, at pp. 15-18.

[143] *See*, 2022 Telecommunications Monitoring Report, at pp. 36, 85.

[144] *See*, Commerce Commission SOI February 2024, at pp. 9-10.

[145] *See,* 2022 Telecommunications Monitoring Report, at p. 10.

[146] *See infra* pp. 9-11.

[147] For example, the Rural Connectivity group states that "RCG will mainly use 700 MHz frequency because it is the spectrum best suited for rural users, and this will be supported with 1800 MHz and 2100 MHz frequencies if additional capacity is required.", *See*, "RCG Network," *Rural Connectivity Group,* accessed February 26, 2024, https://www.thercg.co.nz/rcg-network/.

[148] *See*, 2022 Telecommunications Monitoring Report, at pp. 73, 83 and Table 10.

[149] As discussed earlier in this report, it is unambiguous that FWA and 5G can be deployed in bands other than 2.3 GHz – 2.6 GHz. This is because the fungibility of different types of spectrum and the economics of a wireless network.

2degrees states that fibre broadband should not be considered in the same market as 4G FWA because 4G FWA is not a viable substitute for users with high data usage.[150] However, this argument for why 4G FWA should be considered as a separate market is logically inconsistent. For instance, if 2degrees' statement was true, then for high data users, the Proposed Acquisition is marginally irrelevant both in the factual and counterfactual because FWA was never in their choice set. However, for low data users, 4G FWA is indeed a substitute to fibre and hence in the same relevant market, so fibre should be included in any analysis.

b. The Mobile Broadband Market

In our earlier discussion (see Table 1), we observed that modern mobile wireless services are necessarily provided to customers by deploying a mix of coverage and capacity layers on a network. Hence, considering 2.3 GHz – 2.6 GHz in isolation to assess the competitive effects of the proposed acquisition is not consistent with the basics of mobile network engineering. The output market in question, *i.e.*, mobile wireless services (4G, 5G or otherwise), would not be able to exist with just the 2.3 GHz – 2.6 GHz band.

Relatedly, we do not believe product markets cannot be draw across the various generations of wireless technology (*i.e.*, 2G, 3G, 4G, and 5G). This is because as discussed above in Section III.B.4., consumers choose telecommunication services as a bundle of characteristics offered (*i.e.*, a speed-price-data bundle), not on technological generations. For example, a customer that is observed to have purchased a 3G capable device over a 5G capable device is making their decision by considering the trade-off between price and service quality measures (*i.e.*, the bundle of characteristics). In addition, a mobile service is utilized a wide range of generations as the customer moves around the country. If a customer drives to a part of NZ that does not have 5G deployed by their provider of choice, then as a technical fall back the customer may be put on a 3G or 4G connection. Analogous to the necessity of various frequencies to operate a wireless network, various generation of wireless technologies are required to provide a coherent mobile service to customers, until a generation has been entirely phased out.

In addition, low-band can substitute for mid-band while mid-band cannot always substitute for low-band. In the U.S. there is a separate low-band spectrum screen because of low-band coverage advantage, but all mixed together for the overall screen.[151] This highlights the importance of including low-band in any consideration about spectrum concentration.

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[150] *See*, Submission of 2degrees Related to the Proposed Acquisition, at pp. 25-26.

[151] The FCC uses a spectrum screen as a tool to evaluate the competitive implications of proposed transactions involving wireless spectrum licenses. This screen helps the Commission assess whether a merger or

As reported by the Commission, in the output market, NZ consumers get to choose from a variety of wireless service providers, including MVNOs.[152] As shown in Table 1 and Table 3, MNOs all deploy a combination of spectrum bands as inputs and are not constrained by the availability of any particular band to launch a service. Hence, even if further aggregation in a specific frequency band (*e.g.,* the 2.6 GHz band) by one of the MNOs occurred, it is unlikely that it would lead to market power in the output market. Additionally, the NZ government is considering other bands such as the remaining spectrum is the 3.3 – 3.8 GHz band and the frequencies in the 3.8 – 4.2 GHz and 6 GHz bands.[153] Thus, in addition to the substitutability of various frequencies, the supply of spectrum is also expected to increase and therefore the Proposed Acquisition will likely not lead to market power.

2. The Economically Sound Input and Output Market Definition

Given the above discussion, we believe that the correct market definitions for the input and output markets are:

Input Market –

- All Spectrum bands that are available on the market and can be utilized to deploy commercial wireless services.

Output Market –

- For mobile broadband services: all product offerings by the three MNOs and MVNOs for the post-paid and pre-paid services.

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acquisition would result in a concentration of spectrum that might harm competition in the wireless industry. "The current spectrum screen considers the total amount of spectrum suitable and available for mobile broadband held in a market by a wireless provider," and can "trigger a more detailed competitive analysis (on a case-by-case basis) if a wireless operator 'holds approximately 1/3 or more of the available spectrum in a given market.'"[151] Currently, the FCC does not apply the screen on a national basis, but rather applies it at a local level for secondary market transactions.[151] The screen is not applied to auctions. *See,* FCC, "In the Matter of Policies Regarding Mobile Spectrum Holdings Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions," Report and Order, WT Docket No. 12-269, adopted May 15, 2014, ¶ 8, available at https://docs.fcc.gov/public/attachments/FCC-14-63A1.docx. *See also*, 2022 Communications Marketplace Report, ¶ 83.

[152] *See,* 2022 Telecommunications Monitoring Report, at pp. 110-115.

[153] Radio Spectrum Management, "Summary of RSM's Potential Work Plan," accessed February 29, 2023, available at https://www.rsm.govt.nz/about/publications/spectrum-outlook-and-annual-reports/new-zealand-spectrum-outlook-2023-management/upcoming-projects-2023-to-2027/potential-work-plan/.

- For fixed broadband services: Fibre (included in fibre geographies and not included in non-fibre geographies), ADSL/ADSL2+, satellite internet, FWA.[154] If the speed-price-data quota bundles are comparable, then mobile broadband could also be considered as being in the same market.

C. Spectrum and Competition in the Relevant Markets

Concentration in the input markets are of particular concern in the wireless telecoms space because, as discussed above in Section II, access to spectrum is a necessary condition for providing services for wireless service providers. Even though on the margin, spectrum and the number of cell sites are substitutes in generating network capacity (*i.e.*, can be substituted for each other for a given amount of capacity), inframarginally, they are ultimately complements, *i.e.*, network capacity and hence wireless services cannot exist with only cell sites or only spectrum. Given this, it is important to note that the accumulation of spectrum by any MNO is not *per se* anticompetitive.

It is not anticompetitive to acquire essential inputs such as spectrum at the market price determined by an open bidding process. This is particularly true in a competitive landscape where an MNO's competitors have substantial capacity, and scope to build capacity through complementary means. However, a sign that accumulation of spectrum could lead to horizontally anticompetitive outcomes would be if the price that the MNO was willing to pay for the spectrum was unreasonably high, foreclosing a more competitive rival MNO. There is no evidence that this was the case. In fact, the price that One NZ was willing to pay was reasonable as indicated by [BEGIN HIGHLY CONFIDENTIAL INFORMATION]

[END HIGHLY CONFIDENTIAL INFORMATION]. One NZ's offer for the 2.6 GHz band is also lower than comparable spectrum in other countries. For example in Norway, for the auction held in 2021 for the 2.6 GHz band Telia Norge AS paid approximately NZ$48 million

[154] In the 2016 Sparks and Craig Wireless decision, the Commerce Commission had stated that "[F]or the purposes of assessing the competitive impacts of this acquisition, the Commission considers that FWA broadband services should, as a matter of fact and commercial common sense, be included within a broader residential broadband market." See, Commerce Commission, "Spark New Zealand Trading Limited and Craig Wireless New Zealand Spectrum Operations Limited and Woosh Wireless Holdings Limited [2016] NZCC 7," Determination, Project no. 11.04/15746, ¶ 55.

for 2 x 30 MHz of 2.6 GHz spectrum, and Telenor Norge AS paid approximately NZ$69 million for 2 x 40 MHz of 2.6 GHz spectrum.[155]

In fact, it is a necessary part of an MNO's ordinary course of business to better their economics of providing services. Increases in spectrum holdings for an MNO can generate procompetitive effects as it could reduce costs, lower prices and increase the quality and breadth of the services it can offer. This directly benefits the current customers of the MNO and also places competitive pressures on any competitors that had market advantages. Hence, in analyzing whether a particular merger or spectrum acquisition deal will substantially lessen competition, one must carefully establish the procompetitive effects of the acquisition and compare that to the likely effects in the counterfactual. Furthermore, we find evidence that the factual scenario will be more procompetitive that the counterfactual for three reasons.

First, as discussed in Section III.A.3, NZ MNOs are generally not spectrum constrained when compared to their U.S. counterparts. This fact does not change whether we consider the factual or the counterfactual. This is because Dense Air NZ's spectrum is currently not deployed and will be an addition to the deployed spectrum inventory. Whichever MNO is cleared to purchase the spectrum, it will increase their capacity without lowering others'. Table 7 shows our capacity metric for the factual and counterfactual scenarios (assuming that 2degrees purchases all 70 megahertz form Dense Air NZ).

TABLE 7: CAPACITY PER SUBSCRIBER BY MNOS IN U.S. AND NZ IN FACTUAL AND COUNTERFACTUAL SCENARIOS

		United States			*New Zealand (Factual)*			*New Zealand (Counterfactual)*		
		AT&T	T-Mobile	Verizon	Spark	One NZ	2degrees	Spark	One NZ	2degrees
Sub-1 GHz Spectrum Holdings (Megahertz)	[1]	53.2	54.8	47.3	70	60	40	70	60	40
1 - 6 GHz Spectrum Holdings (Megahertz)	[2]	211.4	302	231.7	260	270	150	260	200	220
Total Spectrum Holdings (Megahertz)	[3]	264.6	356.8	279	330	330	190	330	260	260
Macro Sites (approximation)	[4]	73,700	79,000	68,000	1,616	1,759	1,448	1,616	1,759	1,448
Subscribers (millions)	[5]	217.4	113.6	115.0	2.6	2.4	1.4	2.6	2.4	1.4
Capacity/Subscriber	[6]	0.09	0.25	0.16	0.20	0.24	0.19	0.20	0.19	0.26

Sources and Notes:

[155] *See,* "The Norwegian 5G auction has concluded," *Nasjonal kommunikasjonsmyndighet*, September 30, 2021, accessed February 26, 2024, available at https://nkom.no/aktuelt/the-norwegian-5g-auction-has-concluded and assume NOK to NZD exchange rate of 0.165. "Norwegian Krone (NOK) To New Zealand Dollar (NZD) Exchange Rate History for 2021," *Exchange-Rates.Org*, accessed February 26, 2024, available at https://www.exchange-rates.org/exchange-rate-history/nok-nzd-2021.

[1], [2]: Federal Communications Commission (FCC), "2022 Communications Marketplace Report," December 30, 2022, Fig. II.B.13, accessed February 27, 2024, available at https://docs.fcc.gov/public/attachments/FCC-22-103A1.pdf; Submission of 2degrees Related to the Proposed Acquisition.
[3]: [1] + [2]
[4]: According to various analyst sources Verizon, AT&T and T-Mobile had approximately 68,000 macro sites (towers) (2021 estimate), 73,700 towers (2021 estimate) and 79,000 macro sites (2023 estimate), respectively. For tower data, *see* Bevin Fletcher, "Verizon Readies for C-band Deployments with Crown Castle, SBA Deals," Fierce Wireless, April 12, 2021, accessed February 27, 2024, available at https://www.fiercewireless.com/operators/verizon-readies-for-c-band-deployments-crown-castle-sba-deals; Steel in the Air, "AT&T Forecasts 6,700 New Macrocells from 2017-2022," June 9, 2016, accessed February 27, 2024, https://www.steelintheair.com/blog/att-forecasts-6700-new-macrocells-from-2017-2022; Steel in the Air, "T-Mobile Cell Tower Lease Rates in 2023," accessed February 27, 2024, https://www.steelintheair.com/t-mobile-cell-tower-lease. For the NZ site data, *see* [[]]
[5]: AT&T 2022 Annual Report, at p. 10, available at https://investors.att.com/~/media/Files/A/ATT-IR-V2/financial-reports/annual-reports/2022/2022-complete-annual-report.pdf; T-Mobile 2022 Annual Report, p. 5, available at https://s29.q4cdn.com/310188824/files/doc_financials/2022/ar/TMUS-2022-annual-report-final.pdf; Verizon 2022 Annual Report, p. 5, available at https://www.verizon.com/about/sites/default/files/2022-Annual-Report-on-Form-10K.pdf; New Zealand Telecommunications Market Report 2023-2030, at p. 32.
[6]: ([4] x [5]) / [3]

From Table 7, we can see in the factual and counterfactual, all NZ MNOs will continue to enjoy more capacity that AT&T and Verizon, and in the counterfactual, 2degrees would have more capacity per subscriber than all the U.S. MNOs and Spark and One NZ.

Given that NZ MNOs are not spectrum constrained, we believe that additional 2.6 GHz spectrum band will not be of any inframarginal, discrete consequence to any retail or wholesale services offered by any MNO. In other words, given the ample capacity 2degrees should be able to offer FWA and wholesale services with its current spectrum holdings and incremental network buildout. In addition, we understand that 2degrees 5G deployments are very nascent, which means that they should have significant capacity on their network for 4G FWA and other wholesale services. Hence, we see no reason for the Commission to take regulatory measures to subvert market outcomes (*i.e.*, Dense Air NZ's open bidding process for the 2.6 GHz spectrum) for concern of unilateral and/or vertical anticompetitive effects on the relevant markets defined above.

Second, it will be more efficient and cost-effective for One NZ to deploy the 2.6 GHz band than 2degrees. This is because, 2degrees will need to invest in new infrastructure to bring this spectrum online, and if they are going to make infrastructure investments, they can do so in increasing the reuse of their existing bands. In contrast, Dense Air NZ had loaned the 2.6 GHz band to One NZ (then Vodafone) during the COVID-19 pandemic to improve 4G FWA, which was deployed immediately, so it is clear One NZ can immediately utilise the spectrum and unleash its value to NZ consumers. This is supported by the market outcome of Dense Air NZ's auction. It is unsurprising that 2degrees, who currently does not deploy any 2.3 GHz – 2.6 GHz equipment, [

] reflects the inefficiency that will ultimately be passed down to end consumers even if 2degrees was to end up deploying the band at issue.

Third, there is evidence that One NZ's deployment of the 2.6 GHz band will generate more quality benefits for NZ consumers compared to the counterfactual. Currently, One NZ is a better utilized network compared to 2degrees as seen from the capacity per subscriber estimates in Table 7 and from the performance metrics presented in Table 8. In other words, One NZ provides better quality service, at a cheaper price, at similar network utilization levels. Even when compared to Spark, One NZ's quality of wireless service appears to outperform and be cheaper. This implies that One NZ has higher productivity per MHz of spectrum relative to the other MNOs and the incremental spectrum from the Proposed Acquisition will be used more efficiently by One NZ. The company should not be penalized for its efficiency by not being allowed to acquire the 2.6 GHz spectrum from Dense Air, and the spectrum should not go to a less efficient provider.

TABLE 8: ARPU AND PERFORMANCE BY PROVIDER IN NEW ZEALAND

Provider	2022 Mobile Subscribers	2022 Mobile ARPU (NZD)	Median Download Speeds (Mbps)	Median Multi-Server Latency (ms)	Consistency (%)	5G Download Speed (Mbps)	5G Availability (% of time)	5G Reach (0-10 points)
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Spark	2,606,000	31.1	70.23	58	83%	228.6	2.8%	1.6
One NZ	2,395,000	26.2	73.52	48	85%	253.8	3.9%	1.7
2 Degrees	1,440,000	26.9	64.86	40	91%	--	--	--

Sources and Notes:
Note that, multi-server latency measures "latency to multiple connections and then takes an average." Latency is the "reaction time of your connection" or "how quickly your device gets a response after you've sent out a request." The consistency score is the metric used by Ookla to gauge the quality of service by using thresholds of 5Mbps minimum download speed and 1Mbps minimum upload speed for mobile. *See,* Ookla, Ookla's Speedtest Methodology, accessed February 23, 2024, https://www.ookla.com/resources/guides/speedtest-methodology#ookla-metrics-and-scores.
5G availability shows "the proportion of time Opensignal users with a 5G device and a 5G subscription had an active 5G connection." 5G reach "analyzes the average proportion of locations where users were connected to a 5G network out of all the locations those users have visited." *See*, Opensignal, Methodology Overview, accessed February 23, 2024, https://www.opensignal.com/methodology-overview. [1] - [3]: New Zealand Telecommunications Market Report 2023-2030.
[4] - [6]: Speedtest, "New Zealand Median Country Speeds January 2024," Speedtest Global Index, accessed February 16, 2024, https://www.speedtest.net/global-index/new-zealand.
[7] - [9]: Sam Fenwick, "New Zealand Mobile Network Experience Report May 2022," Opensignal, accessed February 16, 2024, https://www.opensignal.com/reports/2022/05/newzealand/mobile-network-experience.

Thus One NZ, who is currently the lowest ARPU MNO, is better suited to bringing genuine competitive pressures to Spark, the highest ARPU MNO, compared to 2degrees whose

deployment of the band will be, as discussed above, costly. In addition, such increased competition can positively affect innovation, as firms vie for market share through competition on dimensions other than price.[156]

For these three reasons, we believe that the Proposed Acquisition is procompetitive when compared to the counterfactual. We see no evidence that 2degrees would be unable to compete or offer retail and wholesale services with its current spectrum holdings. We see evidence that it will be more likely that NZ consumers will get higher quality and lower prices on wireless services in the factual relative to the counterfactual.

V. Conclusion

Our analysis concludes, with respect to the Commission's Statement of Issues with regards to relevant market definition, that:

- The Commission's current approach to market definition is consistent with economic principles and the characteristics of the NZ wireless telecommunications market.[157] Relevant markets should be determined based upon the consideration of the end consumer's choice set and substitutability within that choice set. For instance, the mobile services provided by MVNOs should be included in the assessment of the output market. In particular, we believe there are no economically consistent reasons that wireless broadband services should be a separate retail market for competition assessment.[158]

- Spectrum bands are fungible and substitutable across bands for mobile wireless and wireless broadband services. We provide examples of how other countries have deployed 4G, 5G and FWA. However, some bands maybe more substitutable that others depending on existing network infrastructure. For example, One NZ already has the infrastructure in place to deploy 2.6 GHz immediately while 2degrees does not. This implies that the 2.6 GHz band is *more* substitutable with other bands for 2degrees

[156] Giulio Federico, Fiona Scott Morton, Carl Shapiro, "Antitrust and Innovation: Welcoming and Protecting Disruption," Innovation Policy and the Economy, Volume 20, Issue 1, 2020, pp. 125-136, available at https://www.journals.uchicago.edu/doi/epdf/10.1086/705642.

[157] *See*, Section IV.B.

[158] Commerce Commission SOI February 2024, ¶¶ 45, 68.

than for One NZ, *i.e.*, for 2degrees, deploying 2.6 GHz will be just as costly as upgrading and densifying to better utilize the existing capacity that 2degrees holds.[159] In addition, no single frequency band can provide a consistent and high quality mobile service. For example, low-band deployments are required for a coverage layer, and simultaneously, mid-band/mmW deployments are required for capacity layer. Similar arguments apply for wireless broadband services too.[160]

- Separate retail markets for 2G, 3G, 4G, 5G retail mobile services are not generally relevant to competition assessment. Mobile services always require a combination of generations of wireless technologies to be deployed for a consistent and reliable customer experience. Whether a given customer is receiving 2G, 3G, 4G, or 5G service, is not the customer's choice. Rather, the customer is ultimately making their decisions by considering various service quality and price combinations, not wireless standards.[161]

  Whether the customer connects to a 2G, 3G, 4G, or 5G network or whether wireless broadband services are provided over a 4G network or 5G network depends largely on technological progress, end customer needs, and new device adoption, which necessitates older generations of technologies to be phased out and spectrum to be repurposed for newer generations.[162]

Our analysis concludes, with respect to the Commission's Statement of Issues on NZ MNOs' capacity and ability to compete in retail mobile services, fixed broadband services, and wholesale mobile and fixed broadband services, that:

- Relative to the U.S., NZ MNOs do not appear to be constrained with respect to spectrum. The NZ MNOs, Spark, One NZ, and 2degrees have more capacity per subscriber compared to the top two U.S. MNOs, Verizon and AT&T. This suggests that with further densification and cell site deployments can go quite far in adding capacity and providing both mobile services and wireless broadband services (retail and wholesale).[163] Thus, 2degrees does not appear to be constrained in terms of mobile or FWA spectrum (for both 4G and 5G uses) and there is no concern for unilateral of vertical concerns.

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[159] *See,* Commerce Commission SOI February 2024, ¶ 174.

[160] *See,* Commerce Commission SOI February 2024, ¶¶ 54, 194.

[161] *See,* Commerce Commission SOI February 2024, ¶¶ 57, 194.

[162] *See,* Commerce Commission SOI February 2024, ¶¶ 57, 146.

[163] *See,* Commerce Commission SOI February 2024, ¶¶ 131.

- Network capacity can be increased by deploying new spectrum and/or adding more base stations/cell sites. Given this, for a given amount of incremental network capacity, the maximum amount MNOs are willing to pay for new spectrum is the expected cost of the alternative (*i.e.*, building more cell sites) method of adding capacity. Hence, building and upgrading new sites is only "second best" for an MNO if the market prices for spectrum are lower than the MNOs expected cost of new site buildout. Note that the market price for spectrum need not be lower than site build costs, and in a heavily spectrum constrained environment spectrum prices may be well above site build costs, which would imply that adding new spectrum is the "second best" alternative to adding capacity.[164] This is simply how the economics of the wireless services industry works, and it does not indicate anything about unilateral or vertical anticompetitive outcomes.

- The Proposed Acquisition is likely to be procompetitive in both output markets (*i.e.*, terrestrial mobile services and terrestrial fixed services). One NZ's deployment of Dense Air NZ's spectrum is likely going to be more efficient than that of 2degrees as One NZ has prior experience deploying this band (when it was leased during the COVID-19 pandemic), while 2degrees does not currently have any infrastructure to deploy this band. This is apparent in market outcomes, where [ ]. 2degrees higher costs of deploying the 2.6 GHz band is likely to be passed on to consumers.

- The Proposed Acquisition is likely to be procompetitive compared to the counterfactual because evidence shows that One NZ provides better quality service, at a cheaper price, at similar network utilization levels. Even when compared to Spark, One NZ's quality of wireless service appears to outperform and be cheaper. This implies that the most procompetitive/efficient thing to do will be for One NZ (which has similar ARPU as 2degrees) to close the gap with, and put pricing pressure on, Spark.

[164] *See,* Commerce Commission SOI February 2024, ¶¶ 146, 163, 174.

Appendix A

APPENDIX TABLE A 1: COUNTRY COMPARISONS 2021

		New Zealand	Australia	Norway	United States
Population	[1]	5,111,400	25,685,412	5,408,320	332,031,554
Urban population	[2]	4,436,133	22,182,436	4,506,374	275,164,510
Land area (sq km)	[3]	263,310	7,692,020	364,270	9,147,420
Population density	[4]	19.41	3.34	14.85	36.30
Number of MNOs	[5]	3	3	3	3
Mobile cellular subscriptions	[6]	5,846,000	27,092,000	5,926,491	361,664,000
Average mobile data usage per mobile broadband subscription (GB)	[7]	4.60	11.16	9.56	8.46

Sources and Notes:
[1] - [4], [6]: World Bank Open Data, https://data.worldbank.org/
[5]: 2022 NZ Telecommunications Monitoring Report; "Mobile Infrastructure Report 2023," *Australian Competition & Consumer Commission,* November 2023, https://www.accc.gov.au/system/files/Mobile%20Infrastructure%20Report%202023.pdf; "Comparing mobile experience across the Nordics: Chapter 2 – Coverage," *Tutela*, https://shorturl.at/hxZ02.
[7]: OECD, Broadband Portal, http://www.oecd.org/digital/broadband/broadband-statistics/, Mobile data usage per mobile broadband subscriptions.

APPENDIX TABLE A 2: TELECOMMUNICATIONS MARKET REVENUE AND MOBILE SUBSCRIBERS IN NZ

	Market Revenue (Million NZD)							*Mobile Subscribers (000s NZD)*						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
Spark	2,839	2,806	2,766	2,778	2,666	2,718	2,774	2,529	2,407	2,435	2,472	2,406	2,421	2,606
One NZ	2,027	2,039	1,962	2,047	1,954	1,968	1,984	2,429	2,485	2,521	2,315	2,235	2,252	2,395
2Degrees	695	729	836	748	707	778	1,225	1,439	1,421	1,399	1,459	1,483	1,443	1,440
Vocus	349	356	371	391	409	424		--	--	--	--	--	--	--
Mercury	66	81	88	98	102	108	121	--	--	--	--	--	--	--
Total	**5,976**	**4,272**	**4,174**	**3,997**	**3,794**	**4,242**	**3,882**	**6,397**	**6,313**	**6,351**	**6,246**	**6,124**	**6,116**	**6,441**

Sources and Notes:
New Zealand Telecommunications Market Report 2023-2030.

APPENDIX TABLE A 3: MVNOS IN NZ

MVNO [1]	MNO Host [2]
Compass	Spark
Kogan Mobile	Vodafone
Megatel	Spark
MyRepublic	Vodafone
Trustpower	Spark
Warehouse Mobile	2degrees

Sources and Notes:
2022 Telecommunications Monitoring Report, at p. 117.

APPENDIX TABLE A 4: BREAKDOWN OF HISTORICAL NZ BROADBAND SUBSCRIBERS

Subscribers (000s)	2016	2017	2018	2019	2020	2021	2022
Total UFB Passed	1,007	1,252	1,433	1,646	1,714	1,790	1,834
Total UFB connected	328	506	714	925	1,080	1,210	1,307
Spark (total)	635	590	569	551	538	515	502
Spark - UFB	138	206	273	340	381	402	423
Spark - Copper	497	384	296	211	157	113	79
% UFB	22%	35%	48%	62%	71%	78%	84%
One NZ (total)	423	424	429	420	448	461	455
One NZ - UFB + Copper	349	351	357	348	376	388	382
One NZ - HFC	74	73	72	72	72	73	73
% UFB and Copper	83%	83%	83%	83%	84%	84%	84%
2degrees (total)	56	69	82	108	132	149	380
Vocus (total)	192	196	194	205	214	217	
Vocus - UFB	38	62	85	123	155	178	
Vocus - Other	154	134	109	82	59	39	
% UFB	20%	32%	44%	60%	72%	82%	
Trustpower (total)	73	85	93	101	108	115	118
Other	105	102	127	155	106	112	128
Total Subscribers	1,484	1,466	1,494	1,540	1,546	1,569	1,583
Growth Rate	-0.1%	-1.2%	1.9%	3.1%	0.4%	1.5%	0.9%
Household Penetration	84.6%	81.9%	81.9%	83.2%	82.4%	82.4%	82.0%

Sources and Notes: New Zealand Telecommunications Market Report 2023-2030, at p. 51. Note, Trustpower was acquired by Mercury in June 2023.[165] 2degrees acquired Vocus in June 2022.[166]

[165] *See,* "Trustpower is now Mercury," *Mercury,* accessed February 26, 2024, available at https://ask.mercury.co.nz/app/answers/detail/a_id/3177/~/trustpower-is-now-mercury.

[166] *See*, Rob O'Neill, "2degrees Reveals its First Board since $1.7B Merger with Vocus NZ,' *Reseller News,* August 8, 2022, accessed February 26, 2024, available at https://www.reseller.co.nz/article/700527/2degrees-announces-its-first-board-since-1-7-billion-merger-vocus-nz/.