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PHOENIX CENTER POLICY BULLETIN NO. 55

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March 2022

POLICY FAILURES FOR PUBLIC SAFETY: NEW RULES FOR THE 4.9 GHZ BAND

Abstract: Last fall, the Federal Communications Commission issued an *Order on Reconsideration and Eighth Further Notice of Proposed Rulemaking* to establish a clear set of rules for public safety spectrum located in the 4.9 GHz band. Among other reforms, the *Notice* proposes to centralize non-public safety use of the band, which is feasible under pre-emption by first responders, by a national spectrum coordinator. This nationwide management framework replaces the decentralized approach and the state-level management adopted by the Commission in 2020 (which offered no apparent improvement over its prior decentralized approach). As we show here, this centralized approach has economic support, since the decentralized approach acts as a tax on spectrum use. Also, we estimate, albeit crudely, that if the Commission designates the FirstNet Authority as the national spectrum coordinator, adding the 4.9 GHz block to the FirstNet Authority would release about \$34 billion in Gross Domestic Product and create about 160,000 jobs.

I. Introduction

Following the deadly September 11, 2001 attacks on the United States, it became clear that the nation's first responders lacked an adequate and coordinated communications infrastructure. The problem, it appeared, was a highly-decentralized, agency-by-agency, jurisdiction-by-jurisdiction approach to public-safety communications, where incompatibilities across networks made inter-agency communications problematic. Such failures were not a minor inconvenience:

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the communications breakdown is considered a factor in the inability to evacuate 343 firefighters from the World Trade Center towers, all of whom perished.¹

When decentralization causes a problem, centralization is typically a solution. While it seemed clear that a more centralized approach to public safety communications was needed, policymakers struggled to find a formula. It was not until 2012 that the centralized approach was fully embraced. The *Middle Class Tax Relief and Job Creation Act of 2012* dedicated billions in funding and a 20 MHz block of spectrum in the prime 700 MHz band (including the 10 MHz D Block) to the newly created National Public Safety Broadband Network – the FirstNet Authority.² In 2016, a competitive contracting process led to a deal with AT&T for the construction and operation of the public safety broadband network using public safety’s 20 MHz of spectrum. A fully centralized approach paid off. The FirstNet Authority today serves over three million public safety subscribers across 19,500 safety agencies, and billions in investment, financed by the FirstNet Authority and AT&T, have poured into the network.³ The FirstNet Authority’s success may be attributed to, among other things, clear spectrum rights for public safety (the 20 MHz block), the national coordination of the network through the FirstNet Authority, and a public-partnership with an established mobile wireless provider.⁴

Today, the Federal Communications Commission (“FCC”) appears ready to advance the public safety communications network into the 5G era. As the Public Safety Spectrum Alliance has observed, “5G functionality is expected to be the future of public safety cellular

¹ D. Orr, *How 9/11 Changed Me and First Responder Communications*, NATIONAL INSTITUTE OF SCIENCE & TECHNOLOGY BLOG (August 20, 2021) (available at: <https://www.nist.gov/blogs/taking-measure/how-911-changed-me-and-first-responder-communications>).

² G.S. Ford and L.J. Spiwak, *Re-Auction of the D Block: A Review of the Arguments*, PHOENIX CENTER POLICY PERSPECTIVE NO. 11-03 (May 24, 2011) (available at: <https://www.phoenix-center.org/perspectives/Perspective11-03Final.pdf>); G.S. Ford and L.J. Spiwak, *Public Safety or Commercial Use? A Cost/Benefit Framework for the D Block*, PHOENIX CENTER POLICY BULLETIN NO. 26 (March 2011) (available at: <https://www.phoenix-center.org/PolicyBulletin/PCPB26Final.pdf>).

³ *FirstNet exceeds 3 million connections and 19,500 agencies, AT&T reports*, ALL THINGS FIRSTNET (January 27, 2022) (available at: <https://allthingsfirstnet.com/firstnet-exceeds-3-million-connections-and-19500-agencies-att-reports/>); *AT&T Recognized for 2021 Customer Value Leadership*, Frost & Sullivan (2021) (available at: https://www.firstnet.com/content/dam/firstnet/white-papers/att-customer-value-leadership-award.pdf?_gl=1*1fwzwhfi*_gcl_aw*R0NMLjE2NDMyMjE2ODAuQ2owS0NRaUFfOE9QQmhEdEFSSXNBS1F1MGdaQ3FXTllqaTVndUhiN0tmd0lUX3BZXzFMSlwd1NNVmhfQzRsZkptOUJab0g2Q3p1TXNGNGFBbWJZRUFMd193Y0I.*_gcl_dc*R0NMLjE2NDMyMjE2ODAuQ2owS0NRaUFfOE9QQmhEdEFSSXNBS1F1MGdaQ3FXTllqaTVndUhiN0tmd0lUX3BZXzFMSlwd1NNVmhfQzRsZkptOUJab0g2Q3p1TXNGNGFBbWJZRUFMd193Y0I).

⁴ For a discussion of the history of the FirstNet Authority, see, e.g., J. C. Gallagher, *The First Responder Network (FirstNet) and Next-Generation Communications for Public Safety: Issues for Congress*, CONGRESSIONAL RESEARCH SERVICE R45179 (April 27, 2018) (available at: <https://sgp.fas.org/crs/homesecc/R45179.pdf>); L.J. Spiwak, *Remembering A Time When Broadband Policy Was Bipartisan*, FEDERALIST SOCIETY BLOG (May 11, 2021) (available at: <https://fedsoc.org/commentary/fedsoc-blog/remembering-a-time-when-broadband-policy-was-bipartisan>).

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communications because it will support new high-speed applications that leverage rich media, such as augmented and virtual reality, and video streaming, while also offering extremely low latency, allowing true real-time data streaming and transfer necessary for use of autonomous vehicles, bomb and hazardous material detection and remediation, and mobile video surveillance capabilities.”⁵ The high data flows of 5G services are best provided over mid- and high-band spectrum, so it is fortunate that public safety also has access to 50 MHz of spectrum in the 4.9 GHz band (though a 5G network is best delivered with at least a 100 MHz block).⁶ Yet, the 4.9 GHz band lies nearly dormant due to a highly-decentralized licensing approach not unlike that responsible for the failures of 9-11. This decentralized approach results in the common pool problems (e.g., interference, congestion) and retards the coordinated use of the band for robust, preemptable, and secure 5G communications.⁷ Under existing licensing rules, this valuable slice of spectrum produces scarcely any value.

Perhaps seeing the factors leading to the success of the FirstNet Authority, the Commission recently proposed in its *Order on Reconsideration and Eighth Further Notice of Proposed Rulemaking* a fully centralized coordination of the band, seeking to establish “full and open cooperation” by the public safety community by formulating “a clear set of rules governing access to the band” in the form of “nationwide spectrum management framework for the 4.9 GHz band.”⁸ The *Eighth NPRM* sets the policy reform process in motion, proposing to centralize the management of non-public safety use of the band, which is feasible under pre-emption by first responders, by a national spectrum coordinator.

This nationwide management framework replaces the decentralized approach and the state-level management adopted by the Commission in 2020 (which offered no apparent improvement

⁵ *In the Matter of Amendment of Part 90 of the Commission's Rules*, FCC 21-106, ORDER ON RECONSIDERATION AND EIGHTH FURTHER NOTICE OF PROPOSED RULEMAKING, __ FCC Rcd __ (rel. October 1, 2021) (hereinafter “*Eighth NPRM*”) at ¶ 57.

⁶ This spectrum that was dedicated to public safety by the FCC in 2002, observing there is “[n]o responsibility is more fundamental and reflective of the nation’s values than that of its public safety agencies.” See *4.9 GHz Band Transferred from Federal Government Use*, FCC 13-137, SECOND REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING, 17 FCC Rcd 3955 (2002) (*Second Report and Order*) at ¶ 69; see also, *Vision 2030: Insights for Mid-Band Spectrum Needs*, GSMA (July 2021) (available at: <https://www.gsma.com/spectrum/wp-content/uploads/2021/07/5G-Mid-Band-Spectrum-Needs-Vision-2030.pdf>).

⁷ AT&T has granted access to first responders to its 5G services offered over its 5G millimeter wave network and is working with the FirstNet Authority to expand 5G services (perhaps in the 700 MHz band).

⁸ *Eighth NPRM*, *supra* n. 5 at ¶ 21 (“Petitioners persuasively argue that this creates a risk that some operators, whether licensees or lessees, may undermine others’ access to the band, whether within or between jurisdictions, and that coordination and protection methods are necessary to safely enable non-public safety access.”).

over its prior decentralized approach).⁹ History, even if limited, suggests the Commission is on the right track. A nationwide framework allows (but not does demand) the valuable 4.9 GHz block to be rolled into the FirstNet Authority for immediate use in combination with its partner's other mid-band spectrum. As we show here, this centralized approach has economic support, since the decentralized approach acts as a tax on spectrum use. Also, we estimate, albeit crudely, that if the Commission designates the FirstNet Authority as the spectrum coordinator, adding the 4.9 GHz block to the FirstNet Authority would release about \$34 billion in Gross Domestic Product and create about 160,000 jobs.

II. An Economic Analysis of Repurposing

At its core, policy reform in the 4.9 GHz band involves a change in property rights. Historically, licensing (property rights) in the 4.9 GHz band has been highly decentralized, a senseless and uncoordinated approach that has led to the gross underuse and inefficient use of the spectrum. The alternative is to switch to centralized spectrum management, wherein a spectrum coordinator (e.g., the FirstNet Authority) manages the use of the spectrum across jurisdictions, agencies, and even by non-public-safety users when excess capacity is available. The decentralized approach adds costs to the use of the spectrum. As the Commission noted in its *Eighth NPRM*, a decentralized approach leads to a “patchwork of possibly incompatible regulatory regimes going into effect on different timelines.”¹⁰ Alternately, “a clear set of rules” and the “nationwide spectrum management framework” produces “full and open cooperation” of public safety community and encourages “driving down equipment costs and increasing equipment innovation.”¹¹ Likewise, FCC Chair Jessica Rosenworcel stated that the decentralization of band management leads to “no consistent and reliable information about what spectrum is available where or how it is being used—making it difficult for wireless service providers to plan or invest in deployments.”¹² Such concerns proved accurate this year when some states began deliberating on how to manage the spectrum.¹³ Thus, a patchwork of

⁹ *In the Matter of Amendment of Part 90 of the Commission's Rules*, FCC 20-137, SIXTH REPORT AND ORDER AND SEVENTH FURTHER NOTICE OF PROPOSED RULEMAKING, 36 FCC Rcd 1958 (rel. October 2, 2020); see also L.J. Spiwak, *The FCC Should Not Take a Piecemeal Approach to Public Safety Spectrum*, NOTICE & COMMENT - YALE JOURNAL ON REGULATION (May 27, 2021) (available at: <https://www.yalejreg.com/nc/the-fcc-should-not-take-a-piecemeal-approach-to-public-safety-spectrum-by-lawrence-j-spiwak>).

¹⁰ *Eighth NPRM*, *supra* n. 5 at ¶ 22.

¹¹ *Id.*

¹² <https://docs.fcc.gov/public/attachments/FCC-20-137A5.pdf>

¹³ For example, a state task force in Louisiana recommended holding a state-level auction for 10 MHz blocks by each parish. This ill-advised approach raises serious doubts about the state's ability to manage spectrum resources. D. Jacobs, *Louisiana Task Force Recommends Auctioning Parts of Spectrum Previously Reserved for Public Safety*, THE WEST SIDE JOURNAL (February 25, 2021) (available at: <https://www.thewestsidejournal.com/news/louisiana-task-force>).

(Footnote Continued...)

incompatible regulatory regimes acts as a tax on spectrum use, driving up the cost service provision and reducing the use of and the investment in the 4.9 GHz band.

Organization research points to a few key questions when contemplating centralization, which may be summarized by two questions: (1) Does centralization add value?; and (2) Does centralization risk bureaucracy, business rigidity, reduced motivation, or distraction?¹⁴ As for value, it seems near certain that the centralized management of the 4.9 GHz band will increase value, if for no other reason than the value today is near zero. The success of the FirstNet Authority also suggests the value of the 4.9 GHz band will be greater in a more centralized regime. And the risks are likely low. If, for instance, the Commission designates the FirstNet Authority as the spectrum manager, then its interests are aligned with those of the public safety users. Also, national management does not limit what sorts of devices may be used on the network and for what purposes. Rather, national management will produce a largely device/service agnostic nationwide 5G network on which agencies can customize their uses (a network local or state agencies cannot produce). With all states participating in the FirstNet Authority, there seems to be little risk of reduced motivation or distraction. In fact, having local agencies manage spectrum, build and operate networks, or contract among varying providers, is a distraction from their primary, often life-saving purposes.

An economic analysis of the issue requires some abstraction. Let's take the simple case of allocating spectrum across two separate markets (or uses): *A* and *G*. (We might describe market *G* as incremental increases in 5G services and market *A* as the disaggregated, low value services available from self-provisioning by local public safety agencies.) Let Q_A and Q_G denote the quantity of this scarce spectrum block allocated to each use and let the total amount of the spectrum block be denoted by $S [= Q_A + Q_G]$. For simplicity, we assume that a unit of spectrum will convert to a standardized unit of output in both markets (we also normalize the marginal production costs to zero). Let the market demands/marginal valuations for *A* and *G* be given by:

$$P_A = M - aQ_A, \quad (1)$$

[recommends-auctioning-parts-of-spectrum-previously-reserved-for-public-safety/article_a1a2f7c2-76d9-11eb-a148-fb3bea6f5f25.html](https://www.mckinsey.com/business-functions/people-and-organizational-performance/our-insights/to-centralize-or-not-to-centralize#download/%2F~%2Fmedia%2Fmckinsey%2Fbusiness%20functions%2Fpeople%20and%20organizational%20performance%2Four%20insights%2Fto%20centralize%20or%20not%20to%20centralize%2Fto%20centralize%20or%20not%20to%20centralize.pdf%3FshouldIndex%3Dfalse)).

¹⁴ See, e.g., A. Campbell, S. Kunisch, and G. Müller-Stewens, *To Centralize or Not to Centralize?*, McKinsey Quarterly (June 1, 2011) (available at: <https://www.mckinsey.com/business-functions/people-and-organizational-performance/our-insights/to-centralize-or-not-to-centralize#download/%2F~%2Fmedia%2Fmckinsey%2Fbusiness%20functions%2Fpeople%20and%20organizational%20performance%2Four%20insights%2Fto%20centralize%20or%20not%20to%20centralize%2Fto%20centralize%20or%20not%20to%20centralize.pdf%3FshouldIndex%3Dfalse>).

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$$P_G = M - gQ_G, \quad (2)$$

where the P indicates prices (willingness to pay for a marginal unit of service). A benevolent social planner would allocate the scarce spectrum across the two markets to maximize total consumer surplus or benefits. Formally, the social planner would solve:

$$\max_{Q_A, Q_G} \left\{ \int_0^{Q_A} P_A(Q) dQ + \int_0^{Q_G} P_G(Q) dQ \right\} \text{ such that } Q_A + Q_G = S. \quad (3)$$

This formulation merely asks that the planner allocate the spectrum between the competing uses in the most socially beneficent manner. The first-order condition for this constrained maximization problem yields the basic characterization that the social planner would attempt to equate prices/marginal benefits in the two markets:

$$P_A(Q_A^e) = P_G(Q_G^e). \quad (4)$$

Of course, it is possible that the optimal allocation gives all the spectrum to the G use if the marginal value of an additional unit of service at $Q_G = S$ exceeds the value of use in A at $Q_A = 0$. Combined with the spectrum constraint, this yields the socially efficient allocation of spectrum for the incremental increase in 5G services:

$$Q_G^e = \frac{aS}{a+g}. \quad (5)$$

Expression (5) shows the social planner's choice. Interestingly, a private actor's decision is the same as the social planner. To see this, consider a firm's problem associated with the demand system and the resource constraint:

$$\max_{Q_A, Q_G} \{P_A Q_A + P_G Q_G\} \text{ such that } Q_A + Q_G = S. \quad (6)$$

The first-order condition implies:

$$2aQ_A^* = 2gQ_G^*. \quad (7)$$

Hence, the firm would allocate the scarce spectrum in the same manner as the social planner:

$$Q_G^e = \frac{aS}{a+g}. \quad (8)$$

Expressions (5) and (8) are identical, indicating that the private actor's decision is the same as the social planner's decision in this scenario.¹⁵

Now, let us suppose that there is an increase in the size (i.e., the number of consumers) in rapidly growing G market so that $\tilde{g} < g$ (a rotation of the demand curve),

$$\tilde{P}_G = M - \tilde{g}Q_G. \quad (9)$$

The benevolent social planner would increase the spectrum allocation to the growing market as follows:

$$\tilde{Q}_G^e = \frac{aS}{a+\tilde{g}} > Q_G^e. \quad (10)$$

If market G is growing relative to market A , then the social planner allocates more spectrum to market G . Left to its own devices and profit incentives, a firm would follow suit with the social planner: $\tilde{Q}_G^e = \tilde{Q}_G^*$.

The Commission's primary concern with respect to the 4.9 GHz band is that a patchwork of regulations, say at the local or state level, make coordinated use of the spectrum costly. Let these costs take the form of a linear regulatory cost (or tax), denoted by r . Hence, the firm's problem associated with reallocating a portion of the scarce spectrum (Δ) to the growing G market would be:

¹⁵ Verizon discourages the centralized management of the band, perhaps a "sour grapes" position reflecting Verizon's failure to get the FirstNet Authority contract. *See, e.g.*, Reply Comments of Verizon Communications in FCC Docket No. WP Docket No. 07-100 (January 11, 2022) at 4 ("Verizon, AT&T/FirstNet, T-Mobile, and regional wireless carriers vigorously compete in providing public safety communications services. This competitive environment yields a host of benefits for public safety – greater choice, more innovation, and lower costs. Granting AT&T, by virtue of its proprietary contractual relationship with FirstNet, a single de facto nationwide license or exclusive band manager privileges for the 4.9 GHz band would upset this dynamic, undermining and distorting competition in public safety communications services, and ultimately denying public safety stakeholders and the broader public the benefits of a competitive landscape."). As for competitive concerns, we show here that decision of the private firm is the same as the social planner.

$$\max_{\Delta} \left\{ R_A(Q_A^* - \Delta) + \tilde{R}_G(Q_G^* + \Delta) - \Delta r \right\}, \quad (11)$$

where R denotes the total revenue function (price times quantity). The first-order condition for the firm's maximization problem is given by:

$$2a(Q_A^* - \Delta) - 2\tilde{g}(Q_G^* + \Delta) - r = 0. \quad (12)$$

Solving for the optimal amount of spectrum to shift from A to the growing G market:

$$\tilde{\Delta} = \frac{aQ_A^* - \tilde{g}Q_G^* - r/2}{a + \tilde{g}}. \quad (13)$$

Thus, we can see that the regulatory costs imposed on the repurposing of spectrum reduces the amount of spectrum that the firm will shift to the growing G market:

$$\tilde{Q}_G^*(r) = Q_G^* + \tilde{\Delta} < \tilde{Q}_G^e. \quad (14)$$

The higher the regulatory costs, the greater the loss in the amount of spectrum that will be shifted towards the G market compared to the social optimum. Generally speaking, the greater the costs of regulation compliance for public service users, the greater the regulatory cost and hence the larger the distortion. According to the FCC, and the nation's experience with the FirstNet Authority, a centralized management approach would result in a lower value for r and hence the firm would repurpose more spectrum towards the growing G market, resulting in a spectrum allocation closer to the social optimum.

What lessons does this analysis have for the 4.9 GHz block? First, this spectrum, which can be used for 5G services with appropriate investments, is grossly underused currently—a reflection of the poor property rights (a high r) that characterize the current system. From the standpoint of the social planner and the private firm, spectrum should be allocated between the two markets in the most efficient manner by equalizing the marginal value between uses. Since much of this spectrum is virtually unused currently, the present situation is clearly not optimal. Further, because of the binding constraint spectrum imposes on service provision, the proper reallocation from the social point-of-view is not fundamentally different than that a private owner would undertake. Social welfare is higher when regulation reduces the implicit "tax" imposed on reallocation, and this can be done through regulatory reform that reduces or eliminates the fragmented nature of the current spectrum assignments. Doing this will increase social welfare for the same reasons tax reductions increase social welfare. The analysis thus suggests that in formulating its policy for the 4.9 GHz block, the FCC should institute regulatory reforms that

reduce the costs of managing spectrum while those repurposing costs that reflect the essential character of public safety use, such as assuring priority in emergencies, are recognized and internalized.

As mentioned earlier, this analysis is purposely simple: allocate scarce spectrum between competing uses so that its marginal value in each use is equalized, taking account of repurposing costs. Repurposing costs, though, are of at least two sorts: costs that reflect the priority given to first responder users, and costs that just reflect the current, fragmented property rights to this spectrum. It is these latter costs that can and should be minimized through regulatory action.

Several important complications serve to strengthen these conclusions. First, we ignore incremental cost savings in providing 5G services (market G) that repurposing may occasion. Scale economies are one obvious potential source for these savings. Such savings increase the social welfare effects of shifting spectrum to 5G uses. Second, and importantly, we do not count benefits that are likely to arise due to increased investment and innovation in devices that make economic sense only when large numbers of public safety users are operating in the same band. International spectrum coordination, according to the ITU, produces a “stable, predictable, and universally applied regulatory environment that secures the trillions of dollars of long-term investments of radio systems.”¹⁶ The incentive of equipment manufacturers to design and build new and better devices for 5G capable networks, especially for public safety use, surely depends on the extent and ubiquity of such networks. This phenomenon amplifies our basic conclusions.

III. Value of the Spectrum in Use

At present, public safety’s 4.9 GHz block is scarcely used. What is the value of that spectrum if it was fully utilized to provide 5G services? Recognizing that whatever provider accesses the spectrum may serve (under preemption) both public safety and private uses, the value of the 4.9 GHz band is likely at least as socially valuable as the spectrum if held in purely private hands given the high value of public safety.

There are a few ways to contemplate value. For instance, based on the 3.5 GHz auction, the private value of the spectrum (at auction) is probably around \$3 to \$4 billion. Auction value understates the full value of the spectrum, which is the surplus obtained from its use. With public safety use, the value of lives and property saved is presumably enormous. (If, for instance, half

¹⁶ ITU-R: *Managing the Radio-Frequency Spectrum for the World*, ITU (Last Update: October 2021) (available at: <https://www.itu.int/en/mediacentre/backgrounders/Pages/itu-r-managing-the-radio-frequency-spectrum-for-the-world.aspx>).

the firefighters that died in the World Trade Center were saved by better communications, the statistical value of those lives would be around \$1.7 billion).¹⁷

Value may be contemplated in terms of economic impact. An analysis of the deployment of 5G technology by Sosa and Rafert (2019) estimates that the allocation of 400 MHz of mid-band spectrum to the mobile wireless industry will create \$274 billion in additional Gross Domestic Product (“GDP”) and 1.3 million new jobs (based on investments spanning seven-years). At the average value per-MHz of spectrum, public safety’s 50 MHz of mid-band spectrum would then about \$34 billion in additional GDP and as many as 162,500 new jobs. These are sizable benefits compared to the small value the spectrum produces today given its gross underuse.

IV. Conclusion

Despite the desperate need for mid-band spectrum for 5G services, both generally and for the public safety community, the 4.9 GHz block has not been incorporated into the FirstNet Authority network. The FCC seems poised to remedy that inefficiency by establishing clear and centralized property rights in the 50 MHz block for public safety users. In light of the success of the allocation of the D Block in the 700 MHz band to public safety and the creation of a national coordinator for the public safety network (the FirstNet Authority), it seems likely that this national framework will bear fruit. According to the Commission, the motivation for policy reform in the 4.9 GHz band is “increasing use of and investment in the 4.9 GHz band,” and there is no reason to suspect a national framework will fail to meet those goals.¹⁸ We find that the Commission’s proposal for the 4.9 GHz band has economic support, and that the efficient use of the 4.9 GHz block could create significant value (\$34 billion in GDP and about 160,000 new jobs). And providing first responders with 5G connectivity using a robust, low-cost network may prove invaluable when disaster next hits.

¹⁷ S. Gonzales, *How Government Agencies Determine the Dollar Value of Human Life*, NPR.COM (April 23, 2020) (available at: <https://www.npr.org/2020/04/23/843310123/how-government-agencies-determine-the-dollar-value-of-human-life#:~:text=One%20human%20life%20is%20worth%20about%20US%2410%20million>).

¹⁸ *Eighth NPRM*, *supra* n. 5 at ¶ 18.

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