May 22, 2024

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: *Ex Parte Letter* – Amendment of Part 90 of the Commission's Rules, WP Docket No. 07-100

The Coalition for Emergency Response and Critical Infrastructure (CERCI) submits the attached report prepared by the Brattle Group, *Valuing the 4.9 GHz Band*,[1] in response to efforts to convert the 4940 – 4990 MHz band (4.9 GHz band) into another FirstNet band by essentially handing over 50 megahertz of highly desirable mid-band spectrum to FirstNet's exclusive contractor, AT&T, to serve public safety *and* commercial customers.[2] The Brattle Group estimates that, if deployed as a high-power band for 5G, as the Public Safety Spectrum Alliance (PSSA) suggests, the commercial value of the 4.9 GHz band would be approximately $14.3 billion. Even if it were, alternatively, licensed at lower power levels, the commercial value of the band would be approximately $3.4 billion.

In 2023, the Commission restored the 4.9 GHz band as a public safety band and announced that the 4.9 GHz band must "retain[] its locally controlled, public safety nature."[3] CERCI, comprised of national law enforcement organizations, Critical Infrastructure Industry (CII) stakeholders, mobile network operators, and wireless industry stakeholders, strongly supports the Commission's vision for the 4.9 GHz band and has repeatedly emphasized that this

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[1] Coleman Bazelon & Paroma Sanyal, *Valuing the 4.9 GHz Band,* BRATTLE GROUP (May 22, 2024) ("Valuing the 4.9 GHz Band").

[2] *See generally* Letter of the Public Safety Spectrum Alliance to Marlene H. Dortch, FCC, WP Docket No. 07-100 (Apr. 23, 2024).

[3] *See* Amendment of Part 90 of the Commission's Rules, Seventh Report and Order and Ninth Further Notice of Proposed Rulemaking, FCC 23-3, ¶ 1 (rel. Jan. 18, 2023).

is essential spectrum for current and future state and local public-safety systems. In contrast, the PSSA's proposal to turn the band over to FirstNet would undermine the Commission's vision for the 4.9 GHz band as a locally controlled public safety band.

In response to numerous objections to its controversial proposal, the PSSA has offered alternative options for turning the band over to FirstNet and AT&T, first calling for a nationwide FirstNet license and more recently seeking a nationwide overlay license to be assigned to a band manager for the sole purpose of entering a sharing arrangement with FirstNet. As CERCI has demonstrated, however, either scenario is unlawful and unsound.[4]

In the attached report, the Brattle Group finds "it is appropriate to consider the commercial value of the 4.9 GHz band,"[5] as the PSSA proposals would give 50 megahertz of prime mid-band spectrum to FirstNet and, in effect, its exclusive contractor, AT&T, to provide service for a fee to both its public safety and commercial customers. As CERCI has emphasized, any such step would substantially harm and distort competition in the marketplace for both public safety and commercial wireless services where spectrum access is premised on auctions and secondary market transactions.[6]

The Brattle Group study considers two valuations that rest on alternative band characteristics, determined by how spectrum will be used. One estimate measures the opportunity cost of not using this band for its highest valued alternative as a band licensed for exclusive use. If deployed utilizing high-power levels, the Brattle Group estimates this band to be worth approximately $14.3 billion. If licensed at lower power levels in a non-exclusive regime, the Brattle Group estimates the band to be worth approximately $3.4 billion.

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[4] *See* Letter of the Coalition for Emergency Response and Critical Infrastructure to Marlene H. Dortch, FCC, WP Docket No. 07-100 (Apr. 15, 2024); Letter of the Coalition for Emergency Response and Critical Infrastructure to Marlene H. Dortch, FCC, WP Docket No. 07-100 (May 10, 2024) ("CERCI May 10 Letter").

[5] Valuing the 4.9 GHz Band at 2.

[6] *See* CERCI May 10 Letter at 3.

The Commission should reject the PSSA proposals, which would undermine local control and the public safety nature of the band and disrupt today's competitive marketplace by providing AT&T free access to billions of dollars' worth of spectrum.

Sincerely,

The Coalition for Emergency Response and Critical Infrastructure ("CERCI")

/s/ Kenneth Corey
Kenneth Corey
NYPD Chief of Dept. (Ret.)
CERCI Chairman

/s/ Roger C. Sherman
Roger C. Sherman
CERCI Policy Advisor

Attachment

Valuing the 4.9 GHz Band

THE BRATTLE GROUP

PREPARED BY

Coleman Bazelon
Paroma Sanyal

PREPARED FOR

CERCI

DATE

MAY 22ND 2024

AUTHORS

Coleman Bazelon is an economic expert with much of his practice focused on regulation, strategy and valuation in the wireless, wireline and video sectors. His practice encompasses the modern information infrastructure and the content that fills it. He regularly advises regulators and Congress on radio spectrum policy.

Coleman.Bazelon@brattle.com

Paroma Sanyal is the co-leader of Brattle's Telecommunications, Media and Entertainment practice. She is an expert on telecom regulation and competition issues, spectrum policy, broadband data issues and consumer protection cases in the telecom and internet sphere. Prior to joining Brattle, she was the Chief Economist of the Federal Communications Commission's Wireless Telecommunications Bureau.

Paroma.Sanyal@brattle.com

NOTICE

- This report was prepared for the Coalition for Emergency Response and Critical Infrastructure (CERCI), in accordance with The Brattle Group's engagement terms, and is intended to be read and used as a whole and not in parts.
- The report reflects the analyses and opinions of the authors and does not necessarily reflect those of The Brattle Group's clients or other consultants.
- There are no third-party beneficiaries with respect to this report, and The Brattle Group does not accept any liability to any third-party in respect of the contents of this report or any actions taken or decisions made as a consequence of the information set forth herein.

TABLE OF CONTENTS

I. Introduction

The Federal Communications Commission (FCC) has allocated 50 megahertz of spectrum in the 4,940-4,990 MHz range (4.9 GHz band) for fixed and mobile services, excluding aeronautical mobile services. Today, this spectrum band has been designated by the FCC specifically for public safety purposes. Non-traditional public safety entities, including utilities, commercial organizations, and the Federal Government, may collaborate with eligible traditional public safety entities to share the 4.9 GHz band, enhancing their efforts in homeland security and the protection of life and property. In 2020, the FCC announced a freeze on new applications for, and modifications to, licenses in the 4.9 GHz band, and although this freeze was partially lifted in 2021, it remains in effect as to non-incumbent applicants for new 4.9 GHz band licenses.[1]

In 2023, the FCC established a nationwide framework with a single band manager, an approach designed to allow individual public-safety licensees to retain local control over non-commercial operations in the band.[2] The FCC issued a further notice to consider various issues, including two potential band manager models for leasing spectrum to non-public safety entities.[3]

Notwithstanding the FCC's proposals to the contrary, the Public Safety Spectrum Alliance (PSSA) subsequently petitioned the FCC to award a nationwide license of 4.9 GHz spectrum to the FirstNet Authority, which had entered into an exclusive contract with AT&T in 2017 that allows AT&T to provide service to its public safety (*i.e.*, FirstNet) customers, and also to otherwise incorporate FirstNet's spectrum into its commercial wireless network.[4] More recently, PSSA has suggested in the alternative that the FCC grant a nationwide overlay license to a band manager

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1 *See,* Amendment of Part 90 of the Commission's Rules, WP Docket No. 07-100, Order on Reconsideration and Eighth Further Notice of Proposed Rulemaking, 36 FCC Rcd 15032, 15036 (2021).

2 *See,* Amendment of Part 90 of the Commission's Rules, Seventh Report and Order and Ninth Further Notice of Proposed Rulemaking, FCC 23-3 (rel. Jan. 18, 2023) ("Order" or "FNPRM"). Under "Model 1," the band manager would lease spectrum access rights from public-safety licensees and then sub-lease access to that spectrum to its choice of non-public-safety entities; under "Model 2," public-safety licensees would engage in lease arrangements directly with non-public-safety entities and the band manager would coordinate and approve the leases.

3 FCC, "In the Matter of Amendment of Part 90 of the Commission's Rules, Seventh Report and Orde and Ninth Further Notice of Proposed Rulemaking," adopted January 18, 2023, https://docs.fcc.gov/public/attachments/FCC-23-3A1.pdf.

4 Donny Jackson, "PSSA Suggests a Way for FCC to Give FirstNet Authority Access to 4.9 GHz, Even with Legal Questions," IWCE's Urgent Communications, April 26, 2024, https://urgentcomm.com/2024/04/26/pssa-suggests-a-way-for-fcc-to-give-firstnet-authority-access-to-4-9-ghz-even-with-legal-questions/.

and that the band manager then be obligated to enter a sharing arrangement with FirstNet to allow its use of the band. PSSA's plan of giving the band to FirstNet and its commercial partner has been opposed over the last year by numerous entities from the public safety, transportation, critical infrastructure, and wireless industries.[5]

There is a question in this proceeding of whether the FCC should grant this valuable spectrum to FirstNet and, in turn, to allow FirstNet's contractor AT&T to provide service over the band to public safety and use it for commercial customers when the band is not in use by public-safety. Mid-band spectrum, like the 4.9 band, is highly valuable in the 5G space due to its unique balance of coverage and capacity. Positioned between the low-band and high-band spectrums, mid-band frequencies typically range from 1 GHz to 6 GHz, making them essential for achieving the optimal performance of 5G networks. Notwithstanding a demonstrated need to make more mid-band spectrum available for commercial use over coming years, the pipeline for such spectrum is currently empty.

The PSSA seeks to incorporate the 4.9 band into the National Public Safety Broadband Network (NPSBN), which AT&T uses to provide service to both its public safety and commercial customers. Thus, while Coalition for Emergency Response and Critical Infrastructure (CERCI) has advocated that the FCC maintain local control for the band, it is appropriate to consider the commercial value of the 4.9 GHz band in considering the opportunity costs associated with PSSA's proposal.

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[5] *See, e.g.,* City of Toledo, Protecting Continued Local Control of First Responder Communications Networks – Amendment of Part 90 of the Commission's Rules, WP Docket No. 07-100, FCC (filed May 21, 2024); Ex Parte of American Association of State Highway and Transportation Officials, Emergency Response Policy American Petroleum Institute, Enterprise Wireless Alliance, Forestry Conservation Communications Association, FCC, WP Docket No. 07-100 (filed May, 20, 2024); Ex Parte of the Southwestern Border Sheriffs' Coalition Texas Border Sheriff's Coalition, FCC, WP Docket No. 07-100 (filed Apr. 26, 2024); Ex Parte of Industry Council for Emergency Response Technologies (iCERT), FCC, WP Docket No. 07-100 (filed Feb. 7, 2024); Ex Parte of The Coalition for Emergency Response and Critical Infrastructure, FCC, WP Docket No. 07-100 (filed Feb. 6, 2024); Ex Parte of American Association of State Highway and Transportation Officials, FCC, WP Docket No. 07-100, at 2-3 (filed Jan. 24, 2024; Ex Parte of California Office of Emergency Services, FCC, WP Docket No. 07-100 (filed Jan. 16, 2024); Response of Major Cities Chiefs Association, Nat'l Sheriffs' Ass'n, Nat'l Ass'n of Women Law Enforcement Executives, FCC, WP Docket No. 07-100 (filed Dec. 20, 2023); Ex Parte of the American Petroleum Institute, Enterprise Wireless Alliance, Forestry Conservation Communications Association, International Municipal Signal Association, National Sheriffs' Association, Utilities Technology Council, FCC, WP Docket No. 07-100 (filed Sept. 21, 2023); Reply Comments of the Metropolitan Transportation Authority, FCC, WP Docket No. 07-100 (filed May 15, 2023).

To understand the commercial value of this spectrum, we provide two valuations that rest on alternative band characteristics, determined by how it will be used.[6] Our first estimate measures the opportunity cost of not using this band in its highest valued alternative use as a band licensed for exclusive, full-powered use. If deployed in this manner, we estimate this band to be worth about **$14.3 billion**. If it were licensed at lower power in a non-exclusive regime, we estimate that the commercial value of the band be less, but still substantial – approximately **$3.4 billion**.

II. Valuing the 4.9 GHz Band

A. Valuation Methodologies

The economic value of a band of spectrum is the present value of future expected cash flows that can be earned from the spectrum. Notably, future cash flows include the expected price a spectrum license can be sold for at some point in the future. The analysis in this section focuses on estimating the likely underlying spectrum value.

Several factors influence the valuation of wireless broadband spectrum. These include the propagation characteristics of the spectrum band, the relative supply and demand for the spectrum, various impairments, the cost of relocating existing users, and the timing and uncertainty regarding availability, among other considerations. These factors can be divided into two groups: (1) components that affect the value of all bands of similarly deployed spectrum, (2) components that affect the specific band, including institution-imposed regulations.[7] The first group includes factors such as the overall demand for wireless services, general macroeconomic condition of the economy, technologies that can economically use available spectrum, and the overall supply of spectrum. For instance, previous Brattle work has estimated that there has been an increase in the sea-level value of spectrum in the 5G era.[8] The second set of factors that

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[6] Note we are only providing the benefit side of a cost-benefit analysis that would be used to determine the appropriate path forward for this band of spectrum.

[7] Coleman Bazelon and Giulia McHenry, "Spectrum Value," Telecommunications Policy, October 2013, https://www.sciencedirect.com/science/article/abs/pii/S0308596113001006. ("Spectrum Value"). *See also*, Matt C. Courtnage and Stephen P. Halligan, "Considerations Related to the Valuation of Wireless Spectrum," Property Tax Valuation Insights, 2016, https://willamette.com/insights_journal/16/summer_2016_2.pdf.

[8] Coleman Bazelon, Paroma Sanyal, Yongjoon Paek, Ryan Taylor and Austin Lajoie, "Understanding Spectrum Prices in Recent Upper Mid-Band FCC Auctions," TPRC, 2022, https://dx.doi.org/10.2139/ssrn.4178817, ("Understanding Spectrum Prices in Recent Upper Mid-Band FCC Auctions").

impact valuation are band-specific, including such concerns as the frequency's propagation and bandwidth characteristics, and development of band-compatible infrastructure and technology.

There are three primary methods used for spectrum valuation: market-comparables, discounted cash flow (DCF), and econometric. The approach used depends on context; courts prefer market-comparables analysis, while DCF can be useful in valuing new spectrum use cases by considering novel uses and deployment technology.[9] A market-comparables analysis uses previous transactions of similar spectrum bands as a baseline to value the spectrum band in question. The final value is then calculated by adjusting for differences between the previous spectrum in the comparable transactions and the current spectrum being auctioned. The DCF method relies on the concept that the current value of a band is the present value of its future profits. The econometric method estimates a statistical relationship between values of assets and explanatory variables and is often used to determine the importance of an explanatory variable in the asset values and corroborate results from other valuation approaches. We will use an adjusted market-comparables approach to value the 50 megahertz of the 4.9 GHz band.

B. Valuation Using the Market-Comparables Approach

The market-comparables method uses prior auctions or secondary market transactions for similar spectrum as a baseline to value a given spectrum band. It then adjusts for differences between the spectrum band used in those transactions and the band being valued.[10] We begin by establishing a base value of spectrum, establish the relative value of the 4.9 GHz band, and then compute the dollar value of the 4.9 GHz band based on this relative value.

At a micro level, the value of a band of spectrum is based on the profits that can be earned by deploying it.[11] Therefore, similar spectrum bands can be expected to have similar profit expectations and thus, similar value. In this sense, for valuation purposes the similarity of two bands of spectrum is measured on the similarity of the cash flows they can generate. The initial step is to find a band that has similar propagation, licensing, and ownership characteristics. However, it is often difficult to find a band with the identical characteristics. In such cases, we

[9] Spectrum Value.

[10] Understanding Spectrum Prices in Recent Upper Mid-Band FCC Auctions.

[11] Understanding Spectrum Prices in Recent Upper Mid-Band FCC Auctions.

find a spectrum band with known characteristics, and use that as the initial valuation base, and then adjust for differences.

In this instance, there are three mid-band spectrum bands that have been auctioned in the past 4 years that may be appropriate comparables: (i) The 3.45 GHz (3.45–3.55 GHz band) auction (Auction 110) that concluded in January 2022 and the net price across all categories was $0.73/MHz-pop.[12] (ii) The C-Band (3.7 – 3.98 GHz band) auction (Auction 107) that concluded in February 2021 where the fully-loaded net price accounting for accelerated payments and clearing costs was $1.10/MHz-pop.[13] (iii) The CBRS (3.55-3.65 GHz) auction (Auction 105) that concluded in 2020 where the average nationwide price was $0.22/MHz-pop.[14]

In this valuation, we will use the C-Band and the CBRS band as comparables, depending on the technical characteristics and use cases of the band. We do not use the 3.45 GHz band as a baseline comparable, as this band had significant and uncertain impairments and a limit on the amount of spectrum an individual bidder could acquire.[15] We value the 4.9 GHz band under two scenarios: (1) where the band will have higher power levels similar to the C-Band; and (2) where the band will have lower power levels and is subject to some incumbent protections, with performance more similar to the CBRS band.

1. Valuing the Band as a High-Power Band

We use the C-Band spectrum for our baseline under the scenario that the 4.9 GHz band will have power levels similar to the C-Band that will enable widespread 5G mobile terrestrial deployment.

Baseline Value

The one complexity with the C-Band is that the nationwide price from the auction does not capture all the relevant license characteristics, which drive differences in value. This is due to the

[12] FCC, "Auction 110: 3.45 GHz Service," https://www.fcc.gov/auction/110; Sasha Javid, "Post Auction Analysis for Auction 110 (3450-3550 MHz Band)," https://www.sashajavid.com/FCC_Auction110.php.

[13] FCC, "Auction 107: 3.7 GHz Service," https://www.fcc.gov/auction/107; Sasha Javid "Post Auction Analysis for Auction 107 (3700-3980 MHz Band)," https://sashajavid.com/FCC_Auction107.php.

[14] FCC, "Auction 105: 3.5 GHz Service https://www.fcc.gov/auction/105; Sasha Javid "Auction 105 Summary (3550-3650 MHz Band)," https://sashajavid.com/FCC_Auction105.php.

[15] FCC, "Auction of Flexible-Use Service Licenses in the 3.45-3.55 GHz Band for Next-Generation Wireless Services; Comment Sought on Competitive Bidding Procedures for Auction 110," ¶¶ 9, 29, DA/FCC # 21-33, Public Notice, March 18, 2021, https://www.fcc.gov/document/fcc-seeks-comment-mid-band-spectrum-auction-0, ("Auction 110 PN") This price is based on 100% of NTIA's estimated relocation cost of $13.4 billion. This implies $0.45/MHz-Pop.

early clearing of certain frequencies in large geographic areas, accelerated relocation payments and separate clearing costs. Several considerations are taken into account before utilizing C-Band prices as a comparable for the 4.9 GHz band. First, all of the C-Band's accelerated relocation payments and clearing costs should be included because this determines the dollar amount that was committed to the auction by the bidders, *i.e.*, the baseline comparable C-Band price should be the "fully loaded" or "all-in" price because the 4.9 GHz band will be available in a time frame commensurate with the 'accelerated' C-Band licenses. Bidders who won accelerated blocks were willing to pay their gross bid plus the accelerated clearing costs allocated to that license at the end of the auction.

Relative to these accelerated licenses, the value of licenses in Phases II and III were discounted because they were not available as quickly.[16] Based on whether the 4.9 GHz spectrum will be subject to a delay (in clearing the incumbents) or whether it will become available within 18 months to 2 years, we consider two baseline scenarios.

- *Baseline with Delay*: In our first baseline scenario, we assume that clearing the 4.9 GHz band from the public safety incumbents will be on a similar timeline to the C-Band and thus we use the $1.10/MHz-Pop as the baseline value.
- *Baseline without Delay*: In our second baseline scenario, we assume that there will likely be not similar delays in utilizing the 4.9 GHz band, *i.e.*, it will not take more than 18 months – 2 years for the band to be available for mobile terrestrial use.[17] In order to more accurately capture the hypothetical value of C-Band spectrum if there had not been delays in the clearing of some licenses, we scale up the value of the Phase II and III licenses. Using PEAs that included some accelerated Phase I licenses and some delayed Phase II licenses, we take the ratio of the Phase I fully loaded average price and Phase II fully loaded average price, and multiply all the delayed Phase II and Phase III bids by this scalar.[18] We then calculate a C-Band national average using the fully loaded Phase I bids, and the fully loaded and scaled Phase II and III bids. Our baseline value is $1.26/ MHz-Pop.

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[16] There was a three-phase clearing schedule in the C-Band auction, and a relocation deadline for all clearing by December 2025 and two early clearing Phase I and Phase II deadlines. The A Block in the top 46 PEAs has a clearing deadline of December 2021 (Phase I) and for the B/C Blocks in the 46 PEAs and the A/B/C Blocks in the remaining 360 PEAs the accelerated clearing deadline is December 2023 (Phase II). *See*, FCC, "Expanding Flexible Use of the 3.7 to 4.2 GHz Band," Report and Order, adopted February 28, 2020, ¶¶ 24, 155, https://docs.fcc.gov/public/attachments/FCC-20-22A1.pdf, ("C-Band R&O").

[17] We have found that when spectrum is available withing about two years of a sale, there is no discount to value. This is because it typically takes about that amount of time to plan for and deploy new frequencies.

[18] The ratio of Phase I to Phase II license prices in the C-Band was 1.21.

Adjustments

Given the differences in propagations characteristics between the 4.9 GHz band and the C-Band, we need to adjust the valuation. From prior work we know that the population covered is one of the primary drivers of value.[19] We model the value assuming the 4.9 GHz will be deployed on the existing C-Band towers. This provides a minimum valuation approach. We recognize that the 4.9 GHz spectrum will likely be deployed beyond the C-Band infrastructure. These additional deployments, however, will come with additional costs. Consequently, as a conservative assumption, we assume any deployments beyond the C-Band infrastructure will not generate additional net cash flows. With this modeling assumption, we can focus on the difference in population covered as the driver of difference in spectrum value. To implement this without explicitly modelling the 4.9 GHz population coverage, we rely on prior work that estimated the share of the U.S. population expected to be covered by the C-Band and 12 GHz for mobile 5G applications.[20] Tracts with populations greater that 7,500 population per square mile are considered dense urban in this model. We assume that the entirety of this dense urban population will be covered by the C-Band for mobile 5G applications, since in the dense urban areas the desired inter-site distances of towers are such that the C-Band coverage radii will cover all of the population. In general, given population density the desired inter-site distance in dense urban areas is between 0.1 to 0.3 kilometers, while the reach of a C-Band site in these areas is assumed to be up to 0.45 kilometers.[21] Given the dense morphology of networks and ubiquity of cell sites in urban settings, 12 GHz frequencies are also expected to cover the same population for mobile 5G applications as C-Band deployed on these dense urban networks. We extend this assumption to the 4.9 GHz band – the frequencies would be deployed to cover all dense urban population.

For the non-dense urban areas (less dense urban, suburban, and rural) where cell towers are more spaced out, the C-Band coverage radii is at least 0.45 km and for 12 GHz, it is at least 0.2 km.[22] Our prior estimates show that, across all morphographies, for mobile 5G applications, the

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[19] Coleman Bazelon, Paroma Sanyal, Jonathan Lee, Ezra Frankel and Ryan Taylor, "Network Value Drivers in a 5G World," TRPC 48, September 15, 2021, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3749891.

[20] Coleman Bazelon and Paroma Sanyal, "Valuing the 12 GHz Spectrum Band with Flexible Use Rights," May 7, 2021, https://5gfor12ghz.com/wp-content/uploads/2021/05/AS-FILED-Comments-of-RS-Access-Apx.-B-Brattle-Group-Economic-Study-5.7.21.pdf, ("Valuing the 12 GHz Spectrum Band with Flexible Use Rights").

[21] Valuing the 12 GHz Spectrum Band with Flexible Use Rights, p. 25.

[22] Valuing the 12 GHz Spectrum Band with Flexible Use Rights, p. 25.

C-Band covers 74.5% of the total U.S. population, and the 12 GHz band was expected to reach 23.8% of the U.S. population.[23]

4.9 GHz Urban Coverage

As noted above our previous work had shown that even the 12 GHz would cover the entirety of the dense urban population since the inter-site distances in these areas were smaller than the coverage radii of the 12 GHz spectrum band. Therefore the 4.9 GHz band, will also cover all the population in the dense urban areas in the US, *i.e.*, 15.6% (See Table 1 below).

4.9 GHz Non-Dense Urban Coverage

For the non-dense urban population, we assume that the 4.9 GHz coverage radii is approximately 0.35 km.[24] Then using our prior analysis of expected C-Band and 12 GHz deployments we estimate how the reduction in coverage radii between the C-Band and the 12 GHz band affects the amount of population covered by the 12 GHz band compared to the C-Band. We find that 56% reduction in coverage radii implies a population coverage reduction of 86%.[25] This implies that a coverage radii reduction of 22% (from the C-Band's 0.45 km to the 4.9 GHz band's 0.35 km) would be expected to lead to a population coverage reduction of about 34%.[26] This implies that the expected non-dense urban population coverage of the 4.9 GHz band is around 54% of population.[27]

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[23] Valuing the 12 GHz Spectrum Band with Flexible Use Rights, p. 26.

[24] From previous work we know that the C-Band coverage radii in non-urban areas is at least 0.45 km and for 12 GHz, it is 0.2km. We assume that the 4.9 GHz radii is approximately 0.35 km. *See,* Valuing the 12 GHz Spectrum Band with Flexible Use Rights. The radii for the 4.9 GHz band is based on an interpolation that uses the radii for band from 600 MHz to 12 GHz and predicts a radii for the 4.9 GHz band.

[25] We use a linear interpolation based on the 12 GHz and C-Band population coverage and radii along with the radii ratio.

[26] Note that this calculation assumes a linear relationship between changes in area covered and changes in population. A more detailed analysis using our network model could provide a more precise estimate of the population expected to be covered by a 4.9 GHz deployment and the C-Band.

[27] We use linear interpolation based on the 12 GHz and C-Band population coverage and radii, and the ratio of the 4.9 GHz and C-Band radii, and back-out the 4.9 GHz population coverage.

TABLE 1: POPULATION FOR MOBILE 5G APPLICATIONS COVERED BY C-BAND AND REACHED BY 4.9 GHZ OVERLAY

Population Category	Share of US Pops	Share of US Pop Covered by C-Band	Share of US Pop Expected to be Covered by 4.9 GHz	Share of Pop Category Covered by C-Band	Share of Pop Category Expected to be Covered by 4.9 GHz
[a]	[b]	[c]	[d]	[e]	[f]
Dense Urban Pops	15.6%	15.6%	15.6%	100.0%	100.0%
Non- Dense Urban Pops	84.4%	58.9%	38.6%	69.8%	45.8%
Total	100.0%	74.5%	**54.2%**		

Population Adjusted Price

From previous work, we had estimated that the C-Band population coverage was around 75% and here we estimate that for 4.9 GHz it is 54%. This yields a value adjustment ratio of around 73%. This yields an interim value of the 4.9 GHz band at $0.80/ MHz-pop if there is a delay in clearing the band and $0.92/ MHz-pop if there is no delay.[28]

Results

[28] *See* Table 2.

TABLE 2: 4.9 GHZ VALUATION ASSUMING A HIGH-POWER LEVEL

Valuation of Comparables		
Fully Loaded Auction Price for C-Band	[1]	$1.10
Scaled Up Fully Loaded Base Price for C-Band	[2]	$1.26
Share of US Population Expected to be Covered by C-Band	[3]	74.5%
Covered Urban Population (% of US Population)	[4]	15.6%
Covered Non-Urban Population (% of US Population)	[5]	58.9%
Share of US Population Expected to be Covered by 4.9 GHz	[6]	54.2%
Covered Urban Population (% of US Population)	[7]	15.6%
Covered Non-Urban Population (% of US Population)	[8]	38.6%
Adjustments		
Implied Percentage, 4.9 GHz to C-Band	[9]	72.8%
Population and Megahertz		
Population Covered based on 2010 Census	[10]	312,000,000
Available Megahertz	[11]	50
Valuation		
Valuation With Delay in Clearing the Band		
Pop-Adjusted National Average Price ($/MHz-Pop)	[12]	$0.80
Total Value ($)	[13]	**$12,484,187,919**
Valuation Without Delay in Clearing the Band		
Pop-Adjusted National Average Price ($/MHz-Pop)	[14]	$0.92
Total Value ($)	[15]	**$14,300,069,799**

Sources and Notes:
[1]: Fully Loaded C-Band Auction Price, i.e., it includes the acceleration payments and the clearing costs.
[2]: This scales up the value for the unaccelerated blocks as if they would also be subject to acceleration. Using PEAs that included some accelerated Phase I licenses and some delayed Phase II licenses, we take the ratio of the Phase I fully loaded average price and Phase II fully loaded average price and multiply all the delayed Phase II and Phase III bids by this scalar.
[3]: [4] + [5]
[4] - [5]: Coleman Bazelon and Paroma Sanyal, "Valuing the 12 GHz Spectrum Band with Flexible Use Rights," May 7, 2021, https://5gfor12ghz.com/wp-content/uploads/2021/05/AS-FILED-Comments-of-RS-Access-Apx.-B-Brattle-Group-Economic-Study-5.7.21.pdf
[6]: [7] + [8]
[7] - [8]: Coleman Bazelon and Paroma Sanyal, "Valuing the 12 GHz Spectrum Band with Flexible Use Rights," May 7, 2021, https://5gfor12ghz.com/wp-content/uploads/2021/05/AS-FILED-Comments-of-RS-Access-Apx.-B-Brattle-Group-Economic-Study-5.7.21.pdf
Note that for [8] we use linear interpolation based on the 12 GHz and C-Band population coverage and radii.
[9]: [6] / [3]
[10]: 2010 Population
[11]: Megahertz available
[12]: [9] * [1]

[13]: [10] * [11] * [12]
[14]: [9] * [2]
[15]: [10] * [11] * [13]

Thus, our best estimate for the 4.9 GHz band under a mobile wireless deployment scenario is $0.80/MHZ-pop *with clearing delay,* with the value of the 50 megahertz of spectrum at **$12.5 billion**. *Without clearing delay*, the value is **$0.92/MHZ-pop,** with 50 megahertz of spectrum valued at **$14.3 billion**.[29]

2. Valuing the Band as Lower Power, With Some State and Local Incumbent Systems Retained

We use the CBRS spectrum for our baseline under the scenario that the current 4.9 GHz band rules may make it similar to the CBRS band in terms of power levels and protection of incumbents. Although the CBRS three-tiered sharing regime is unique, PSSA states that its proposal would protect incumbent public safety licensees and so there may be circumstances that are not exclusive-use. We recognize this scenario may not be as closely aligned with the use cases envisioned by PSSA and FirstNet.

Baseline Value

Auction 105, the CBRS/3.5 GHz auction, which concluded on August 25, 2020, had two important differences with other bands that have been auctioned – the novel shared nature of the band and lower power levels that enabled such sharing.[30] This band had federal incumbents and critical radars that needed to be protected from interference from all other users. The FCC created a three-tiered access and authorization framework to coordinate shared federal and non-federal use of 150 megahertz of spectrum in the band.[31] Seven 10 megahertz Priority Access Licenses (PALs) were auctioned for flexible use in each U.S. county, subject to protecting incumbent operations, and each licensee may hold no more than four PALs in any county at any given time. We use the CBRS auction price of $0.22/MHz-pop as the base value.

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[29] See Table 2.

[30] Coleman Bazelon, Paroma Sanyal and Yong Paek, "Principles of Spectrum Sharing: Understanding the Value of Shared Spectrum," September 18, 2023, p. 31, https://spectrumfuture.com/wp-content/uploads/2023/09/Principles-of-Spectrum-Sharing-Understanding-the-Value-of-Shared-Spectrum.pdf.

[31] FCC, "In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in 3550 – 3650 MHz Band," GN-Docket No. 12-354, Report and Order and Second Further Notice of Proposed Rulemaking, FCC 15-47, adopted April 17, 2015, https://docs.fcc.gov/public/attachments/FCC-15-47A1.pdf.

Comparison to the 4.9 GHz Band

The CBRS band is at 3.5 GHz but has a lower power level than traditional bands, which was one of the reasons for the lower value. Thus, if we consider a lower power scenario for the 4.9 GHz band, the CBRS is an appropriate market-comparable to start with. The higher frequency of 4.9 GHz versus 3.5 GHz would be expected to reduce value. Further, given the sharing with incumbent public safety operations, the effective bandwidth that may be available for priority licensing might be less than the entire 50 MHz of the band, further suggesting a reduction in value, although likely fairly small. However, the CBRS band had a novel, untested shared access regime, but subsequent experience demonstrates that sharing is feasible. This resolution of uncertainty about the feasibility of sharing would suggest an increase in value for the 4.9 GHz band compared to CBRS. It is also unclear if the lower power levels at 4.9 GHz would have as much an impact on value as they did in CBRS because the type of sharing may be easier to coordinate. These relatively less restricted power levels would suggest relatively higher value for the 4.9 GHz band. It is beyond the scope of the current analysis to calibrate these various countervailing factors and instead we simply assume that they may cancel out each other. Thus, our best estimate for the 4.9 GHz band under a shared scenario is a price similar to the CBRS band at **$0.22 /MHz-pop**. The value of the 50 megahertz of spectrum is **$3.4 billion**.[32]

[32] Calculation: $0.22/MHz-pop*50 megahertz*312 million = $3,432,000,000