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Analyzing Plans To Reallocate C-Band for Deployment

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Executive Summary

The ubiquity of smartphones and the advent of the internet of Things has propelled the importance and demand for transmission infrastructure for mobile data. Rising demand for radio spectrum has driven a conversation over how the Federal Communications Commission (FCC) should use its power to allocate spectrum, but recently this discussion has taken a unique turn with a proposal by the C-Band Alliance (CBA) to repurpose 180 megahertz (MHz) of spectrum between 3.7 gigahertz (GHz) and 4.2 GHz through an auction. What follows is an overview of the current proposals for the space known as the C-Band. For policymakers, it is important to understand that:

- The C-Band spectrum is valuable, but its value is highly dependent on the underlying costs required to put this new spectrum to use;
- While many have decried the CBA plan as a private sale, its plan would likely mirror previous FCC auctions and it has strong incentives to create a competitive and efficient process;
- Whatever method is pursued to repurpose the band, the transition needs to be orderly and conducted in a timely manner since a two-year delay could mean a loss of nearly \$18 billion in consumer surplus; and
- Assuming the FCC secures a portion of the spectrum sale proceeds for the public and ensures an open and transparent auction process, moving forward with such a plan appears to be the most economically efficient option available.

History of the C-Band

The history of data transmission in the C-Band begins during World War II. Toward the end of 1943, AT&T secured the ability from the Federal Communications Commission (FCC) to test a series of microwave relays in the 3.7 gigahertz (GHz) to 4.2 GHz space for sending telephone calls between stations in New Jersey. This project developed into the Long Lines (<http://long-lines.net/tech-equip/radio/BLR1067/283.html>), a relay network that supplied long-distance services to AT&T and AT&T's customers in the television industry. Although the telephone company began to phase out the Long Lines system in the 1970s, shifting to fiber, coaxial cable, and other means of transmitting data, this band of spectrum has been continuously used since to transmit data via point-to-point microwave links. Today, these licenses are called Fixed Services, or FS.

Even during the height of FS transmission, another use for the same spectrum range began. In 1965, the American Broadcasting Company (ABC) petitioned (<https://scholarship.law.unc.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1473&context=ncilj>) the FCC to be able to use a satellite to transmit its television feed. It wasn't until 1972 that the FCC finally ruled on the matter (<https://scholarship.law.unc.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1473&context=ncilj>), but the resulting system created the unique pattern of spectrum use that we have today. After asking everyone in the industry to apply for a license in a 1970 order (*Domsat I*), the FCC in a second order (*Domsat II*) implemented the Open Skies policy (<https://scholarship.law.unc.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1473&context=ncilj>), which encouraged the development of the nascent Fixed Satellite Services (FSS) sector.

In allowing open development of the 3.7 GHz to 4.2 GHz band, the FCC rejected the comparative bidding system that was prevalent at the time. These dressed-up beauty contests often gave away licenses due to political connections. Most notably, Lady Bird Johnson made millions (<https://slate.com/news-and-politics/2007/07/how-lady-bird-and-lyndon-baines-johnson-came-by-their-millions.html>) from buying KTBC, as her husband, then-Senator and later President Lyndon Johnson, was able to pressure the FCC to secure a license for the station.

Domsat II took a different tack. Instead of allocating unique slices of spectrum to particular applicants, *Domsat II* gave the applicants access to the full range of C-Band spectrum. As a result, the different users were forced to cooperate. In the FCC's words:

Our decision in favor of multiple entry does not mean that we have opted for a policy of “unlimited or unrestricted open entry.” Our aim, as outlined above, is to afford qualified applicants a reasonable opportunity to demonstrate the public advantages in use of the satellite technology as a means of communications. But such entry cannot be “open” in the sense that it is without any restrictions or limitations.

Spurred on by this relative hands-off approach, the satellite players coordinated to mitigate interference. By the late 1980s there were tens of thousands
(<https://ecfsapi.fcc.gov/file/10022703505533/SIA%20Comments%20on%20Mid-Band%20NOI%202%20Oct%202017.pdf>) of earth stations sharing over 39,000 channel assignments.

Current C-Band operators developed from this Open Skies policy. Registered or licensed earth stations operating in the C-Band coordinate with each other and are authorized to use the entire C-Band across the full geostationary arc (i.e. the area of earth covered by the satellite). This policy is known as full-band, full-arc licensing. Currently, FSS uses the 3.7 GHz to 4.2 GHz band for space-to-earth, or downlink communication, while the 5.925 GHz to 6.425 GHz band is used for earth-to-space or uplink communication. Combined, these two bands are considered the traditional C-Band. Four satellite operators provide the vast majority of services in the C-Band and include Intelsat, SES, Telesat,

and Eutelsat. Today, the C-Band is currently being used by satellite providers to distribute video and radio programming to nearly 120 million U.S. households.

C-Band's Unique Benefits

Because few uncharted regions remain on the spectrum map, spectrum policy has increasingly focused on repositioning incumbents and making bands more efficient. The AWS-3 auction, to name one recent example, came from spectrum previously granted (<https://www.fiercewireless.com/tech/aws-3-auction-dod-pledges-to-enable-greater-access-to-shared-spectrum>) to the Department of Defense. Today, several prime bands, including the C-Band, are being eyed for repurposing.

Why has the C-Band become a topic of interest? First, the C-Band resides in what is known as the mid-band. Lower bands are best suited to broad coverage and can penetrate buildings. Most of the low-band space, which is considered anything below 1 GHz, has already been dedicated to specific uses, so businesses are increasingly looking to the next-best options to deploy new tech. Because the lower band is spoken for, the mid-band is having a renaissance. The Citizens Band Radio Service (CBRS), which runs from 3.5 GHz to 3.7 GHz

(<https://www.satellitetoday.com/government-military/2019/04/05/fccs-cbrs-auction-not-happening-until-at-least-2020/>), will be auctioned in June 2020, while the 5.925 GHz to 7.125 GHz band

(<https://www.multichannel.com/news/fcc-test-concludes-wi-fi-can-share-5-9-ghz-band>) is being targeted for potential unlicensed use as well.

(<https://www.multichannel.com/news/fcc-test-concludes-wi-fi-can-share-5-9-ghz-band>)

Second, the C-Band spans 500 MHz, making it one of the largest contiguous bands in spectrum. Contiguous spectrum allows operators to use larger blocks of spectrum. While having prime spectrum is important, there are clear benefits to using larger blocks of spectrum (<https://www.gsma.com/latinamerica/wp-content/uploads/2011/01/gsmaamericasmbspectrumpaperjan2011-1.pdf>). Increasing the width of the channel in which an operator deploys can increase its traffic carrying capability, which reduces its costs.

Moreover, interest in the C-Band has been picking up because other countries are likely to use this space as well for the deployment of next generation 5G wireless services. The European Conference of Postal and Telecommunications Administrations mandated that the 3.4 GHz to 3.8 GHz band will be the first primary band for 5G, pushing Austria, France, and Germany to take steps to secure it for use by carriers. Japan and Australia are also putting this band at the front of their 5G spectrum plans. In many of these countries, the spectrum has already been auctioned to mobile broadband operators.

To top it all off, the band is being used by satellite providers to distribute video programming, and as in the rest of the industry, newer tech has given these providers other options. For one, the transmissions are more efficient (<http://www.intelsat.com/tools-resources/library/satellite-101/digital-compression/>) than they were years ago, so less total spectrum space is needed to send better transmission. The arrival of fiber has also given companies the ability to send traffic through another route. Both have eased the need to occupy the full 500 MHz space fully.

Given all of these changes, the current allocation could be significantly reduced and still be adequate for the incumbents. The CBA estimates (<https://www.fiercewireless.com/wireless/c-band-alliance-reiterates-200-megahertz-right-number-at-3-7-4-2-ghz>) that, of the total 500 MHz band, around 200 MHz could be repurposed for new uses, including a 20 MHz guard band, for a total of 180 MHz brought to market. According to the CBA (<https://www.fiercewireless.com/wireless/c-band-alliance-reiterates-200-megahertz-right-number-at-3-7-4-2-ghz>), anything larger than 200 MHz might force companies to move to the Ku-Band, which is much higher in spectrum and doesn't have the same kind of propagation qualities, leading to degradation in their services. In contrast, a study commissioned by ACA Connects, formerly the American Cable Association, posits that that 130 MHz is more than enough spectrum for the current companies, which would leave around 370 MHz free to reallocate for 5G in a comparable time period. This proposal has been met with concerns about its complexity, delay, and lack of reliability by existing video customers such as Disney, Fox, and CBS. AT&T and Verizon also opposed it as premature. Nonetheless, most agree that there is an opportunity with the C-Band, but with all opportunities come a cost.

C-Band's Opportunity Cost of Transition

The full-band, full-arc licensing creates a potential conflict in the reallocation of the band. Since the current license inherently grants various actors with overlapping and non-exclusive rights the ability to use the band, any one player could hold up the process to switch to a newer and better use. This kind of license stands in contrast to the recent

600 MHz incentive auction, where individual TV stations radiating in specific regions could make independent decisions to give up their rights.

Indeed, that the industry has coalesced around a singular plan to transition the C-Band underscores the willingness to repurpose the space for a potentially more efficient use. In a free market in which each satellite operator had control and property rights over their piece of the spectrum, a trade within the C-Band would have already occurred. Yet because satellite spectrum allocations aren't full-fledged property rights and license holders must gain favor from the FCC to transition licenses, market failures like the current holdup are endemic.

Valuing the C-Band is challenging because there are no domestic sales with which to compare. In Appendix 1 of this paper, values for a sale are approximated using a maximum likelihood method. Given that the underlying data come from other countries, the estimates should be read with caution. Still, the median sales price was estimated at \$0.201 per MHz per population (MHz pop), with an upper band of \$0.597 per MHz pop and a lower band of \$0.011 per MHz pop, which is explained in Appendix 2.

Policies and Plans for Transitioning

Making the transition from the current allocation system to one where more services are supported will force current operators to incur costs, but there are still a number of unanswered questions that the FCC will need to address.

For one, it is still unclear who will run the auction. The CBA has proposed selling the spectrum through an auction process mirroring that of the FCC. At the helm would be

economist Paul Milgrom

(<https://www.telecompetitor.com/c-band-alliance-you-want-an-auction-for-valuable-spectrum-well-give-you-one/>), who played a key role in designing the multiple-round auction first used by the FCC in 1993 and led the team that created the incentive auction

(https://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db1002/FCC-12-118A2.pdf).

This kind of auction, which some have decried as a private sale, will need the blessing of the FCC. Earlier this year, Citizens Against Government Waste worried that (<https://www.telecompetitor.com/watchdog-group-joins-opposition-to-private-c-band-spectrum-sale-valuable-5g-spectrum-at-stake/>) “If it is sold on the secondary market through a private sale, there is no guarantee taxpayers would see any of the revenues generated from the sale; incumbent users are not assured they will be made whole; and there would be limited FCC oversight.” In response, the CBA modified its proposal (<https://docs.house.gov/meetings/IF/IF16/20190716/109797/HHRG-116-IF16-Wstate-PitschP-20190716.pdf>) to ensure that a portion of the revenues would be directed to the Treasury.

Michael Calabrese of New America Foundation has also expressed doubts, explaining (<https://www.fiercewireless.com/wireless/cba-proposes-fuel-auction-process-for-c-band>), “a private FCC-like auction subject to FCC oversight proposed here clearly violates Section 309(j) of the Communications Act. Only a public auction with the lion’s share of revenue returned to the public is within the FCC’s authority to authorize.” Section 309(j) of the Communications Act grants the FCC the authority to conduct auctions, but it doesn’t limit the FCC to assigning spectrum through public auctions or prevent

private sales or auctions of interference rights by other entities. Rather, section 309(j)(6)(E) requires the FCC to consider other assignment mechanisms when appropriate to protect the public interest. Although the FCC must avoid unjust enrichment in certain contexts, whether an unjust enrichment claim could apply in this matter is up for debate. Traditionally, concerns about unjust enrichment have concerned the issuance of licenses as well as the resale of spectrum within a five-year period by entities that qualified for credits in an auction. On the other hand, broadcasters were compensated by more than \$2 billion in the Incentive Auction, so it isn't without precedent that some kind of monetary trade should occur. Thus, the question at hand is the *extent* to which current operators should be compensated for the move.

Still, it is a fundamental mistake to think that the auction mechanism that the CBA has proposed is a private sale. Unlike a private sale, an auction would allow all qualified entities to bid. Given that the FCC would likely adopt a similar plan if it ran the auction, the result should approximate what the agency would have garnered. Yet, the FCC might not be able to solve the holdout problem. Thus, in the most optimistic of scenarios, the FCC would do only as well as the CBA plan. In the worst case, the agency might not come close to transitioning as large a swath of spectrum.

A chief selling point of the CBA plan (<https://ecfsapi.fcc.gov/file/106102490907232/CBA%20-%20FUEL%20ex%20parte%206-10-19.pdf>) is the relatively quick timeframe that spectrum could come to the market, which it projects will be 18 months for the first 60 MHz tranche of spectrum and 36 months for the rest of the 180 MHz. Furthermore, CBA states that if the FCC were to make its

decision this fall, the CBA could conclude its sales process in the first half of 2020. While it is difficult to know exactly how long an analogous process will take for the FCC, the agency is hardly a hare on these matters. According , it takes the agency on average 13 years to complete an auction fully. If the FCC were to undertake its own version of an auction, it would surely take much longer than the timeline set out by the CBA.

Already the FCC has a full plate. Auction 101 wrapped up in January, raising \$702 million. Auction 102 was completed at the tail end of May 2019. The agency plans to hold one more auction in 2019, Auction 103, which will sell off spectrum at 37 GHz, 39 GHz, and 47 GHz. However, that auction has been delayed, pushing back other scheduled auctions as well (<https://www.telecompetitor.com/orielly-doesnt-expect-cbrs-auction-date-before-2q-2020-wants-more-mid-band-spectrum/>). Commissioner O’Rielly put a fine point on the FCC’s relative slowness when he noted,

Most of the criticism of what is known as the CBA Proposal shows a lack of understating of how the internal Commission works. For instance, the argument has been made that the FCC should conduct a public auction for these frequencies rather than allowing the private sector to do it. Please don’t anyone try to lecture me on the Commission’s supposed efficiency and timeliness in conducting auctions, as I have experienced the latter firsthand for the past six years and twenty more from a different perch. This is not a new problem by any stretch of the imagination. Given what is already in the pipeline and how long it takes for the Commission to set up and operate an auction, we are talking years – and I mean years – before

completion. We can certainly ensure transparency, accountability, fairness, and openness without having to run the auction ourselves.

Since there is a time value of money, the FCC will need to determine if the quick turnaround set out by the CBA is worth pursuing. This delay can be modeled using discounted cash flow analysis, as explained in more detail in Appendix 2. Assuming a conservative one- or two-year delay, the lost value could be between 8 percent and 25 percent of the value of the spectrum. Empirical studies (<https://ecfsapi.fcc.gov/file/60001117200.pdf>) in the broadband space typically find that annual consumer surplus is equal to the value of a spectrum sale.

Thus, at the low end, the total value lost given a year delay by the FCC roughly equates to:

	C-Band Low Estimate	C-Band Mean Estimate	C-Band High Estimate
100 MHz	\$29.2 million	\$516.9 million	\$1.5 billion
180 MHz	\$52.5 million	\$930.5 million	\$2.7 billion
370 MHz	\$107.6 million	\$1.9 billion	\$5.7 billion

And at the top end, if the agency were to delay for two years, the total value lost would be:

	C-Band Low Estimate	C-Band Mean Estimate	C-Band High Estimate
100 MHz	\$92.7 million	\$1.6 billion	\$4.8 billion
180 MHz	\$166.8 million	\$3 billion	\$8.7 billion

370 MHz	\$341.6 million	\$6 billion	\$17.9 billion
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Inaction and delay by the FCC on this matter could be costly, especially for consumers, to the tune of nearly \$18 billion.

Conclusion

With these considerations in mind, the FCC should:

- Ensure that the transition is orderly and is conducted in a timely manner;
- Safeguard incumbents by keeping them whole;
- Establish that whatever mechanism is used is open and transparent; and finally
- Secure a portion of the spectrum-sale proceeds for the public.

Regardless of the path that is taken, the proposals by the CBA have reinvigorated the conversation around this important band. The C-Band is undergoing a transition (<https://www.linkedin.com/pulse/state-satellite-industry-nsr-fss-index-gagan-agrawal/>), and operators in the band have come forward with a market-driven approach. For the FCC, the most important question is how to transition this part of the spectrum to its highest and best use at the lowest cost as quickly as possible.

Appendices can be found here

(<https://github.com/willrinehart/c-band-estimation/blob/master/C-Band%20Appendices.pdf>).

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