

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Wireless E911 Location Accuracy Requirements) PS Docket No. 07-114

FIFTH REPORT AND ORDER AND
FIFTH FURTHER NOTICE OF PROPOSED RULEMAKING

Adopted: November 22, 2019 Released: November 25, 2019

By the Commission: Chairman Pai and Commissioners Carr and Starks issuing separate statements;
Commissioner Rosenworcel approving in part, dissenting in part and issuing a statement.

Comment Date: 30 days from the date of publication in Federal Register
Reply Comment Date: 60 days from the date of publication in Federal Register

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I. INTRODUCTION

1. All Americans using mobile phones—whether they are calling from urban or rural areas, buildings or outdoor venues—should have the capability to dial 911 and receive the support they need in times of an emergency. Consumers make 240 million calls to 911 each year, and in many areas 80% or

more of these calls are from wireless phones.¹ While advances in technology have improved the overall ability of first responders to locate 911 callers, challenges remain particularly for locating 911 callers in multi-story buildings.

2. To ensure that first responders and Public Safety Answering Points (PSAPs) can find 911 callers quickly and accurately when a consumer calls from a multi-story building, we adopt a vertical, or z-axis, location accuracy metric of plus or minus 3 meters relative to the handset for each of the benchmarks and geographic requirements previously established in the Commission's E911 wireless location accuracy rules. This action will more accurately identify the floor level for most 911 calls, reduce emergency response times, and save lives.

II. BACKGROUND

3. The Commission has been working with the public safety community and industry partners to ensure the accurate delivery of 911 vertical location information for the better part of a decade. In 2011, the Commission tasked the Communications Security, Reliability, and Interoperability Council (CSRIC) with testing indoor location accuracy technologies, including barometric pressure sensors, in a test bed. CSRIC conducted tests on a variety of technologies in 2012, and the results showed that at least one vendor—NextNav LLC (NextNav)—could locate a caller's vertical location within 3 meters more than 67% of the time in dense urban, urban, and rural morphologies.² In 2013, NextNav conducted additional testing on the second generation of its location technology and reported that it provided callers' vertical location within 3.2 meters 80% of the time, across all morphologies.³ Accordingly, in 2014, the Commission proposed measures and timeframes to improve location accuracy for wireless E911 calls originating indoors, including, among others, a 3-meter z-axis metric for 80% of such calls.⁴

4. In 2015, the Commission adopted rules for improving E911 wireless location accuracy.⁵ Under these rules, Commercial Mobile Radio Service (CMRS) providers must meet a series of accuracy benchmarks by either conveying dispatchable location (e.g., street address, floor level, and office or apartment number)⁶ or coordinate-based location information to the appropriate PSAP.⁷ For vertical location, the Commission required wireless providers to provide either dispatchable location using the National Emergency Address Database (NEAD) or vertical (z-axis) location information in compliance

¹ Nat'l Emer. Number Assoc., *9-1-1 Statistics*, <https://www.nena.org/page/911Statistics> (last visited Oct. 24, 2019).

² See CSRIC III WG3, Indoor Location Test Bed Report at 36 (Mar. 14, 2013) http://transition.fcc.gov/bureaus/pshs/advisory/csric3/CSRIC_III_WG3_Report_March_%202013_ILTestBedReport.pdf.

³ See Letter from Bruce A. Olcott, Counsel, NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 8 (filed Aug. 14, 2013) (NextNav Aug. 14, 2013 *Ex Parte* Letter).

⁴ See *Wireless E911 Location Accuracy Requirements*, Third Further Notice of Proposed Rulemaking, 29 FCC Rcd 2374, 2390-91, para. 38 (2014) (*Third Further Notice*). The Commission proposed to require that CMRS providers provide z-axis information within 3 meters of the caller for 67% of indoor 911 calls within 3 years of the adoption of rules, and for 80% of calls within 5 years. *Id.* at 2403, para. 73. See Federal Communications Commission, *Wireless E911 Location Accuracy Requirements*, 79 Fed. Reg. 17819 (Mar. 28, 2014).

⁵ *Wireless E911 Location Accuracy Requirements*, Fourth Report and Order, 30 FCC Rcd 1259, 1304, para. 117 (2015) (*Fourth Report and Order*).

⁶ See 47 CFR § 9.10(i)(1)(iii); *Fourth Report and Order*, 30 FCC Rcd at 1273-74, paras. 43-44. "Dispatchable location" is "[a] location delivered to the PSAP by the CMRS provider with a 911 call that consists of the street address of the calling party, plus additional information such as suite, apartment or similar information necessary to adequately identify the location of the calling party. The street address of the calling party must be validated and, to the extent possible, corroborated against other location information prior to delivery of dispatchable location information by the CMRS provider to the PSAP." 47 CFR § 9.10(i)(1)(i).

⁷ See *id.* § 9.10(i)(2)(i)(B).

with the FCC-approved metric. If dispatchable location is used, there must be a density of NEAD reference points distributed throughout the CMA equivalent to 25% of the population in that CMA.⁸ If z-axis location technology is used, it must be deployed to cover 80% of the CMA population.⁹ Nationwide CMRS providers must meet these benchmarks in each of the top 25 Cellular Market Areas (CMAs) by April 3, 2021 and in each of the top 50 CMAs by April 3, 2023.¹⁰ Non-nationwide CMRS providers that serve any of the top 25 or 50 Cellular Market Areas have an additional year to meet these benchmarks.¹¹ In addition, the Commission required the nationwide CMRS providers to test and develop a proposed z-axis accuracy metric and submit the proposed metric to the Commission for approval by August 3, 2018.¹²

5. On August 3, 2018, CTIA submitted the “Stage Z Test Report” (Report or Stage Z Test Report) on behalf of the four nationwide CMRS providers.¹³ According to the Report, Stage Z testing sought to assess the accuracy of solutions that use barometric pressure sensors in the handset for determining altitude in support of E911.¹⁴ Two vendors, NextNav and Polaris Wireless, Inc. (Polaris), participated in Stage Z.¹⁵ The test results showed that in 80% of NextNav test calls, vertical location was identified to a range of 1.8 meters or less, while 80% of Polaris test calls yielded a vertical accuracy range of 4.8 meters or less.¹⁶ The Report noted that Polaris’ performance “could likely be significantly improved should a more robust handset barometric sensor calibration approach [than that used in the test bed] be applied.”¹⁷

6. In its August 3, 2018, cover letter submitting the Report, CTIA stated that the test results provided “helpful insight” into the state of z-axis technologies, but that “significant questions remain about performance and scalability in live wireless 9-1-1 calling environments.”¹⁸ On behalf of the four nationwide wireless providers, CTIA therefore proposed a z-axis metric of “5 meters for 80% of fixes from mobile devices capable of delivering barometric pressure sensor-based altitude estimates.”¹⁹ CTIA also stated that further testing of vertical location technologies could yield results to validate adoption of a more accurate z-axis metric.²⁰ On September 10, 2018, the Public Safety and Homeland Security Bureau (Bureau) released a *Public Notice* seeking comment on the Report and the carriers’ proposed z-axis

⁸ *Id.* § 9.10(i)(2)(ii)(C)(1); ATIS Test Bed Program Management, E911 Location Test Bed Dispatchable Location Summary Report at 8 (2019), <https://ecfsapi.fcc.gov/file/104260730612217/190425%20911%20Loc%20Tech%20Test%20Bed%20LLC%20Aggregated%20NEAD%20Based%20DL%20Summary%20Report.pdf> at 3 (ATIS Repoert) (Describing the NEAD as the “The National Emergency Address Database (NEAD) – the ‘Reference Point’ database that associates WiFi Access Point and Bluetooth Beacon identities with validated civic address information, and that provides a secure system for database access and maintenance.”).

⁹ *Id.* § 9.10(i)(2)(ii)(C)(2).

¹⁰ *Id.* § 9.10(i)(2)(ii)(C)-(D).

¹¹ *Id.* § 9.10(i)(2)(ii)(E).

¹² *Fourth Report and Order*, 30 FCC Rcd at 1304, para. 116. See, e.g., *Public Safety and Homeland Security Bureau Provides Guidance to CMRS Providers Regarding Upcoming Certification Of Compliance with Three-Year E911 Location Accuracy Benchmark and Reminds CMRS Providers of Additional Location Accuracy Deadlines in 2018*, PS Docket No. 07-114, Public Notice, 33 FCC Rcd 2981 (2018) (reminding nationwide CMRS providers of the August 3, 2018, deadline to submit the proposed z-axis metric).

¹³ 9-1-1 Location Technologies Test Bed, LLC, Report on Stage Z (2018), <https://www.fcc.gov/ecfs/filing/10803074728956> (Report or Stage Z Test Report). CTIA is a wireless communications industry trade association. The four nationwide CMRS providers are AT&T Mobility, Sprint, T-Mobile USA, and Verizon.

¹⁴ *Id.* at 27. According to the Report, the overall objective of the z-axis test campaign was to “provide a rigorous, transparent process to evaluate the accuracy and overall assessment of Z-axis technology based on standard testing methodologies.” *Id.* at 3. “The Stage Z testing was specifically conducted in accordance with ATIS standards and testing parameters, which account for unique factors beyond those that affect x/y (horizontal) technologies.” *Id.*

metric.²¹

7. In March 2019, the Commission released the *Fourth Further Notice of Proposed Rulemaking (Fourth Further Notice)* in this proceeding.²² There, we proposed a z-axis metric of 3 meters relative to the handset for 80% of indoor wireless E911 calls for each of the benchmarks and geographic requirements previously established in the Commission's E911 wireless location accuracy rules.²³ Based on existing test data from the two vendors that participated in the industry test bed, we tentatively concluded that achieving this standard was technically feasible. We also tentatively concluded that unlike the 5-meter standard originally proposed by the wireless carriers, a 3-meter standard would provide sufficient accuracy to identify the caller's floor level in most cases.²⁴ We sought comment on adopting a stricter 2-meter metric but tentatively concluded that it was not yet technically achievable on a consistent basis, although it could become achievable in the longer term as technology continues to evolve.²⁵

8. In response to the *Fourth Further Notice*, the Commission received 20 comments and 11 reply comments, filed by public safety entities, vendors, wireless carriers, technology companies, and industry associations.²⁶

III. FIFTH REPORT AND ORDER

9. We adopt a 3-meter z-axis 911 location accuracy metric to be implemented by the April 2021 and 2023 vertical accuracy deadlines as proposed in the *Fourth Further Notice*. Numerous commenters, including public safety entities, vendors, and carriers, agree that implementing the proposed 3-meter metric within existing timelines will benefit public safety and is technically feasible. Although some industry commenters contend that we should take a phased approach or delay adopting a metric pending further testing, and some public safety commenters advocate adopting stricter accuracy standards for the 2021 and 2023 deadlines, we find these arguments unpersuasive.

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¹⁵ *Id.* at 3. The Report notes that the systems tested are “primarily based on barometric pressure observations but may include additional location sources or a form of vendor-specific processing customized by each z-axis technology vendor.” *Id.* at 13.

¹⁶ *Id.* at 120. The Report defines Vertical Location Accuracy as “the error between the reported altitude location of the device, as provided by the Stage Z vendor’s location system under test, and the surveyed ground truth position of the test location (determined through a precise land survey).” *Id.* at 55. For both participants in the Stage Z testing, the Report included delivered altitude (Z) and computed vertical distance error in meters. Test results also included “the following for each test handset, at a test point, in a test building, and aggregated per morphology: average (arithmetic mean) altitude error, standard deviation of altitude error (in meters), average (arithmetic mean) vertical distance error (absolute value of altitude error; always positive), and 67th, 80th, and 90th percentiles of vertical distance error (in meters).” *Id.*

¹⁷ *Id.* at 99.

¹⁸ Letter from Scott K. Bergmann, Senior Vice President of Regulatory Affairs, CTIA *et al.*, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 5 (filed Aug. 3, 2018) (Stage Z Cover Letter).

¹⁹ Stage Z Cover Letter at 6. CTIA notes that a “fix” is a location estimate. *See id.* at 2.

²⁰ *See id.* at 6.

²¹ *Public Safety and Homeland Security Bureau Seeks Comment on Vertical (Z-Axis) Accuracy Metric Proposed by the Nationwide Wireless Carriers*, PS Docket No. 07-114, Public Notice, 33 FCC Rcd 8616 (PSHSB 2018) (*Public Notice*).

²² *Wireless E911 Location Accuracy Requirements*, Fourth Further Notice of Proposed Rulemaking, 34 FCC Rcd 1650 (2019) (*Fourth Further Notice*). After the close of comments, the Commission adopted a *Report and Order* in the Kari’s Law and RAY BAUM’S Act proceeding that consolidated the 911 rules under Part 9, and therefore renumbered Section 20.18 as new Section 9.10. *See generally Implementing Kari’s Law and Section 506 of RAY*

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A. The 3-Meter Metric

10. We agree with commenters who conclude that a 3-meter metric will bring real public safety benefits to the American public and is technically feasible in the near term.²⁷ A broad cross-section of public safety commenters agree that, in the near term, a 3-meter metric will meet public safety needs and will provide actionable information to first responders. Public safety organizations in support of the 3-meter metric include the International Association of Fire Chiefs (IAFC), the International Association of Chiefs of Police (IACP), the National Association of State EMS Officials (NASEMSO), the National Sheriffs' Association (IAFC *et al.*); International Association of Fire Fighters (IAFF); NENA: The 9-1-1 Association (NENA); State of Florida Department of Management Services, Division of Telecommunications, Bureau of Public Safety (Florida); and Texas 9-1-1 Alliance, the Texas Commission on State Emergency Communications (CSEC), and the Municipal Emergency Communication Districts Association (Texas 911 Entities).²⁸ The Boulder Emergency Telephone Service Authority (BRETSA) notes that "floor-level accuracy is a critical objective, and 3-meter accuracy is floor level accuracy."²⁹ The International Association of Fire Fighters states that the Commission was "correct in concluding that a 3 meters vertical accuracy requirement 'will significantly narrow the scope of the search and can provide a reasonable basis for identifying the correct floor in most cases.'"³⁰ For example, in-building tests that International Association of Fire Fighters conducted in July 2014 using NextNav technology showed significant improvement in search time compared to searching without any vertical location information component.³¹ The International Association of Fire Fighters asserts that "vertical altitude information can provide a substantial improvement in search effectiveness in multistory structures, even without a precise floor number or a dispatchable address."³² Texas 911 Entities supports immediate adoption of a 3-meter metric on the grounds that "the 'perfect' should not be the enemy of the 'good.'"³³ The International Association of Fire Chiefs similarly supports adopting a 3 meter metric and then narrowing the metric "over a timeframe as technology develops."³⁴

11. What is more, we find that implementing the 3-meter metric on schedule is technically

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BAUM'S Act, PS Docket No. 18-261, Report and Order, 34 FCC Rcd 6607 (2019) (*Kari's Law/RAY BAUM'S Act Order*).

²³ *Fourth Further Notice*, 34 FCC Rcd at 1654, para. 11.

²⁴ *Id.* at 1654-55, paras. 11-12.

²⁵ *Id.* at 1655, para. 13.

²⁶ Comments were filed by: ADT LLC d/b/a ADT Security Services (ADT); Airwave Developer LLC (AWD); Association of Public-Safety Communications Officials-International, Inc. (APCO); AT&T Services, Inc. (AT&T); Alliance for Telecommunications Industry Solutions (ATIS); Boulder Emergency Telephone Service Authority (BRETSA); Competitive Carriers Association (CCA); CTIA; Google LLC (Google); International Association of Fire Chiefs (IAFC) *et al.*; International Association of Fire Fighters (IAFF); NENA: The 9-1-1 Association (NENA); NextNav, LLC (NextNav); Precision Broadband LLC (Precision Broadband); Public Knowledge; Qualcomm Inc. (Qualcomm); State of Florida Department of Management Services, Division of Telecommunications, Bureau of Public Safety (Florida); Texas 9-1-1 Alliance, the Texas Commission on State Emergency Communications (CSEC), and the Municipal Emergency Communication Districts Association (Texas 9-1-1 Entities); T-Mobile; and Verizon. Reply comments were filed by AT&T; BRETSA; CTIA; IAFC; IAFF; NCTA – The Internet & Television Association (NCTA); NENA; NextNav; Polaris Wireless (Polaris); Precision Broadband; and T-Mobile.

²⁷ See AWD Comments at 2; Polaris Reply at 1; NextNav Comments at 2; Verizon Comments at 2-3; NENA Comments at 2; IAFF Comments at 1; IAFC *et al.* Comments at 2; State of Florida Comments at 1; Texas 911 Entities Comments at 2. See also Letter from Matthew Gerst, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 2 (filed Dec. 19, 2018), (CTIA Dec. 19, 2018 *Ex Parte* Letter) (recognizing "that public safety representatives have encouraged the Commission to adopt a more aggressive Z-Axis metric of ± 3 meters in the near term... [and] participants noted that certainty as to the Z-Axis metric in the near term, whether via an Order or expeditiously seeking public comment, may help advance the

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feasible. Two vendors have consistently shown in testing that they can meet or surpass this standard.³⁵ Since 2012, NextNav has repeatedly achieved 3-meter accuracy in multiple independently-conducted tests.³⁶ In the Stage Z test bed, NextNav's technology was accurate within 1.8 meters or better for 80% of indoor fixes and 3 meters or better for 94% of indoor fixes.³⁷ In other words, NextNav's technology is capable of "consistent performance within an accuracy metric of 3 meters or less."³⁸

12. Polaris too can achieve accuracy within 2.8 meters for 80% of test calls by using additional available location data to recalibrate and refine its Stage Z data.³⁹ Although Polaris did not employ active calibration of the barometric sensors during Stage Z testing, the Stage Z Report acknowledges that the test results for Polaris "may underestimate the performance results that might be achieved" if a calibration approach had been employed.⁴⁰ We agree with Polaris that its technology can deliver 3-meter accuracy,⁴¹ and with NextNav that "the Stage Z test process confirmed, once again, that existing location technologies available from multiple vendors can reliably achieve floor level vertical accuracy within +/-3 meters for at least 80 percent of indoor wireless calls to E911 emergency services."⁴²

13. The record suggests that other technological options for vertical location accuracy are emerging, and that, as T-Mobile describes, the market is driving innovation in location accuracy technology for E911.⁴³ AWD submits that Citizens Broadband Radio Service (CBRS) technology low cost antennas installed on each floor of a building will generate data allowing for the PSAP to pinpoint the floor from which the wireless call was made.⁴⁴ In 2018, CTIA announced nationwide wireless providers AT&T, Sprint, T-Mobile and Verizon were adding new location-based tools with existing wireless 9-1-1 location technologies by the end of that year.⁴⁵ Two device based approaches are Apple's delivery of Hybridized Emergency Location (HELO) data and Google's Android Emergency Location Service (ELS).⁴⁶ Apple has announced that it will use new technology to quickly and securely share Hybridized Emergency Location information with 911 call centers.⁴⁷ The HELO "solution has offered z-axis estimates and uncertainties beginning in 2013, and those estimates have been consumed by carriers since its first adoption in 2015."⁴⁸ Apple has committed to improving its vertical, as well as horizontal,

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development process necessary to meet the 2021 and 2023 vertical location accuracy benchmarks in the *Fourth Report & Order*"); AT&T Comments at 2 ("AT&T is in favor of the Commission's proposal to adopt a z-axis metric based on a 3-meter standard. Although... "CTIA Test Bed" results did not indicate with certainty that a 3-meter metric was currently achievable in all scenarios, AT&T supports adoption of this requirement as it will give the industry certainty and advance the development process necessary to meet the 2021 and 2023 vertical location accuracy benchmarks in the *Fourth Report & Order*"); But see AT&T Reply at 3 ("solutions meeting the proposed metric are not available, scalable, and ready for action...the best way to speed up the availability of this date may be through adoption of a phased-in approach.").

²⁸ Florida Comments at 1 (supporting "the FCC's proposed z-axis metric of 3 meters relative to the handset for 80% of wireless E911 calls."); IAFC *et al.* Comments at 3 (recommending that the Commission "should immediately adopt a 3 meter vertical location accuracy requirement and mandate its implementation in the top 25 cellular market areas (CMAs) by April 2021 and in the top 50 CMAs by April 2023."); IAFF Comments at 1 (strongly supporting the Commission's proposal "to adopt a vertical location metric of 3 meters to assist fire fighters and other responders in locating wireless callers to E911 emergency services."); NENA Comments at 2 (finding "the proposed accuracy thresholds — 3 meters of vertical accuracy and 50 meters of horizontal accuracy — reasonable."); Texas 911 Comments at 2 (urging the Commission to adopt the proposed 3-meter z-axis metric without requiring additional testing); Letter from Daniel Henry, Director of Government Affairs, NENA The 9-1-1 Association, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Nov. 15, 2019) (NENA Nov. 15, 2019 *Ex Parte*); Letter from Brandon W. Allen, Manager, Government Relations, International Association of Fire Chiefs (IAFC), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Nov. 13, 2019) (IAFC Nov. 13, 2019 *Ex Parte*); Letter from Shannon A. Meissner, Director, Governmental Affairs, International Association of Fire Fighters (IAFF), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Nov. 7, 2019); Letter from Chief Steven R. Casstevens, President, International Association of Chiefs of Police (IACP), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Nov. 7, 2019) (IACP Nov. 7, 2019 *Ex Parte*).

²⁹ BRETSA Comments at 4 ("While BRETSA would not object to a 3-meter accuracy standard for 80% of all calls, BRETSA believes the Commission should not adopt a standard significantly less stringent than that which

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location accuracy and will participate in CTIA's z-axis testing by the end of 2020.⁴⁹ Google in turn has described its Emergency Location Service solution, which can record and report z-axis information, as a feature fully integrated in the operating system on 99% of Android handsets that makes handset location known when the user initiates an emergency call or text.⁵⁰ Google plans to test the vertical accuracy capabilities of its Emergency Location Service solution in Stage Za.⁵¹ In short, companies are actively exploring new types of cellular air interfaces for location accuracy "including 5G interfaces, additional satellite constellations, and other wireless infrastructure, such as Wi-Fi access points, Bluetooth beacons and small cells, as well as information provided by sensors within today's smartphones."⁵²

14. We further conclude that adopting the 3-meter metric will keep deployment of z-axis information to public safety officials on schedule. Public safety commenters support the current 2021 and 2023 deadlines for applying the z-axis metric and oppose delay for further testing.⁵³ The International Association of Fire Fighters finds it "inconceivable . . . that either the Commission or the public safety community would allow themselves to get this close to achieving a historic benefit in the capabilities of emergency services and so much as hesitate in taking the next step."⁵⁴ BRETSA maintains that "[a]doption of a vertical location standard will benefit the public"⁵⁵ and "additional testing should not delay provision of the public benefit."⁵⁶ Vendors also support adoption of a z-axis metric without further delay.⁵⁷ NextNav states "[n]ot only would further delay pose a continued risk to public safety, but it is also unclear whether it would appreciably improve the information that is currently available to the Commission."⁵⁸ AWD notes that current technology is able to meet the 3-meter metric.⁵⁹

15. We disagree with commenters that raise a number of objections. To start, we disagree with commenters like Google, who argue for a "phased" approach that would involve setting a 4-meter metric initially and tightening the metric to 3 meters by 2023.⁶⁰ Google argues that "[w]hile major progress has been made, consensus has not been reached on the appropriate z-axis metric, and the full capabilities of alternative technologies cannot yet be determined," so that a phased approach would "better reflect[] the current abilities and future promise of vertical location technologies."⁶¹ We believe

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technology providers already meet. The Stage Z testing of NextNav's 2-meter standard for 80% of all calls results in a 3-meter standard for 94% of all calls.").

³⁰ IAFF Comments at 1.

³¹ *Id.* at 2.

³² Letter from Harold A. Schaitberger, General President, International Association of Fire Fighters, to Commissioner Jessica Rosenworcel, FCC at 1 (Sept. 16, 2019) (on file in PS Docket No. 07-114) (IAFF Letter).

³³ Texas 911 Entities Comments at 2.

³⁴ Letter from Brandon W. Allen, Manager, Government Relations, International Association of Fire Chiefs (IAFC), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed on April 30, 2019) (IAFC April 30, 2019 *Ex Parte*).

³⁵ BRETSA Comments at 4; Polaris Reply Comments at 3; NextNav Comments at 2.

³⁶ NextNav Comments at 2; *see also Third Further Notice*, 29 FCC Rcd at 2401-02, para. 71; NextNav Comments at 24; Letter from Bruce A. Olcott, Counsel to NextNav, LLC to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 2 (filed Aug. 16, 2018) (NextNav Aug. 16, 2018 *Ex Parte*).

³⁷ Stage Z Test Report at 120.

³⁸ NextNav Comments at 2-3; NextNav Reply at 4 (stating that the Stage Z report "clearly validated the highly accurate performance capabilities of NextNav's vertical location technology. The Stage Z report also mirrored the results of prior independently conducted test beds in which NextNav's vertical location technology produced very consistent levels of accuracy.").

sufficient testing that has already occurred and that the technology trends that Google itself cites validate our conclusion that 3 meters is already technically feasible and provides the appropriate metric for the development of alternative new technologies.

16. Similarly, we disagree with commenters who ask us to delay action for further testing. To start, we note that these arguments ring hollow when several CMRS providers—those who bear direct responsibility for complying with the 3-meter metric on schedule—are on record as supporting adoption of the 3-meter metric without further testing.⁶² For example, AT&T favors the Commission’s proposal because “it will give the industry certainty and advance the development process necessary to meet the 2021 and 2023 vertical location accuracy benchmarks in the *Fourth Report & Order*.”⁶³ CTIA reiterates that it supports the proposed z-axis metric without changes,⁶⁴ having previously stated that “[t]he Fourth Further Notice offers a reasoned approach to the definition of floor level accuracy as part of the proposed z-axis metric: within 3 meters above or below the vertical location provided by the phone.”⁶⁵ And Verizon supports the Commission’s proposed metric, stating that it is “a good target for 9-1-1 calls from devices with the necessary capability.”⁶⁶ Google also supports a 3 meter metric and asks that our approach remain technology neutral so that CMRS providers may select the technology to meet their location accuracy obligations.⁶⁷

17. More specifically, we disagree with Google and Qualcomm that there has been insufficient testing of barometric sensor-based technologies in extreme cold-weather conditions.⁶⁸ Although CTIA and Qualcomm note that NextNav was unable to participate in Stage Z winter testing in Chicago,⁶⁹ we do not consider this to be sufficient reason to delay our decision. Polaris did participate in Stage Z winter testing in Chicago and achieved results that were comparable to the results it achieved in the other test bed locations in more moderate weather conditions.⁷⁰ Moreover, as BRETSA states, “[e]ven if vertical location results would be less accurate during episodes of climactic extremes; that cannot justify delaying adoption of a standard and deployment of vertical location technologies which have been proven in common weather conditions.”⁷¹ Finally, despite its own complaints about a lack of cold

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³⁹ Stage Z Test Report at 130-34. Polaris states that it originally proposed to include an active compensation correction model that would operate in an application running in the background of the device but that it did not enable this feature on the basis of communications with the test bed administrator and Polaris’ understanding of instructions from the test bed on allowable procedures. *Id.* at 131-132. The reprocessed data offers adjusted performance outcomes accordingly.

⁴⁰ Stage Z Test Report at 51.

⁴¹ Polaris Reply at 3. Polaris reiterates “the current capabilities of its software-based solution that delivers affordable and scalable 3-meter z-axis accuracy.” Polaris states that “its technology is available today as an over-the-top offering for First Responders and other commercial applications.” Letter from Ian D. Volner, Counsel, Polaris Wireless, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Sept. 19, 2019) (Polaris Sept. 19 *Ex Parte*).

⁴² NextNav Comments at 3.

⁴³ T-Mobile Comments at 8.

⁴⁴ AWD Comments at 2-3.

⁴⁵ See CTIA, *Press Release, Wireless Industry Announces Development in Improving 9-1-1 Location Accuracy* (Sept. 2018), <https://www.ctia.org/news/wireless-industry-announces-development-in-improving-9-1-1-location-accuracy>. CTIA stated that device-based hybrid “solutions use a combination of technologies and sensors—including satellite GPS and crowd-sourced Wi-Fi measurements—that can supplement wireless providers’ existing 9-1-1 network and device-assisted information to produce a higher-accuracy location, particularly indoors.” *Id.* CTIA added that by integrating DBH “location technology solutions – similar to those used by popular commercial services, like ride-sharing and navigation apps – the public safety community can more accurately determine a wireless 9-1-1 caller’s location, particularly inside buildings.”).

weather data, CTIA waited to conduct Stage Za testing to conclude in late 2019, so it will be unable to provide winter test data for at least another year.⁷² We cannot accept such a long delay in adopting a metric, given that two vendors can meet the metric and there are emerging device-based solutions.

18. We disagree with Google that additional testing is needed in rural morphologies.⁷³ The rural morphology is “the sparsest environment overall” and is mostly residential, with most structures between 1 and 2 stories high.⁷⁴ As Verizon notes, urban areas are important for vertical location accuracy because “[i]t is in these areas where multi-story buildings are concentrated, so service providers should focus their deployments on urban and dense urban areas within the covered CMAs.”⁷⁵ In these morphologies, the test bed shows that NextNav’s solution would meet a 3-meter metric.⁷⁶ Additionally, NextNav’s technology was tested for vertical accuracy in rural areas during the original CSRIC Test Bed conducted in 2012, and NextNav’s results from that testing fell within 3 meters for 80% of all calls.⁷⁷ In the Addendum to the Stage Z Report, Polaris explains that its results in all morphologies would fall below 3 meters had it used limited active calibration during the Stage Z test.⁷⁸ The Stage Z Test Report acknowledges that Polaris did not employ continuous calibration during the test⁷⁹ and that Polaris’ results “may underestimate the performance results that might be achieved using an effective continuous (background) calibration algorithm for each individual mobile device.”⁸⁰

19. We also disagree with Apple’s suggestion that we should delay action based on concerns that the test bed did not adequately test z-axis solutions under real-world conditions. Apple states that results were obtained in the test bed “only under conditions that deviate significantly from realistic user patterns and constraints” and “do not necessarily mean that a ± 3 meter accuracy metric is achievable by April 2021 in real-world circumstances.”⁸¹ In fact, the testing was conducted in multiple regions, morphologies, and building configurations in order to assess how z-axis technology would perform in a variety of real-world environments.⁸² Test bed procedures were based on the recommendations of the Commission’s fourth Communications, Security, Reliability & Interoperability Council (CSRIC IV),⁸³ and testing followed guidelines developed by the Alliance for Telecommunications Industry Solutions’

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⁴⁶ AT&T Reply at 5. In September 2018, Google announced the launch of ELS in the U.S. with RapidSOS, T-Mobile and West. Jen Chai, *Expanding Emergency Location Service in Android to the U.S.* (Sept. 19, 2018), <https://www.blog.google/products/android/expanding-emergency-location-service-android-us/>. Google also announced that it “already launched ELS in the U.S. Virgin Islands through a partnership with West and a regional wireless provider, Viya.” *Id.*

⁴⁷ See Press Release, Apple, *Apple’s iOS 12 Securely and Automatically Shares Emergency Location with 911* (June 18, 2018), <https://www.apple.com/newsroom/2018/06/apple-ios-12-securely-and-automatically-shares-emergency-location-with-911/>; T-Mobile Comments at 10. In an August 2018 Enhanced Emergency Data (EED) white paper for PSAPs, Apple explained that it has “offered wireless carriers free access to HELO in response to traditional Network-Initiated Location Requests (NILR).” Apple, Inc., *Enhanced Emergency Data* at 3 (2018) https://cdn.ymaws.com/www.nena.org/resource/resmgr/docs/Apple_Enhanced_Emergency_Data.pdf (Apple White Paper). NILR are 3GPP-standardized transport mechanisms that allows 2G 3G and 4G “mobile networks to securely acquire location data, like HELO fixes, from user devices during an emergency call, and route that data to local 9-1-1 centers.” *Id.* at 5. Apple stated that “HELO is a measurement and estimation technology, not a location transport.” *Id.* at 9. “Apple began offering HELO to wireless carriers using the traditional Network Initiated Location Request transport and “Mobile Station - Based” (MSB) location determination in 2015.” *Id.* at 9. Advanced Mobile Location (AML) “is a transport protocol that conveys HELO data via a specially-formatted SMS text message to one end-point for each AML country.” *Id.* “Support for AML transport was added in 2018 (iOS 11.3) in countries that lack NILR support.” *Id.* We note that in 2016, the European Telecommunications Standards Institute (ETSI) Emergency Telecommunications Subcommittee (EMTEL) specified AML in Technical Report (TR) EMTEL-00035. See ETSI, *Emergency Communications (EMTEL); Advanced Mobile Location for Emergency Calls*, Technical Report (2016), https://www.etsi.org/deliver/etsi_tr/103300_103399/103393/01.01.01_60/tr_103393v010101p.pdf (AML Technical Report). Apple also explained that its “Enhanced Emergency Data (EED) is a new location transport that uses a secure internet-protocol data connection to convey HELO data to RapidSOS, and standards-compliant NG9-1-1 methods to make that data available to PSAPs.” Apple White Paper at 9.

(ATIS) Emergency Services Interconnection Forum (ESIF), including ESIF's Emergency Services and Methodologies (ESM) subcommittee.⁸⁴ As the Stage Z Test Report states, "ATIS provided guidelines on test building and test point selection and oversaw implementation of the Test Bed by the Administrator-Executor. In addition, Test Bed, LLC receives guidance from the TAC, which includes representatives of the nationwide wireless service providers, as well as the Association of Public-Safety Communications Officials International (APCO) and the National Emergency Number Association (NENA)."⁸⁵ Although it is not possible for any test bed to replicate every conceivable real world scenario, we find the test bed results to be sufficiently representative and robust to support our establishment of the 3-meter metric. We also agree with NextNav that "not only would further delay pose a continued risk to public safety, but it is also unclear whether it would appreciably improve information that is currently available to the Commission."⁸⁶

20. We also disagree with T-Mobile that further testing is first needed with a wider variety of handsets, including older handsets.⁸⁷ NextNav and Polaris each tested six handsets, for a total of twelve handsets, in Stage Z.⁸⁸ These handsets were selected by the test bed administrator, not the vendors, and the Report states that they were selected "to ensure variety between sensor manufacturers, the age of handsets (within limits) and their overall use characteristics."⁸⁹ The handsets used in testing were "the same production-ready handsets sold by wireless carriers and available to the general public" and did not contain any hardware modification that would favor these handsets over any commercially available handsets.⁹⁰ Thus, we adopt our tentative conclusion from the *Fourth Further Notice* that a sufficient variety of devices have been tested to support moving forward with our proposed 3-meter metric at this time.⁹¹

21. We also decline to adopt a 2-meter metric, as suggested by BRETSA, at this time.⁹² The record confirms that a 2-meter metric is not technically feasible under the existing timelines, although it may become achievable in the long term as technology continues to evolve.⁹³

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⁴⁸ Letter from Paul Margie, Counsel for Apple Inc., to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 4 (filed Oct. 29, 2019) (Apple Oct. 29, 2019 *Ex Parte*).

⁴⁹ *Id.*

⁵⁰ Google Comments at 2-4. In 2016, Google launched ELS in Europe and announced that ELS is supported by over 99% of existing Android devices (version 2.3 out and upwards) through Google Play services. See Akshay Kannan, Google, *Helping emergency services find you when you need it most*, (July 25, 2016), <https://blog.google/around-the-globe/google-europe/helping-emergency-services-find-you/>; Google ELS provides x,y, and z for both indoor and outdoor environment. It is scalable, free and enabled in 24 countries including the United States. Letter from Megan Stull, Counsel, Google, LLC, to Marlene H. Dortch, Secretary, FCC, at attach. 3-5 (filed Nov. 8, 2019) (Google Nov. 8, 2019 *Ex Parte*).

⁵¹ Google Comments at 2-4. With ELS, Google states that when a user contacts a configured emergency number from a handset, the device automatically activates ELS to send location information. See Google, *Android ELS - How It Works*, <https://crisisresponse.google/emergencylocationservice/how-it-works/> (last visited Oct. 24, 2019) (describing ELS as "a supplemental service that sends enhanced location directly from Android handsets to emergency services when an emergency call is placed."). This happens, according to Google, "via a high accuracy location request that is registered with the Android Fused Location Provider (FLP)." *Id.* The FLP is a location API in Google Play services that combines different signals to provide the location information that a user app needs. See Google, *Fused Location Provider API*, <https://developers.google.com/location-context/fused-location-provider/> (last visited Oct. 24, 2019). The fused location provider manages the underlying location technologies, such as GPS and Wi-Fi. *Id.*; Google Nov. 8, 2019 *Ex Parte* at 1 ("ELS is activated only when the user contacts emergency services, at which time the user's location is computed using the Android Fused Location Provider (FLP), which allows provision of indoor or outdoor location using a variety of sensors and is often more accurate and reliable than legacy Phase 1 and Phase 2 control plane locations. Although FLP is the same geolocation technology used by many

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22. Finally, we need not address APCO's suggestion in its comments that the Commission proceed without adopting a metric.⁹⁴ In a recent *ex parte* filing, APCO stated that based on the record and its discussions with stakeholders, it "does not recommend that the Commission decline to adopt a z-axis metric altogether."⁹⁵ APCO's revised position aligns with the views of all other public safety commenters that adopting a z-axis metric remains an essential measure to ensure that first responders receive important location information when providing dispatchable location is not feasible. We agree.

B. Deployment

23. In the *Fourth Further Notice*, we proposed that the 3-meter z-axis metric apply to 80% of calls from all handsets, i.e., that to comply with the metric, z-axis technologies would have to be demonstrated in the test bed to provide 3-meter accuracy for 80% of wireless calls.⁹⁶ We asked whether applying the metric to 80% of wireless calls was appropriate, and if not, what percentage of calls would be appropriate.⁹⁷ We also noted that CTIA had proposed that its 5-meter metric apply only to "mobile devices capable of delivering barometric pressure sensor-based altitude estimates."⁹⁸ We asked whether the z-axis metric should only be applied to devices with barometric pressure sensors, or to devices manufactured after a date certain, or whether it should apply to all handsets, as we proposed.⁹⁹ We observed that to the extent that CMRS providers elect to use solutions that rely on barometric pressure readings, nearly all smartphones on the market appear to be equipped with barometric pressure sensors.¹⁰⁰ We observed that barometric sensor-based solutions are likely to be scalable and can be made readily available to wireless consumers within the timeframes required by the rules.¹⁰¹ We sought comment on this assessment and its underlying factual assumptions. We also sought comment on the potential for development and deployment of other new or emerging vertical location solutions that could be used to meet the proposed z-axis metric.

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Android apps, including Google's own apps, Google does not receive or use the user's location information when ELS uses FLP. Location data is sent via Data SMS (per AML specifications) or HTTPS. ELS data remain available during the emergency call." (footnote omitted)).

⁹² Qualcomm Comments at 4.

⁹³ IAFC Comments at 3 ("the FCC should immediately adopt its 3 meter metric proposal, ensure its implementation in major cities by the existing deadlines for vertical location accuracy, and act upon narrowing the metric in 5 years' time."); IAFF Reply at 2; BRETSA Comments at 1; Texas 911 Entities Comments at 2; Letter from Douglas M. Aiken, Acting Chairman Nat'l Pub. Safety Telecommunications Council, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1, 3 (filed Sept. 25, 2019) (NPSTC *Ex Parte*) (urging "the Commission to hold fast to the 2021 and 2023 deadlines established in the Fourth Report and Order, regardless of any further testing carriers may plan to conduct.").

⁹⁴ IAFF Reply at 2.

⁹⁵ BRETSA Comments at 1.

⁹⁶ *Id.* at 1.

⁹⁷ Polaris Reply at 2; NextNav Reply at 9.

⁹⁸ NextNav Reply at 9.

⁹⁹ AWD Comments at 2.

¹⁰⁰ Google Comments at 10.

¹⁰¹ *Id.* at 5.

¹⁰² AT&T Comments at 2; CTIA Comments at 9; Verizon Comments at 2.

¹⁰³ AT&T Comments at 2. AT&T states that "the biggest determinant to meeting the vertical accuracy metric is incorporating the technology into the handsets." *Id.* As discussed below, we conclude that there is adequate time to deploy z-axis technologies into handsets before the April 2021 initial vertical accuracy deadline.

24. As proposed, we apply the 3-meter accuracy metric to 80% of wireless E911 calls. This is consistent with our approach to E911 horizontal accuracy, which requires wireless carriers to meet horizontal accuracy requirements for 80% of calls by April 2021. Thus, as the basis for validation of any z-axis technology, we require wireless carriers to demonstrate in the test bed that the technology achieves 3-meter accuracy for 80% of wireless E911 calls.¹⁰²

25. We also conclude that application of the 3-meter metric should apply to all handsets that have the capability to support vertical location, regardless of technology, not just new handsets or barometric pressure sensor capable handsets. We thus clarify that a device will be considered “z-axis capable” so long as it can measure and report vertical location without a hardware upgrade. Thus, devices that can be modified to support vertical location by means of a firmware or software upgrade will be considered z-axis capable.¹⁰³ This definition makes clear that any device technically capable of measuring and reporting vertical location information without a change in hardware must be enabled to do so—and actions by carriers, device manufacturers, operating system providers, chipmakers, or z-axis vendors that would prohibit technically capable devices from actually and effectively measuring and reporting z-axis information put the public and emergency personnel at unacceptable risk.¹⁰⁴ We expect to closely monitor the roll-out of z-axis capable devices to the American public over the next two years and take all appropriate action against any company that obstructs the effective deployment of such technologies in a timely manner.

26. The record reflects that z-axis capable devices are widely available. NENA concludes that “it is safe to assume that a comparatively small portion of modern phones lack [barometric pressure] sensors.”¹⁰⁵ NENA also states that market trends suggest an increase in barometric pressure sensor prevalence “as applications such as fitness apps and small electronic devices like standalone GPS and fitness trackers increasingly incorporate altitude measurements, driving incentives to include [barometric pressure] sensor hardware.”¹⁰⁶ As Google points out, the *Fourth Report & Order* “established benchmarks and timetables clear enough to signal that development of z-axis capability should be a top priority.”¹⁰⁷ Google states that “industry has risen to the challenge with manifold options to enable z-axis

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⁶⁴ CTIA Nov. 5, 2019 *Ex Parte* at 1 (expressing “support for the Commission establishing a ± 3 meter metric for Z-axis information as a goal and did not seek any changes to the rule.”). CTIA states that while a 3-meter metric is an important goal, “further testing, development and collaboration is necessary to validate that Z-axis solutions can meet this metric by April 2021.” *Id.* at 2. We agree that once the metric is established, z-axis solutions that carriers intended to use for compliance purposes must be tested and validated against the metric. However, we disagree with CTIA insofar as we find, for reasons discussed elsewhere in this *Fifth Report and Order*, that further testing is not required to support our establishment of the metric nor our expectation that carriers can meet the deployment benchmarks in a timely manner.

⁶⁵ CTIA Comments at 9.

⁶⁶ Verizon Comments at 2.

⁶⁷ Google Nov. 8, 2019 *Ex Parte* at 2.

⁶⁸ See, e.g., Google Comments at 12-13; Qualcomm Comments at 6-7.

⁶⁹ Qualcomm Comments at 6-7; Stage Z Cover Letter at 3.

⁷⁰ NextNav Aug. 16, 2018 *Ex Parte* at 2 (“In any event, the Chicago tests that were conducted did not produce any novel results. For example, as shown in the figure below, the z-axis results for Polaris’ indoor location technology were arguably better in Chicago than Polaris’ results for San Francisco.”).

⁷¹ BRETSA Comments at 2-3.

⁷² Letter from Matthew Gerst, Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 2 (filed on Sept. 11, 2019) (CTIA Sept. 11, 2019 *Ex Parte*) (stating Stage Z testing should begin in late September 2019 and conclude later in 2019).

⁷³ Google Comments at 12-13.

capability,”¹⁰⁸ including the barometric pressure sensor-based solutions developed by NextNav and Polaris and “handset-based solutions like ELS [that] have been widely deployed around the world.”¹⁰⁹ Google credits this rapid and widespread availability of z-axis capable devices to the Commission’s flexible and evolutionary approach to location accuracy.¹¹⁰

27. What is more, both NextNav and Polaris have software-based solutions.¹¹¹ Thus, if carriers choose either of these solutions, hardware upgrades to handsets are not required and solutions can be implemented by means of software modifications that are readily achievable ahead of the 2021 deadline.¹¹² The record describes scalable methods of implementation for barometric-based solutions that do not require hardware changes.”¹¹³ As Polaris states, “[o]ne method is to implement adopted 3GPP and OMA standards for barometric compensation”¹¹⁴ which is a “firmware-based approach [that] is achievable through cooperation among carriers, device manufacturers, and chipmakers.”¹¹⁵ Another method Polaris describes is to “place necessary functionality on devices,” which is a “software-based approach [that] is achievable through cooperation among carriers, location vendors, and device Operating System providers.”¹¹⁶ Polaris maintains that it “can support a variety of implementation methodologies and remains committed to work with carriers and other involved parties to implement any agreed upon methodology.”¹¹⁷ NextNav also states handsets can be made z-axis compliant with over-the-air updates.¹¹⁸

28. We disagree with some commenters that suggest that old handsets should be categorically excluded from the rules; they do not propose or provide a clear rationale for a specific cutoff.¹¹⁹ Instead, we apply the metric to all z-axis capable devices, as supported by commenters like AT&T.¹²⁰

29. We also disagree with CTIA who suggests we apply the metric only to devices “equipped with barometers and any other functionality necessary to support barometric pressure-based altitude estimation solutions.”¹²¹ As APCO argues, this approach would violate the principle of technological neutrality.¹²² We have previously recognized that no single technological approach will solve the challenge of indoor location, and we have consistently favored technologically neutral rules “so that

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⁷⁴ Stage Z Test Report at 24.

⁷⁵ Verizon Comments at 5.

⁷⁶ Stage Z Test Report at 65.

⁷⁷ See CSRIC III WG3, Indoor Location Test Bed Report at 36 (2013)

http://transition.fcc.gov/bureaus/pshs/advisory/csric3/CSRIC_III_WG3_Report_March_%202013_ILTestBedReport.pdf.

⁷⁸ Stage Z Test Report, Addendum at 133-134; Polaris Oct. 18, 2018 Reply at 2 (submitting a statement from Dr. R. Michael Buehrer opining that the gains demonstrated in the Addendum are “consistent with what one would expect using Polaris’ “‘limited active compensation’ process” and that the gains shown are likely a “conservative estimate of the improvement that could be achieved through active compensation.”)

⁷⁹ Stage Z Test Report at 53 (noting that “[c]ontinuous opportunistic (background) calibration procedures could potentially improve location accuracy performance, and therefore their absence may have had an impact on the performance results of the Polaris Wireless solution under test.”).

⁸⁰ *Id.* at 51.

⁸¹ Apple Oct. 29, 2019 *Ex Parte* at 3. Apple maintains that “power and connectivity conditions in the testbed were not representative of real world use” and that “[t]he only testbed results obtained without implicating one or more of these problems fell short of the ± 3 meter metric.” *Id.*

⁸² Stage Z Test Report at 119; *see also* NextNav *Public Notice* Comments at 14 (“Indeed, the z-axis tests were conducted in real world environments. The test locations that were selected by the independent test bed administrator in San Francisco and Atlanta included a wide range of morphologies and indoor environments that were intended to replicate the conditions that would exist for actual consumers using their personal wireless handsets in emergency situations. Therefore, it is reasonable and appropriate to conclude that the Stage Z Report

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providers can choose the most effective solutions from a range of options.”¹²³ Although both technologies tested in Stage Z relied on barometric pressure sensor capable handsets, and it is possible that the carriers could adopt barometric-based solutions exclusively, other vertical location technologies may develop that do not require a barometric sensor in the handset. In fact, Google has stated that its Stage Za testing will include solutions that do not use barometric pressure sensors.¹²⁴ Therefore, in order to preserve the technological neutrality of the rules and encourage development of the broadest possible array of vertical location technologies, the metric will not be limited to barometric pressure sensor capable handsets.

30. Qualcomm and Google raise a concern that vertical location technology needs to be standardized so it can be “economically implemented.”¹²⁵ However, Verizon states that “extensive standardization work on vertical location solutions has already been completed,”¹²⁶ and further work is under way.¹²⁷ Apple states that “vertical location accuracy performance requirements should be evaluated in the context of solutions that must be implemented at large scale, subject to real world operational considerations,” and “[t]echnologies that depend on the deployment of new infrastructure in every major city to achieve even less-stringent performance metrics also raise significant questions about the viability of the tested approaches.”¹²⁸ BRETSA also comments that “one would expect the accuracy of vertical location systems to improve as they are deployed “at scale” and additional experience with them is gained.”¹²⁹ We also recognize that if carriers use barometric sensor based solutions, they will depend to some extent on third parties to support proper installation and calibration of barometric sensors in user devices, and that solutions will only work if the systems are compatible and information is correctly relayed between providers, the handset and operating system providers, and the PSAPs. However, while we acknowledge CMRS providers’ concerns about their ability to compel handset manufacturers and operating system providers to cooperate,¹³⁰ we believe CMRS providers are capable of negotiating

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provides accurate information regarding the performance that can be expected of barometric pressure sensors in real world conditions.”)

⁸³ Stage Z Test Report at 14.

⁸⁴ *Id.*

⁸⁵ *Id.*

⁸⁶ NextNav Reply at 9.

⁸⁷ T-Mobile Comments at 4-5.

⁸⁸ NextNav tested the following handsets: Samsung Galaxy S8, Samsung Galaxy 8 Plus, iPhone 7, iPhone 7 Plus, iPhone 8 and iPhone 8 Plus. Stage Z Test Report at 48. Polaris tested the following handsets: Essential PH-1, Huawei Mate 9, Motorola Z2 Force, Samsung Galaxy Note 8, Samsung Galaxy S8, and Sony Xperia XZ1 Compact. Stage Z Test Report at 52. The Report notes that Polaris did not test iOS (i.e., Apple iPhone) devices. *See* Stage Z Test Report at 52; Cover Letter at 3. Polaris responds that while the application it tested in the Stage Z test bed was developed only for Android devices, its barometric sensor-based solution is supported on iOS devices, and it has developed and tested a test application for iOS devices. Letter from James Arden Barnett, Jr., Counsel to Polaris Wireless, Inc., to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 3 (filed Sept. 10, 2018) (Polaris Sept. 10, 2018 *Ex Parte*); Polaris Nov. 30, 2018 *Ex Parte* at 1-2. Polaris submits that its technology “can achieve a vertical location benchmark metric of 3 meters on 80% of fixes for E9-1-1 calls, including iPhones.” *Id.* at 1-2.

⁸⁹ Stage Z Test Report at 24.

requirements with such third parties and establishing contractual timelines that will enable timely deployment of z-axis solutions in time to meet the deadlines in the rules. Moreover, the flexible, technology-neutral approach to location requirements adopted in this order removes uncertainty and will give carriers greater leeway to negotiate with competing vendors and to leverage location solutions already being developed by handset manufacturers and operating system providers.

C. Reporting Z-Axis Location Information

31. In the *Fourth Further Notice*, we sought comment on how CMRS providers should report vertical location information, noting that several measurement methods exist. Specifically, we sought comment on whether reporting vertical location information as height above ground level (AGL) would be preferable to reporting height above mean sea level (MSL), and whether to require CMRS providers to use one measurement standard exclusively.¹³¹ We asked commenters to address whether CMRS providers should be required to identify the floor level when reporting z-axis information.¹³² Alternatively, we asked whether we should decline to specify this level of detail so that entities developing z-axis solutions have more flexibility.¹³³

32. We require CMRS providers to report z-axis information as Height Above Ellipsoid (HAE).¹³⁴ In this regard, NENA and several other commenters point out that while vertical location information can be reported in multiple ways, e.g., HAE, MSL, or AGL, global standards are being developed around the measurement of such information as a value in HAE in meters, as defined in the World Geodetic System 1984 (WGS-84).¹³⁵ NENA notes that 3GPP is developing standards relating to representation of vertical location information that are based on HAE,¹³⁶ and industry commenters generally agree with NENA that HAE has emerged as the globally recognized standard for generating z-axis measurements.¹³⁷

33. There is a general consensus around using HAE as the baseline for measuring vertical

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⁹⁰ *Id.* at 26. By agreement between the Test Bed, LLC and the z-axis technology vendors, the Report adds, “only relatively new handsets, released more recently than mid-2016, were tested.” *Id.*

⁹¹ *Fourth Further Notice*, 34 FCC Rcd at 1659-60, para. 25.

⁹² BRETSA Comments at 4-5.

⁹³ Stage Z Test Report at 65 (reflecting that NextNav did not consistently achieve sub-2 meter accuracy); *Id.* at 74 (reflecting that Polaris did not achieve sub-3 meter accuracy).

⁹⁴ APCO Comments at 2.

⁹⁵ Letter from Jeffrey S. Cohen, Chief Counsel, APCO, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 n.1 (filed Oct. 25, 2019) (APCO Oct. 25, 2019 *Ex Parte*).

⁹⁶ *Fourth Further Notice*, 34 FCC Rcd at 1655, para. 11.

⁹⁷ *Id.*

⁹⁸ *Id.*

⁹⁹ *Id.*

¹⁰⁰ For the second quarter of 2019, the U.S. smartphone shipments showed Apple with a 41% market share, Samsung with a 21% share, LG with a 13% share, and Lenovo/Motorola with an 8% share. See Counterpoint Research, U.S. Smartphone Market by Quarter (Aug. 27, 2019), <https://www.counterpointresearch.com/us-market-smartphone-share/> (website updated quarterly). Since 2014, the iPhone 6 and later models have had a barometer, while Samsung Galaxy smartphones have had barometers since 2011. See Kaveh Wadell, *How Phones can Help Predict Thunderstorms* (Aug. 11, 2016), <https://www.theatlantic.com/technology/archive/2016/08/how-phones-can-help-predict-thunderstorms/495389/>. See also *Fourth Report and Order*, 30 FCC Rcd at 1299, para. 107 (noting that barometric sensors are increasingly common in handsets, and some analysts project that the number of smartphones equipped with such sensors will increase to 681 million new units per year in 2016).

location, but we recognize that the issue of how vertical location information should be *reported* to PSAPs is complex. ATIS ESIF argues that individual PSAPs may have different requirements for the processing and formatting of vertical location information, and that CMRS providers should not be required to convert location data into multiple formats.¹³⁸ ATIS, AT&T, and T-Mobile suggest that CMRS providers should be responsible only for providing raw location data that meets the z-axis metric, and that PSAPs should be responsible for translating that data into a floor number or other actionable information.¹³⁹ APCO counters that PSAPs do not have the resources to convert raw z-axis data to a floor number, “nor do they have three-dimensional maps to visualize raw z-axis information.”¹⁴⁰ APCO argues that PSAPs “will be left without actionable vertical location information” unless CMRS providers are required to convert z-axis data to a floor level that is reported to the PSAP.¹⁴¹

34. In arguing for floor level, APCO says that the Commission should also require carriers to provide floor level identification.¹⁴² Given the need for timely deployment on our existing timeline, we disagree. While public safety commenters broadly support the delivery of floor level information,¹⁴³ the record is clear that it is not now technically feasible to reliably convert z-axis information to an identified floor level.¹⁴⁴ ATIS states that “there currently exists no data source that correlates any form of z-axis data to a floor index or floor label.”¹⁴⁵ CTIA recognizes public safety’s desire for the most actionable information, but states that it “is not aware of any z-axis technology solutions that can produce specific floor level information.”¹⁴⁶ Apple observes “that providing the “floor level” information alongside a z-axis estimate would necessarily require information on the geodetic position of floors and knowledge of the labels applied to individual floors (e.g., “mezzanine”, “courtyard”),” and Apple is “not aware of any sources for this information.”¹⁴⁷ Apple also states that it is “unclear how uncertainty information could be effectively conveyed under such a regime,” and that “both horizontal and vertical uncertainty would be relevant to floor level information, as buildings implement floor levels in different ways.”¹⁴⁸ In support of its argument, APCO cites an academic paper and trade press reports on emerging floor level reporting technologies, stating that they prove providing floor level is already technically feasible.¹⁴⁹ Other commenters take issue with APCO sources,¹⁵⁰ and CTIA points out that APCO claims are not supported

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¹⁰¹ The *Fourth Further Notice* noted that “both NextNav and Polaris state that calibration of the barometric sensors in their z-axis solutions would be software-based and thus would scale readily for widespread use,” and “also state that industry standards necessary to implement the barometric sensor-based solutions tested in Stage Z are already adopted and that implementation of these standards is in the hands of carriers and device manufacturers.” *Fourth Further Notice*, 34 FCC Red at 1660-61, para. 26.

¹⁰² T-Mobile and Verizon support requiring carriers to meet the specified accuracy metric for 80 percent of test calls collected in the Test Bed rather than for 80 percent of all indoor wireless 911 calls. T-Mobile Comments at 6; Verizon Comments at 3.

¹⁰³ Firmware is a special type of software designed for a specific piece of hardware and is updated by the manufacturer to either fix a problem or to introduce new features.

¹⁰⁴ See CTIA Nov. 5, 2019 *Ex Parte* at 5 (summarizing concerns that certain stakeholders may decline to cooperate in efforts like calibration that are necessary to make z-axis solutions effective).

¹⁰⁵ Letter from Daniel Henry, Director of Government Affairs, NENA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1-2 (filed on Oct. 11, 2019) (NENA Oct. 11, 2019 *Ex Parte*) (stating that “BP sensors have been present in Android handsets since as early as 2011, and in Apple handsets dating to 2014”). See also Letter from Bruce Olcott, Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1-2 (filed Oct. 24, 2019) (NextNav Oct. 24, 2019 *Ex Parte*) (identifying Apple, Samsung, LG, and Google handset models that are equipped with barometric pressure sensors and noting that these manufacturers “account for more than 85 percent of the handsets sold in the United States during the 15 month period between April 1, 2018 and June 30, 2019”).

¹⁰⁶ NENA Oct. 11, 2019 *Ex Parte* at 2.

¹⁰⁷ Google Comments at 9.

by testing.¹⁵¹ While the sources cited by APCO suggest potential floor level location solutions may be on the horizon, the record here reflects that such solutions are untested and not yet sufficiently mature to support a comprehensive floor level requirement.¹⁵² Further, as NENA and BRETSA recognize, floor heights are not standard and an authoritative database for the mapping of floors in a given building does not yet exist,¹⁵³ while building characteristics themselves vary greatly and floor numbering is not always consistent.¹⁵⁴ Verizon notes that “floor level accuracy may depend at least in part on participation by not only service providers and vendors but third party building owners and tenants—which would have technical feasibility and jurisdictional implications beyond the scope of the rules contemplated in this proceeding based on test bed performance to date.”¹⁵⁵

35. Current vertical location technology does not support floor level identification, and some public safety commenters, including the International Association of Fire Fighters and the International Association of Fire Chiefs, state that, contrary to APCO’s view, z-axis data can provide actionable information to first responders.¹⁵⁶ As they put it: “Unlike x/y data, which must be translated from lengthy coordinates to an approximate street address, Height Above Ellipsoid (HAE) altitude data is transmitted in digestible numbers, extending no more than two decimal points. While technologies exist that allow an Emergency Communications Center to translate vertical data from HAE to Height Above Ground Level, emergency responders can act upon the data when it is delivered in either format by simply matching altitude information on their own equipment using an HAE-capable application, device or dedicated wearable display.”¹⁵⁷ And other public safety organizations like NENA agree.¹⁵⁸

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¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ See *Fourth Further Notice*, 34 FCC Rcd at 1660-61, para. 26.

¹¹² Letter from Ian D. Volner, Counsel to Polaris Wireless, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Sept. 19, 2019) (Polaris Sept. 19, 2019 *Ex Parte*).

¹¹³ Polaris Sept. 19, 2019 *Ex Parte* at 1.

¹¹⁴ *Id.* at 2.

¹¹⁵ *Id.*

¹¹⁶ *Id.*

¹¹⁷ *Id.*

¹¹⁸ Letter from Bruce Olcott, Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed June 14, 2019) (NextNav June 14, 2019 *Ex Parte*).

36. We agree and reject the notion that the only “actionable” data we can mandate today is a floor estimate. Many buildings, including the Commission’s headquarters, have non-standard floor numbering schemes, which may not begin on Floor 1 but, instead, “Lobby,” “Main,” or “Ground.” Some buildings skip Floor 13. There is significant risk of error to solutions that assume ground-level floor numbers or standard floor numbering patterns. The record does not show that this risk can be mitigated sufficiently in the near-term such that we could proceed immediately with a decision that requires a floor-level solution. Besides, to first responders, a true height measurement may be more valuable than floor level information. Floors can collapse, rendering a floor estimate less useful. Floor numbering can be difficult to track in an emergency. First responders may not know on what floor they are entering a building, or they may become disoriented during a lengthy search. They may not know whether “Floor X” is above or below them, but by attaching a true height device to their gear, they may be able to learn how close they are to a victim as they approach the origin of a 911 call. This functionality may prove very useful to first responders who try to locate downed or disoriented teammates in an emergency. And a true height measurement is useful (unlike a floor estimate) to a first responder searching outside for a person in need of help.

37. For all these reasons, we decline to require CMRS providers to report floor level where it is not technically feasible to do so and instead require that they deliver z-axis information in HAE. However, we agree with Texas 911 Entities that in cases where the carrier has reliable information about the caller’s floor level, they should provide it.¹⁵⁹

38. We require CMRS providers to deliver z-axis information in HAE, and we do not require CMRS providers to translate from HAE to other formats. The record suggests that translation mechanisms can be developed using HAE as a baseline reference,¹⁶⁰ and that for the time being we should

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¹¹⁹ NextNav Comments at ii (“To enable wireless carriers to report compliance with the first deadline in less than two years, the Commission likely should adopt certain safe harbors, such as requiring initial compliance only with newer handsets equipped with pressure sensors and possibly by requiring that older handsets that are equipped with pressure sensors be made compliant using over-the-air software updates.”).

¹²⁰ AT&T Comments at 3.

¹²¹ T-Mobile Comments at 4; CTIA Reply at 11.

¹²² APCO Comments at 4.

¹²³ See *Fourth Report and Order*, 30 FCC Rcd at 1260, para. 4.

¹²⁴ Google Comments at 3-4.

¹²⁵ Qualcomm Comments at 8; Google Comments at 4-5.

¹²⁶ NextNav Reply at 6 (citing Verizon Comments at 5).

¹²⁷ Verizon Comments at 5 (“Some standards work is already complete (the LPP/LPPE interface), and other work is under way to address how service providers will format and deliver Z-axis information to PSAPs.”).

¹²⁸ Apple Oct. 29, 2019 *Ex Parte* at 3.

¹²⁹ BRETSA Comments at 5.

¹³⁰ See CTIA Nov. 5, 2019 *Ex Parte* at 6-7.

afford industry and public safety flexibility to develop solutions that are cost-effective for both sides. Finally, we agree with public safety commenters that providing a floor level is a priority and therefore seek comment below on the feasibility of ensuring emergency personnel have access to floor level information in the longer term.

D. Confidence and Uncertainty Data

39. In the *Third FNPRM* in this proceeding, the Commission proposed to require provision of confidence and uncertainty data for the location information provided with all wireless 911 calls, whether outdoor or indoor, on a per-call basis at the request of a PSAP, with a uniform confidence level of 90%.¹⁶¹ The Commission anticipated that any requirements adopted regarding standardization of the delivery and format of confidence and uncertainty data would apply in conjunction with the delivery of both indoor and outdoor location information.¹⁶² In the *Fourth Report and Order*, the Commission adopted specific confidence and uncertainty requirements for horizontal (x- and y-axis) data for all wireless 911 calls.¹⁶³ The rules require that the data “specify (i) The caller’s location with a uniform confidence level of 90 percent, and; (ii) The radius in meters from the reported position at that same confidence level.”¹⁶⁴ Because the *Fourth Report and Order* deferred the adoption of a z-axis metric, it also deferred action on extending confidence and uncertainty requirements to z-axis data.

40. We amend our rules to extend the equivalent confidence and uncertainty requirements to z-axis data. As commenters point out, it is just as important for PSAPs to be able to assess the reliability of vertical location information as it is to assess the reliability of horizontal location information. APCO states that without uncertainty data “public safety professionals would lack information that is essential when deciding whether to break down a door or how to develop a search strategy.”¹⁶⁵ NENA asserts that it is critical that all location information, including z-axis, include detailed uncertainty information.¹⁶⁶ BRETSA supports the provision of confidence and uncertainty data along with z-axis information to help public safety assess data that may include sources of error.¹⁶⁷ NextNav and Polaris support extending

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¹³¹ *Fourth Further Notice*, 34 FCC Rcd at 1655-56, para. 14. We noted that AGL height at any horizontal (x,y) location can be obtained by subtracting the terrain height at that horizontal (x,y) location from the corresponding AMSL value. Terrain heights are typically provided in Digital Elevation Model (DEM) databases with varying horizontal (x,y) resolution or bin sizes (e.g., several meters) and corresponding digitized terrain heights resolution (e.g., 1 meter). *Fourth Further Notice*, 34 FCC Rcd at 1656, n.38. See, e.g., Dai Yamazaki *et al.*, *A high-accuracy map of global terrain elevations*, 44 Geophysical Res. Letters 5844-53 (2017), <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2017GL072874>. We observed that “[c]onverting z axis values from AMSL to AGL, however, could introduce additional uncertainty generated by the resolution of the DEM database.” *Fourth Further Notice*, 34 FCC Rcd at 1655-56, n.38.

¹³² *Fourth Further Notice*, 34 FCC Rcd at 1655-56, para. 14.

¹³³ *Id.*

¹³⁴ HAE represents distance (height) between any given point and a globally defined reference ellipsoid. For our purposes, HAE represents altitude between the wireless devices that makes the 911 call and a globally defined (WGS-84) reference ellipsoid.

¹³⁵ NENA Comments at 2-3.

¹³⁶ *Id.* at 3.

¹³⁷ *Id.*; ATIS Comments at 4; CTIA Reply at 8-9; T-Mobile Reply at 6; NextNav Comments at iii (stating that “the Commission should refrain from adopting a specific measurement standard...If a standard is adopted, however, it should be Height Above Ellipsoid (HAE)”); Polaris Reply at 3 (noting that “[c]urrent standards generally call for HAE”).

¹³⁸ ATIS Comments at 3-4.

¹³⁹ See, e.g., ATIS Comments at 3-4 (noting “that, in providing altitude data, the responsibility of service providers should generally be limited to ensuring that the relevant location data gets to where it needs to go. How public safety

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confidence and uncertainty requirements to z-axis data and indicate that their technologies can generate vertical confidence and uncertainty data for each call that can be provided to the PSAP.¹⁶⁸

41. In light of the public safety benefits of confidence and uncertainty data, we require CMRS providers to provide vertical confidence and uncertainty data on a per call basis to requesting PSAPs. As with horizontal confidence and uncertainty data, providers must report vertical confidence and uncertainty data using a confidence level of 90%, i.e., they must identify the range above and below the estimated z-axis position within which there is a 90% probability of finding the caller's true vertical location. For the same reasons, where available to the CMRS provider, floor level information must be provided with associated C/U data in addition to z-axis location information.

E. Compliance Certification and Call Data Reporting

42. Under our existing rules, CMRS providers, within 60 days after each horizontal and vertical location benchmark, "must certify that they are in compliance with the location accuracy requirements applicable to them as of that date."¹⁶⁹ The rules require CMRS providers to "certify that the indoor location technology (or technologies) used in their networks are deployed consistently with the manner in which they have been tested in the test bed."¹⁷⁰ In the *Fourth Further Notice*, we proposed to use this same certification mechanism to validate provider compliance with the 3-meter metric.¹⁷¹

43. We adopt our proposal. In order to be deemed in compliance under our existing rules, nationwide CMRS providers electing to use z-axis technology for vertical location shall certify for purposes of the April 2021 and April 2023 compliance deadlines that z-axis technology is deployed consistent with the manner in which it was tested in the test bed.¹⁷² Commenters generally support this proposed compliance mechanism.¹⁷³ As CTIA outlines, "the Test Bed would validate that a given technology solution can meet the proposed z-axis metric of ± 3 meters for 80 percent of indoor wireless calls in the Test Bed, and a wireless provider would then certify that the z-axis technology in its network is deployed consistently with how it was tested in the Test Bed."¹⁷⁴ Verizon states that requiring

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answering points (PSAPs) use/convert this data is outside the jurisdiction and control of service providers." AT&T Comments at 3 (stating that "[w]hile carriers will provide z-axis location data that meets the metric, first responders should be responsible for translating that data into actionable information."). T-Mobile Comments at 11-12 ("The PSAP, as the end-user of the information, should be in the position to directly use the altitude estimate as received, as they do today for x/y location, or to convert it to another reference system at their discretion." *Id.* at 12).

¹⁴⁰ APCO Comments at 7.

¹⁴¹ *Id.*

¹⁴² APCO Comments at 2, 7 (arguing that if the Commission approves a z-axis metric, then it must include a floor number); APCO Oct. 25, 2019 *Ex Parte* at 6 (stating that z-axis information should "include an estimated floor number (which, consistent with the ± 3 meter requirement, should be accurate within 1 floor for 80% of calls)"); see also Letter from Tyrell T. Morris, Executive Director, Orleans Parish Communication District, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 1 (filed Oct. 16, 2019) (Orleans Parish *Ex Parte*); Letter from Jason E. Kern, Executive Director, Southeast Emergency Communications (SEECOM), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 1 (filed Oct. 16, 2019) (SEECOM *Ex Parte*).

¹⁴³ See e.g., Orleans Parish *Ex Parte* at 1.

¹⁴⁴ Verizon Comments at 2-3 ("Strict floor level accuracy might be a valid longer term goal, but the NPRM correctly finds that the Test Bed results did not support either it or a more stringent two-meter standard."). NextNav July 30, 2019 *ex parte* at 1 ("[I]t is not currently possible to convert a highly accurate 'floor level' vertical altitude measurement into the corresponding 'floor number' of a building. First, there is no uniformity in the height of each floor level in different buildings and many buildings have unique floor numbering systems (such as skipping the 13th floor) that cannot be taken into consideration absent extensive mapping of every building in a covered area. Second, regardless of the precision of the vertical location information, the current requirement of a horizontal location fix within 50 meters does not provide sufficient accuracy to reliably place a wireless caller in a particular

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compliance through the test bed process ensures “that solutions perform as vendors contend, and that they are technically feasible,” and it is also consistent with the Commission’s approach to horizontal accuracy.¹⁷⁵

44. APCO notes that in Stage Z, only barometric sensor-based technologies were tested in the test bed, and questions whether the test bed is configured to test all vertical location technologies on a technology-neutral basis.¹⁷⁶ We believe the test bed is configured to support technology neutral testing. The Commission has previously stated that the core purpose of the test bed is to provide a means to evaluate “the accuracy of different indoor location technologies across various indoor environments.”¹⁷⁷ Thus, the test bed is not limited to testing barometric sensor solutions, but is designed to test all vertical location solutions in a uniform set of indoor test environments. We also note that Google’s testing in Stage Za includes testing of technologies that are not barometric sensor-based.

45. BRETSA recommends that instead of using the test bed, the Commission should establish a “proof-of-performance” method of compliance with live call testing in each market.¹⁷⁸ CTIA urges the Commission to reject this approach.¹⁷⁹ We decline to require live call proof-of-performance testing. In establishing the test bed approach, the Commission found it to be “the most practical and cost-effective method for testing compliance with indoor location accuracy requirements.”¹⁸⁰ Indeed, the purpose of the test bed program is to provide a reliable mechanism for validating the performance of indoor location technologies without the need for the provider to conduct indoor testing in all locations where the technology is actually deployed, which would be impractical and highly burdensome.¹⁸¹ Accordingly, we decline to adopt or require proof of performance testing.

46. CTIA recommends that we add the language “as measured in the test bed” at the end of proposed Sections 9.10(i)(2)(ii)(C)&(D), “thus making explicit in the rules what is in the *Fourth Further Notice*.”¹⁸² We find that the existing rules already clearly identify the test bed as the basis for certifying compliance of all indoor location technologies, horizontal and vertical, making CTIA’s proposed

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building. Thus, the conversion of vertical altitude into a floor number could inadvertently place a wireless caller in the wrong building, inhibiting rather than helping emergency response efforts.”); ATIS Comments at 3 (ATIS ESIF notes that floor level information is not derived directly from location determination processes. Rather floor level may be derived via: (1) manual processes in which data is associated with end devices via proximity techniques; or (2) software processes, such as reverse geocoding using geographic information system -based map data, using the z-axis component as input. However, there currently exists no data source that correlates any form of z-axis data to a floor index or floor label. Because this floor level data is more challenging to obtain and potentially limited by current practical manual or software processes, it should not be required. Instead, ATIS ESIF recommends that, when available, floor level information should be provided in addition to z-axis information.”).

¹⁴⁵ ATIS Comments at 3.

¹⁴⁶ CTIA Comments at 9.

¹⁴⁷ Apple Oct. 29, 2019 *Ex Parte* 3.

¹⁴⁸ *Id.*

¹⁴⁹ APCO Comments at 6 n.22; APCO Oct. 25, 2019 *Ex Parte* at 6 n.15.

¹⁵⁰ T-Mobile Reply at 5-6; CTIA Reply at 10; NextNav Reply at 14 (stating that “...of the four technical sources APCO cites as evidence, none come even close to establishing the technical feasibility, particularly in light of the upcoming 2021 and 2023 deadlines.”).

¹⁵¹ CTIA Reply Comments at 10.

¹⁵² In contrast to the comprehensive testing of z-axis solutions in multiple cities and morphologies that has occurred in the test bed, there has been no such comprehensive testing of the feasibility of floor-level identification. APCO cites a 2018 academic paper as describing a “system capable of predicting the correct floor level with 100% accuracy that does not require the use of beacons, prior knowledge of the building infrastructure, or knowledge of

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amendment unnecessary.¹⁸³

47. In addition, to more fully inform the Commission's understanding of location accuracy progress, we expand the live call data reporting obligations in our existing rules to include z-axis data and, where available, floor level information.¹⁸⁴ The Commission's live call data reporting rules require nationwide CMRS providers to file quarterly reports of their aggregate live 911 call use of each location technology in four geographic morphologies within six representative cities (Test Cities).¹⁸⁵ Non-nationwide CMRS providers must report aggregate live 911 call data collected in one or more of the Test Cities or the largest county in their footprint, depending on the area served by the provider.¹⁸⁶

48. To date, CMRS providers have only reported on horizontal location technologies used for live 911 calls. However, we conclude that it is equally appropriate to require CMRS providers to report on live call use of vertical location technologies. The Commission's live call data reporting requirements established in the *Fourth Report and Order* require CMRS providers to "identify and collect information regarding the location technology or technologies used for each 911 call in the reporting area during the calling period," without distinguishing between reporting of horizontal and vertical location information.¹⁸⁷ Moreover, in the indoor location technologies context, a key purpose of the reporting requirement is to "augment our understanding of the progress of such technologies."¹⁸⁸ Although our vertical location requirements do not include live call compliance metrics, reporting on the use of z-axis and floor level technologies in live calls will provide important real-world data on how frequently z-axis and floor level location is provided, the types of technologies being used, and trends in such usage over time. We emphasize, however, that live call data reported by CMRS providers relating to the use of live call and floor level technologies will be used solely for informational purposes, not compliance purposes.

F. Z-Axis Privacy and Security

49. In the *Fourth Further Notice*, we sought comment on the appropriate data privacy and security framework for z-axis data.¹⁸⁹ We noted that in establishing rules in 2015 governing CMRS

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 user behavior." APCO Comments at 6 (citing William Falcon & Henning Schulzrinne, *Predicting Floor Level for 911 Calls with Neural Networks and Smartphone Sensor Data* (2018), <https://arxiv.org/pdf/1710.11122.pdf>). However, this study was based on two days of limited testing in six buildings and found that the system could only estimate floor level with 65% accuracy "when the floor-ceiling distance in the building is unknown." Falcon & Schulzrinne at 2. We encourage further studies along these lines but do not regard the limited studies and press reports cited by APCO as sufficient to support a floor level requirement at this time.

¹⁸³ BRETSA Reply at 6; NENA Comments at 6.

¹⁸⁴ AT&T Reply at 4; Google Comments at 10-11.

¹⁸⁵ Verizon Comments at 2-3.

¹⁸⁶ IAFF Comments at 1; IAFC Comments at 2-3.

¹⁸⁷ Letter from Brandon Allen, Manager, Government Relations, International Association of Fire Chiefs (IAFC) and International Association of Fire Fighters (IAFF), to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed Nov. 13, 2019) (IAFC and IAFF Nov. 13, 2019 *Ex Parte*).

¹⁸⁸ Letter from Daniel Henry *et al.*, Dir. Gov't Affairs, NENA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-117 at 3 (filed Nov. 15, 2019).

¹⁸⁹ Texas 911 Entities Comments at 5. *See also* ATIS Comments at 3 (recommending "that, when available, floor level information should be provided in addition to z-axis information."). To the extent that Google requests that we make clear that a carrier *may* provide an available "floor label"—that is "the name of the floor that the caller is believed to be on in the particular building from which the call is originating," Letter from Megan Stull, Counsel, Google LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 2 (filed Nov. 15, 2019) (Google Nov. 15, 2019 *Ex Parte*)—in addition to the HAE information, we agree. Letter from Megan Stull, Counsel, Google LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 1-2 (filed Nov. 18, 2019) (Google Nov. 18,

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provider usage of the NEAD, the Commission had stated that “certain explicit requirements on individual CMRS providers are necessary to ensure the privacy and security of NEAD data and any other information involved in the determination and delivery of dispatchable location.”¹⁹⁰ We asked whether use of z-axis data should be limited to 911 calls except as otherwise required by law, and if such a limitation should be implemented and codified in a manner similar to the explicit limitations applicable to the NEAD.¹⁹¹

50. We amend our rules to make explicit that CMRS providers and the vendors upon which they rely for z-axis information may only use 911 call z-axis information for 911 purposes, except with prior express consent or as required by law.¹⁹² This approach is consistent with our long-standing approach to protection of 911 location data. Section 222 of the Communications Act requires CMRS providers, among others, to protect the confidentiality of Customer Proprietary Network Information (CPNI) without the customer’s express prior authorization, but provides an exception for the provision of a customer’s call location information to a PSAP or other emergency response authority in connection with a 911 call.¹⁹³ CTIA also states that it “shares the Commission’s view that location information derived from wireless 9-1-1 calls, including Z axis location data, should only be used for 9-1-1 purposes, except as otherwise provided by law.”¹⁹⁴ And we agree with Apple that other parties—such as device manufacturers and third-party location technology vendors—on whom carriers rely for z-axis information should be similarly subject to the same privacy protections and restrictions on non-911 use as data stored or used by CMRS providers. For the same reasons as we relied on in the dispatchable location context, we believe that CMRS providers are already responsible for third-party use of personal location information in support of the carrier’s delivery of E911 location data to the PSAP.¹⁹⁵ To ensure compliance, we agree that a certification requirement is appropriate. CMRS providers must therefore certify that neither they nor any third party they rely on to obtain z-axis information for 911 purposes will use such information for any non-911 purpose, except with prior express consent or as required by law.¹⁹⁶ We also make clear that such a certification should not be construed to “significantly impede location

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2019 *Ex Parte*); Google Nov. 8, 2019 *Ex Parte* Attach. at 11 (stating that “[f]loor level estimates may become feasible for some technologies; the Rule should encourage—not block—this innovation”). To the extent Google is asking to otherwise modify our rules, such as by allowing a floor label *instead of* the HAE information, we disagree because doing so would undermine the uniform z-axis standard that our present rules achieve. *See also* NENA Nov. 15, 2019 *Ex Parte* at 3

¹⁶⁰ *See, e.g.*, ATIS Comments at 4 (recommending “that, to ensure that PSAPs can convert location information to the format that best suits their needs, a baseline requirement would be to deliver this information as height above ellipsoid per World Geodetic System 1984 (WGS-84) datum.”); CTIA Reply at 8-9 (agreeing “with those commenters that support delivery of z-axis data as height above ellipsoid in meters, as defined in the WGS-84 standard. WGS-84 is a trusted standard and would enable PSAPs to best prepare for and efficiently utilize z-axis information with 9-1-1 calls.”); T-Mobile Reply at 6 (“The record is clear that if carriers are required to provide altitude information to local emergency authorities, they should utilize the WGS-84 standard which provides altitude information as height above the ellipsoid to ensure the best and most consistent information—and allow those authorities to use that information as best meets their needs and capabilities.”).

¹⁶¹ *Third Further Notice*, 29 FCC Rcd at 2431-33, paras. 150-156 & Appendix C.

¹⁶² *Id.* at 2433, para. 158.

¹⁶³ 47 CFR § 9.10(j)(1).

¹⁶⁴ 47 CFR § 9.10(j)(1). The rules provide that “[a]ll entities responsible for transporting confidence and uncertainty between CMRS providers and PSAPs, including LECs, CLECs, owners of E911 networks, and emergency service providers, must enable the transmission of confidence and uncertainty data provided by CMRS providers to the requesting PSAP. *Id.*

¹⁶⁵ APCO Comments at 4 (observing that “the Commission requires carriers to provide C/U data for horizontal location information on a per call basis, with a uniform confidence level of 90% and the uncertainty radius expressed in meters from the reported position[and, unless] the Commission similarly defines C/U requirements for

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technology vendors by preventing them from having access to z-axis information for such valid purposes as system calibration and accuracy verification.”¹⁹⁷ Such a reading of these requirements that would impede the swift development and widespread deployment of z-axis technologies for use in emergency calls would be contrary to the very purpose of this proceeding.

51. We also conclude that any 911-related z-axis or floor level information that is stored before or after the 911 call should be subject to the same privacy and security protections that apply to NEAD data. We agree with Public Knowledge that all 911 location data should be treated consistently from a privacy and security perspective, and that stored coordinate-based data, including z-axis data, should not be subject to lesser consumer privacy and data protection than NEAD data.¹⁹⁸ As Precision Broadband puts it, we should “not decouple the choice of deploying z-axis technology from dispatchable location,” as z-axis data is part of a holistic, multifaceted approach “to solving the vertical location problem.”¹⁹⁹ Consistent with the 2015 *Fourth Report and Order*, however, the practical application of this principle in the geolocation context may be dissimilar in some ways from its application in the dispatchable location context. For example, coordinate-based geolocation does not necessarily rely on previously stored customer location information in a database, and geolocation information generated at the time of a 911 call may be discarded rather than stored for later use. Therefore, we conclude that any 911 geolocation data that is *stored* by a CMRS provider should be subject to the same level of privacy and security protection as NEAD data. Thus, if a CMRS provider intends to store such data for 911 location purposes (like any other stored data not covered by a NEAD privacy and security plan), it “should file an addendum to ensure that the protections outlined in the NEAD plan will cover the provider’s [coordinate-based] location transactions end-to-end.”²⁰⁰ For 911 geolocation data that is not stored, our CPNI requirements continue to apply and prohibit unauthorized use of such data for any purpose other than emergency location.

52. We also clarify that we are in no way altering or addressing existing privacy or security rules or policies that apply to location data outside the 911 context. We agree with CTIA that such issues

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the z-axis metric, ECCs would receive inconsistent C/U data or none at all.”); APCO Oct. 25, 2019 *Ex Parte* at 6.

¹⁶⁶ NENA Comments at 4 (stating that “[r]ecent advances in the availability of geodetic location data have demonstrated the clear benefits of providing telecommunicators with a visual representation of that data.”).

¹⁶⁷ BRETSA Comments at 9 (stating that providing vertical location information presented as a height AGL and AMSL, with accuracy and confidence data would “best provide dispatchers and First Responders an accurate picture of the area within which a caller may be located, and allow them to apply local knowledge, experience and CAD premises and incident data to estimate the caller’s location. Provision of a street and unit address derived from proximity to radio frequency emitters, without accuracy and confidence information, would be nothing more than Commission-sanctioned ‘Swatting,’ exposing First Responders and the public to unnecessary risk.”).

¹⁶⁸ NextNav Reply at 20-21; Polaris Reply at 3.

¹⁶⁹ 47 CFR § 9.10(i)(2)(iii).

¹⁷⁰ 47 CFR § 9.10(i)(2)(iii)(A).

¹⁷¹ *Fourth Further Notice*, 34 FCC Rcd at 1654, para. 11. See Letter from Matthew Gerst, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 2 (filed Mar. 5, 2019), <https://ecfsapi.fcc.gov/file/103061754909737/190305%20CTIA%20911%20Location%20Accuracy%20Ex%20Part%20e.pdf> (CTIA Mar. 5, 2019 *Ex Parte* Letter).

¹⁷² 47 CFR § 9.10(iii). Non-nationwide providers will have an additional year to make each certification. 47 CFR § 9.10(iii)(c).

¹⁷³ CTIA Comments at 8; NextNav Comments at 11-12; Verizon Comments at 3. AT&T Comments at 3; Polaris July 1, 2019 *Ex Parte* at 2; T-Mobile Reply at 1 (“Commenters across the ecosystem support adoption compliance obligations measured with reference to z-axis capable devices...as tested by the carriers in the representative environment of the 9-1-1 Location Technologies Test Bed (“Test Bed”)).

are outside the scope of this proceeding.²⁰¹

G. Comparison of Benefits and Costs

53. In the *Fourth Further Notice*, we sought comment on “which z-axis metric would allow [the Commission] to achieve the anticipated level of benefits in the most cost-effective manner.”²⁰² We tentatively concluded that “a z-axis metric of 3 meters for 80% of calls strikes the best balance between benefits and costs”²⁰³ because “some public safety commenters identify a 3-meter metric as providing sufficient accuracy to identify the caller’s floor level in most cases.”²⁰⁴ We also tentatively concluded that “the value of a 3-meter metric exceeds that of a 5-meter metric because the latter would result in a significant reduction” in benefits.²⁰⁵ A 5-meter metric could indicate a location up to 2 floors below, or up to 2 floors above, the actual floor where a 911 caller may be located.²⁰⁶ This large search range would make it far more likely that first responders would need to search 2 or more additional floors, significantly increasing average emergency response times and consequently degrading patient outcomes. “Due to the likely degradation of patient outcomes with a 5-meter metric,” we tentatively concluded that a 3-meter metric provided greater value and sought comment on the conclusion.²⁰⁷ We also tentatively concluded that the “value of a 3-meter metric exceeded that of a 2-meter metric.”²⁰⁸ We also sought comment on how the benefits and costs of “requiring CMRS providers to identify floor level when reporting z-axis information would compare to the benefits and costs of providing z-axis information as AGL or MSL height.”²⁰⁹ We sought “comment on this analysis and tentative conclusions as to the comparative value of the z-axis metrics.”²¹⁰

54. We conclude that a 3-meter z-axis metric is technically achievable and can be implemented successfully by CMRS providers by the April 2021 and 2023 deadlines in the top 25 and 50 CMAs, respectively. As the record reflects, a 3-meter metric will provide a substantial benefit to public safety because it will “identify the correct floor of wireless callers to E911 in most instances.”²¹¹

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¹⁷⁴ CTIA Comments at 8.

¹⁷⁵ Verizon Comments at 3; 47 CFR § 9.10(i)(2)(iii)(A).

¹⁷⁶ APCO Comments at 4-5.

¹⁷⁷ *Third Further Notice*, 29 FCC Rcd at 2407 para. 84.

¹⁷⁸ BRETSA Comments at 5. Cf. T-Mobile Reply at 3-4 (describing BRETSA’s approach as “clearly infeasible” because “the impracticability of conducting indoor test calls in each market is what led the Commission...to direct the wireless carriers to establish a representative Test Bed to validate technologies for indoor location.”).

¹⁷⁹ CTIA Reply at 11.

¹⁸⁰ *Fourth Report and Order*, 30 FCC Rcd at 1305, para 121.

¹⁸¹ *Third Further Notice*, 29 FCC Rcd at 2407 para. 85.

¹⁸² CTIA Comments at 8.

¹⁸³ 47 CFR § 9.10(i)(3)(i) (“CMRS providers must validate technologies intended for indoor location, including dispatchable location technologies and technologies that deliver horizontal and/or vertical coordinates, through an independently administered and transparent test bed process, in order for such technologies to be presumed to comply with the location accuracy requirements of this paragraph”).

¹⁸⁴ 47 CFR § 9.10(i)(3)(ii).

¹⁸⁵ 47 CFR § 9.10(i)(3)(ii)(B).

¹⁸⁶ 47 CFR § 9.10(i)(3)(ii)(D)-(E)

Additionally establishing a 3-meter metric will afford certainty that will drive innovation to create more z-axis location technological options for CMRS providers and lower technology costs. We now address the benefits and costs of the 3-meter metric.

55. *Implementation benefits.* In assessing the benefits of adopting a 3-meter metric, our analysis begins with the analysis presented in the *Fourth Report and Order* in this proceeding. There, the Commission sought to reduce emergency response time to improve patient outcomes and, ultimately save lives. In the Salt Lake City analysis referenced in the *Third FNPRM*, the Commission found that a one minute increase in response times increases mortality, and that a one minute decrease in response times decreases mortality.²¹² The Commission further found that reducing response times would result in an annual saving of 746 lives as reflected in the Salt Lake City analysis, which could amount to 10,120 lives annually when extrapolated across the United States.²¹³

56. No commenter disputes the benefits of reduced emergency response times on patient outcomes, but NextNav suggests that the “Commission’s analysis made very conservative assumptions and still arrived at an overwhelming economic benefit to the nation.”²¹⁴ Additionally, the International Association of Fire Fighters and NextNav emphasize that compelling evidence exists in the record in this proceeding that the provision of vertical location information to first responders with an accuracy of 3 meters would reduce response times as compared to not specifying a vertical metric or a less granular metric.²¹⁵ NextNav observes that San Francisco emergency first responder field tests in 2014 “revealed dramatic reductions of between 4 and 17 minutes in search times with the addition of vertical information with an accuracy of +/-3 meters.”²¹⁶ We agree with NextNav’s assertion that due to these “substantial” emergency response time improvements, the Commission’s factoring of a *one minute* response time in its benefits analysis underestimates “by a substantial amount the quantifiable benefits of providing emergency first responders with z-axis information with an accuracy of 3 meters.”²¹⁷

57. The record reflects “increasing use of wireless phones by the public, thus further increasing the benefits that can be expected from the adoption of a 3 meter vertical metric.”²¹⁸ As we

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¹⁸⁷ *Id.* § 9.10(i)(3)(ii)(A). See also *Fourth Report and Order*, 30 FCC Rcd at 1310, para. 139 (“the live call data will include identification of the positioning source method or methods used for each call”).

¹⁸⁸ *Fourth Report and Order*, 30 FCC Rcd at 1311, para. 138.

¹⁸⁹ See *Fourth Further Notice*, 34 FCC Rcd at 1662, para. 29.

¹⁹⁰ *Id.* (quoting *Fourth Report and Order*, 30 FCC Rcd at 1285, para. 71).

¹⁹¹ See *Fourth Further Notice*, 34 FCC Rcd at 1662, para. 29; see also 47 CFR § 9.10(i)(4)(iv) (NEAD Use certification); *Wireless E911 Location Accuracy Requirements*, Memorandum Opinion and Order, 32 FCC Rcd 9699 (2017) (approving privacy and security plan for NEAD); Letter from Harold Feld, Senior VP, Public Knowledge, to Marlene H. Dortch, Secretary, PS Docket No. 07-114, FCC, at 2 (filed Mar. 12, 2019), <https://ecfsapi.fcc.gov/file/103120844009252/Randy%20Clark%20Geolocation%203.12.19.pdf>.

¹⁹² We adopt a z-axis certification requirement in section 9.10(i)(4)(v). We note that CMRS providers may not condition use of 911 location data on the consumer consenting to their z-axis information or associated data being used for a non-911 purpose.

¹⁹³ 47 U.S.C. § 222(d)(4)(A).

¹⁹⁴ CTIA Comments at 10.

¹⁹⁵ See *Fourth Further Notice*, 34 FCC Rcd at 1662, para. 29 (seeking comment broadly “on the appropriate data privacy and security framework for z-axis data”, including whether to extend to z-axis data, requirements similar to the NEAD certification and stating “certain explicit requirements on individual CMRS providers are necessary to ensure the privacy and security of NEAD data and any other information involved in the determination and delivery of dispatchable location.”); *Fourth R&O*, 30 FCC Rcd at 1285-86, para. 71 (implementing NEAD certification of not using NEAD data or associated data for non-911 purposes, “to ensure the privacy and security of NEAD data and any other information involved in the determination and delivery of dispatchable location.”).

stated in the *Third Further Notice*, the addition of vertical location information—like the further refinement of horizontal location information—plays a major role in achieving the \$92 billion benefit floor for improving wireless location accuracy.²¹⁹ As we affirmed in the *Fourth Further Notice*, this addition of new vertical information—together with the refinement of existing horizontal information—has the potential of saving “approximately 10,120 lives annually at a value of \$9.1 million per statistical life, for an annual benefit of approximately \$92 billion or \$291 per wireless subscriber.”²²⁰ Due to U.S. Department of Transportation updates for value of a statistical life, we presently estimate this annual benefit floor at \$97 billion.

58. *Implementation costs.* The record indicates that software and hardware implementation costs are low, if not negligible. NextNav asserts that its z-axis solution, which requires only software changes to be made to each handset, could be made available for a nominal cost that amounts to significantly less than a penny per month per handset and would impose no incremental cost burdens on new handsets.²²¹ Polaris states that its z-axis solution is “objectively affordable” because it is software-based, does not require hardware in networks or markets, and “does not require anything special in devices beyond implementation of adopted 3GPP and OMA standards.”²²² Polaris’ solution also is “instantly available and deployable throughout a carrier’s nationwide network.”²²³ As the Commission noted in the *Fourth Report and Order*, we continue to expect that these costs “will decline as demand grows.”²²⁴ Existing smartphone devices with installed barometric pressure sensors, can be further calibrated over-the-air with calibration signals from weather stations.²²⁵ Such calibration software is available “with no additional premium costs.”²²⁶ NextNav estimates that given these factors, 3-meter compliant z-axis services can be provided “at a nominal cost (in aggregate, less than a penny per month per handset).”²²⁷ Moreover, with the emergence of handset-based solutions we expect costs to provide vertical location to further decrease. In addition to the barometric pressure sensor-based solutions developed by NextNav and Polaris, “handset-based solutions like ELS have been widely deployed around the world.”²²⁸

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¹⁹⁶ We are not adopting the prohibition on data-sharing proposed by Apple because we regard it as needlessly prescriptive, since the broader privacy protections apply to any data that is shared. *See* Apple Nov. 12 *Ex Parte* at 3 (recommending that the Commission require CMRS providers to certify that “they will not require or permit disclosure of a user’s precise location to any z-axis technology vendor for purposes of complying with § 9.10(i)(2)(ii).”); 47 U.S.C. § 217.

¹⁹⁷ NextNav Nov. 13, 2019 *Ex Parte* at 2; Polaris Nov. 15, 2019 *Ex Parte* (“Polaris Wireless supports subscriber privacy initiatives and is in general agreement with NextNav’s response to Apple’s filing.”).

¹⁹⁸ *See* Public Knowledge Comments at 1.

¹⁹⁹ Precision Broadband Reply at 2.

²⁰⁰ *Fourth Report and Order*, 30 FCC Rcd at 1285, para. 71.

²⁰¹ *See* CTIA Reply Comments at 13.

²⁰² *Fourth Further Notice*, 34 FCC Rcd at 1662-63, para. 30. Specifically, we sought “comment on how the benefits and costs of the proposed z-axis metric of 3 meters for 80% of calls compares to the benefits and costs of alternative metrics[,] . . . on the expected number of lives saved by adopting a 3-meter metric, versus a 2-meter or 5-meter metric,” and, “comment on the expected number of lives that would be saved if it required CMRS providers to identify floor level when reporting z-axis information.” *Id.*

²⁰³ *Fourth Further Notice*, 34 FCC Rcd at 1663, para. 31.

²⁰⁴ *Id.*

²⁰⁵ *Id.* at 1663, para. 32.

²⁰⁶ *Id.*

59. Beyond software solutions, hardware solutions are additionally nominal, as “nearly all smartphones on the market appear to be equipped with barometric pressure sensors.”²²⁹ One commenter notes that adding barometric sensors to phones does and will entail additional costs, but the cost of those sensors continues to drop.²³⁰ We clarify that we amend our rules today to apply our 3 meter metric to z-axis *capable* devices—in other words, we are not mandating retrofitting of older devices with barometric sensors, thus obviating such costs or, as technological developments unfold, retrofitting older devices in any manner to make such devices z-axis capable.

60. *Cost/benefit comparison.* We reaffirm our earlier decision that implementation of a 3-meter metric for vertical location accuracy will account for a large share of the total annual benefit floor, which we presently estimate to be a total of \$97 billion. Because that estimate includes only the value of statistical lives saved, we expect that there will be many additional benefits—which we are unable to quantify—from the reductions in human suffering and the reduced property losses due to crime and uncontrolled fires. We derive our cost from an estimated annual handset cost of “a penny per month per handset” or \$0.12 per year.²³¹ Assuming there are some 300 million handsets presently in use,²³² we apply the per-year handset cost to estimate a cost ceiling of approximately \$36 million per year. Accordingly, we find that the estimated benefits of this instant rules far outweigh the estimated costs.

IV. FIFTH FURTHER NOTICE OF PROPOSED RULEMAKING

61. Given the likelihood that vertical location technology will continue to improve, we seek comment on whether to establish a long-term timeline for migrating to a more stringent z-axis metric than 3 meters, and ultimately whether to require CMRS providers carriers to deliver floor level information in

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²⁰⁷ *Id.*

²⁰⁸ *Fourth Further Notice*, 34 FCC Rcd at 1664, para. 33. We acknowledged that “a 2-meter metric would further improve the accuracy of 911 calls by increasing the likelihood that the caller’s floor level could be identified with certainty, which would further improve emergency response times and patient outcomes. In other words, while the margins of both the 2-meter and 3-meter search ranges could extend one level above and below a caller’s floor level, a greater portion of the 2-meter search range is likely to be concentrated at the correct floor level. However, because the Commission tentatively concluded that existing solutions are unlikely to achieve 2-meter accuracy for 80% of E911 calls prior to the deadlines established by the Commission’s rules, it expected that adopting a 2-meter metric would likely cause developers of z-axis solutions to incur substantial development, testing, and implementation costs, without any guarantee of achieving the 2-meter metric before the deadline. Rather than force these expenditures in pursuit of additional benefits that may not materialize on schedule, we tentatively concluded that there is greater value in adopting the certain benefits of the achievable 3-meter metric.” *Id.* We observed “that any delay in deployment of z-axis solutions necessitated by a 2-meter metric would also delay realization of the benefits of improved location accuracy—i.e., improved emergency response times, better patient outcomes, and lives saved.” *Id.*

²⁰⁹ *Id.*

²¹⁰ *Id.* at 1664, para. 34.

²¹¹ NextNav Comments at ii.

²¹² *Third Further Notice*, 29 FCC Rcd at 2388-89, para. 33 & n.70.

²¹³ *Fourth Report and Order*, 30 FCC Rcd at 1317, para. 160.

²¹⁴ NextNav Comments at 15.

²¹⁵ See NextNav Comments at 15; *accord* IAFF Comments at 2-3.

²¹⁶ NextNav Comments at 15; *accord* IAFF Comments at 2-3.

²¹⁷ NextNav Comments at 15.

²¹⁸ *Id.* at 16.

conjunction with wireless indoor 911 calls. We also propose to amend the rules to expand on the current options for demonstrating deployment of z-axis or dispatchable location capability.

A. Continuing to Improve the Z-Axis Metric

62. We seek comment on what additional steps we can take to facilitate our long-term location accuracy objectives. Public safety commenters that support the 3-meter standard in the short term also support taking additional steps to achieve floor level accuracy over the longer term. For example, the International Association of Fire Chiefs recommends narrowing the 3-meter metric over a five-year timeline.²³³ Commenters note that vertical location technology solutions will continue to improve, thus making application of a narrower metric more feasible over time.²³⁴

63. We seek comment on the feasibility of phasing in more granular z-axis requirements over time, consistent with the approach that has worked well to date for horizontal location accuracy and allowed valuable vertical location technologies to evolve.²³⁵ We seek comment on whether it would be technologically feasible to achieve a 2 meter metric and if so, over what time frame. For example, should we adopt a phased five-year timeline for migrating from the 3-meter metric towards a 2-meter metric? As part of that phased-in approach should we require nationwide CMRS providers to meet a 2-meter metric within four years and non-nationwide CMRS providers to comply in the fifth year? Is a 1-meter metric feasible over the longer term?

64. Are there other alternatives we should consider for a narrower vertical location accuracy metric? Should we maintain the same requirements as in the current rules for applying future metrics to handsets (80% of wireless E911 calls from z-axis capable handsets) and for providing C/U data (based on a 90% confidence threshold)? Commenters advocating other alternatives and/or a mix of the options described here should explain the technical feasibility, benefits, and costs of their preferred approach(es).

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²¹⁹ Because a 911 call may originate anywhere in the nation, it might seem that horizontal information would account for most of the \$92 billion benefit floor. Most of that horizontal information, however, was already being provided in 911 calls prior to the *Third Further Notice*. The *Third Further Notice* therefore did not propose to add horizontal information but, rather, to refine it by improving its accuracy from 150 meters to 50 meters. In contrast, vertical information had never been provided before, so the *Third Further Notice* proposed that it be provided “within 3 meters accuracy.” *Third Further Notice*, 29 FCC Rcd at 2391, para 38. Hence, the *Third Further Notice* attributed the \$92 billion benefit floor to both the addition of new vertical information and the refinement of existing horizontal information.

²²⁰ *Fourth Further Notice*, 34 FCC Rcd at 1662-63, para. 30. *See also id.* at 1663, n.77.

²²¹ Letter from Bruce A. Olcott, Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 2 (filed Nov. 7, 2018) (NextNav Nov. 7, 2018 *Ex Parte*).

²²² Letter from James Arden Barnett, Jr., Counsel to Polaris Wireless, Inc., to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 3, (filed Nov. 30, 2018) (Polaris Nov. 30, 2018 *Ex Parte*).

²²³ *Id.*

²²⁴ *Fourth Report and Order*, 30 FCC Rcd at 1322, para. 170.

²²⁵ *See* NextNav Comments at 17.

²²⁶ *Id.*

²²⁷ *Id.*

²²⁸ Google Comment at 9.

²²⁹ NextNav Comments at 16.

²³⁰ *Id.*

²³¹ NextNav Comments at 17.

65. To continue to improve the z-axis metric, we seek comment on whether enhancements are needed to the vertical location accuracy testing process. For example, APCO states that “[t]he Commission should require carriers to take additional steps to verify that real-world performance is consistent with test bed evaluation of z-axis technology,”²³⁶ and asserts that the Commission should require more comprehensive testing of devices and testing unique public safety use cases.²³⁷ Should we require testing to include specific first responder scenarios? How does z-axis technology work during power outages?²³⁸ We also seek comment on the impact of power outages on horizontal location accuracy and address-based dispatchable location technologies, such as the NEAD.²³⁹ Should power outage scenarios be included in a z-axis technology test bed? APCO also raises concerns about first responders trying to “match” a 911 caller’s altitude when the first responders are using one technology vendor and the caller’s device uses another.²⁴⁰ Should we require testing protocols to ensure that the “use of different solutions does not produce additional error that exceeds the +/- 3 accuracy baseline”?²⁴¹ We seek comments on APCO’s proposals and other improvements to vertical location accuracy testing.

66. Some representatives of public safety officials argue that they would benefit from actual floor level information. Given the lack of current mechanisms that are consistently and reliably capable of converting z-axis information to a floor level, we seek additional information on efforts to convert z-axis data to precise floor level. What resources are available today for public safety entities and CMRS providers to convert z-axis information into floor-level information? Are there any local or regional tools currently available that could be scaled nationally? What tools and resources are being developed, and on what time horizon? Is there an appropriate timeline for converting z-axis information (as required to be reported above) to floor level information, taking into account the time needed to achieve technical feasibility and the relative costs of doing so? What are some of the technological challenges to delivering floor level and how can we overcome these challenges? BRETSA states that floor heights are not standard²⁴² and other commenters note that an authoritative database for the mapping of floors in multi-

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²³² As of 2017, CTIA estimates that there were approximately 273 million smartphones in active use, and circa 400 million “wireless subscriber connections.” CTIA, 2017 Top-Line Annual Survey, at 4-5 (2017), https://api.ctia.org/wp-content/uploads/2018/07/CTIA_ToplineWirelessIndustrySurvey.pdf. For the purposes of our 2019 estimates here, we use a figure of 300 million. We use the number of smartphones (as opposed to all wireless connections), as we believe smartphone numbers best reflect the number z-axis capable wireless devices presently in use.

²³³ See IAFC Reply at 1.

²³⁴ See CTIA Comments at 2; Qualcomm Comments at 9; NextNav Comments at 7; Google Comments at 6.

²³⁵ See, e.g., Google Comments at 6.

²³⁶ APCO Oct. 25, *Ex Parte* at 6-7.

²³⁷ *Id.* For example, APCO suggests testing “to what extent would barometric-based z-axis information be impacted by the various conditions that might arise during a high-rise apartment fire (temperature changes, pressurizing stairwells, etc.?” *Id.*

²³⁸ Letter from Bruce A. Olcott, Esq., Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 3 (filed Oct. 24, 2019) (noting the “need to ensure that location technologies continue to function during power outages[.]”).

²³⁹ Letter from Bruce A. Olcott, Esq., Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 2 (filed Nov. 4, 2019) (NextNav Nov. 4, 2019 *Ex Parte*) (“As the Commission is aware, power outages no longer occur solely in emergencies, but are now routine events in California and other Western states. Thus, the impact of power outages on all location technologies should be considered by the Commission. The Further Notice should therefore additionally request comment on the impact of power outages on horizontal location

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story buildings does not exist.²⁴³ Are there initiatives under way to develop resources for mapping building heights and floor numbers? What are the costs to carriers and public safety to develop database solutions that can be used to convert altitude measurements to an actual floor-level?

67. One possible technological solution to providing floor or unit number data uses Wi-Fi, Bluetooth, and other wireless signals to query privately-maintained databases linking those signals to the location data. Our record indicates that significant technical and implementation challenges remain with this approach.²⁴⁴ For example, there may be lower densities of Wi-Fi and Bluetooth access points in lower-income communities.²⁴⁵ Privately-maintained reference point databases also do not provide outdoor coverage (such as in national parks),²⁴⁶ may be moved or discarded,²⁴⁷ and may not work at all during power outages.²⁴⁸ We seek to maintain technological neutrality in our z-axis requirements, and we do not want to inhibit the development of technological solutions that will provide the most accurate location data and, ultimately, save lives. At the same time, we encourage commenters to assess the reliability of their proposed technological solutions in foreseeable emergency circumstances and how that should affect any future changes to our location data requirements.

68. Google proposes that the Commission include an option that allows carriers to provide floor level estimates instead of HAE-based 3-meter z-axis measurements.²⁴⁹ We seek comment on Google's proposal to allow provision of floor level information without provision of HAE. What are the drawbacks of delivering vertical location information without HAE?²⁵⁰

69. Some public safety commenters encourage us to require CMRS providers to report floor-level, rather than simply z-axis information,²⁵¹ or dispatchable location *and* z-axis information.²⁵² If we were to do so, would a 5, 7, or 10-year timeline be sufficient to achieve floor level accuracy? What interim deadlines should the Commission impose and what other actions should the Commission take in order to ensure that CMRS providers can provide floor level information and/or multiple data points? If CMRS providers meet such a timeline, will PSAPs be ready within the same timeframe to accept floor level information? What should the testing and development process look like?

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accuracy and address-based dispatchable location technologies, such as the National Emergency Address Database ("NEAD").

²⁴⁰ APCO Oct. 25, *Ex Parte* at 7.

²⁴¹ *Id.*

²⁴² BRETSA Reply at 6

²⁴³ NextNav Reply at 15; Google Comments at 11; CTIA Reply at 9; T-Mobile Reply at 12; Verizon Comments at 2-3.

²⁴⁴ Letter from NENA, Oct. 21, 2019 at 1.

²⁴⁵ HHS filing, June 2019, at 2. www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201906.pdf.

²⁴⁶ Letter from NENA, Oct. 11, 2019, at 2.

²⁴⁷ NCTA, June 18, 2019, at 10.

²⁴⁸ IAFF, May 20, 2019, at 4. See also APCO, Nov. 18, 2014.

²⁴⁹ Google Nov. 8, 2019 *Ex Parte* at 2.

²⁵⁰ See Letter from Daniel Henry, Director of Governmental Affairs, NENA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 1 (filed Nov. 18, 2019) (NENA Nov. 18, 2019 *Ex Parte*).

²⁵¹ See, e.g., APCO Comments at 7; *contra*, e.g., NENA Comments at 11.

²⁵² See Letter from Charles H. Simon, Founder & CEO, Precision Broadband LLC, to Marlene H. Dortch, Secretary, FCC, at 2 (Oct. 21, 2019) (Precision Broadband Oct. 21, 2019 *Ex Parte*).

70. We seek comment on whether to require provision of confidence and uncertainty data with floor level information. We also seek comment on the costs and benefits associated with a requirement to provide floor level in comparison to the costs and benefits of providing z-axis information. In the *Fifth Report and Order* we determine that our location accuracy rules, including the 3-meter z-axis metric, would improve emergency response times, which, in turn, would improve patient outcomes and save lives.²⁵³ Expected benefits far exceed that temporary cost amount which lasts only for a few years. The benefit floor from enhanced horizontal and vertical accuracy for wireless phones adopted in the *Fifth Report and Order* is expected to account for a large part of \$97 billion. Are there alternatives beyond a five-year timeline that we should consider for implementing a floor-level accuracy metric? Commenters advocating a different approach should explain the technical feasibility, benefits, and costs of their preferred approach(es).

B. Alternative Options for Z-Axis Deployment

71. In each CMA where CMRS providers use z-axis technology to comply with vertical location requirements, the current rules require that CMRS providers deploy z-axis technology to cover 80% of the CMA population.²⁵⁴ We seek comment on whether expanding options beyond the population-based CMA coverage requirement would serve the public interest.

72. *Urban and Dense Urban Morphologies.* Verizon states that deploying the network-level components of z-axis solutions should focus on urban and dense urban areas where multi-story buildings are concentrated.²⁵⁵ Verizon reasons that “[t]he Commission’s public safety objectives would not be served if deployment of the capability in a suburban area helps achieve the 80 percent coverage benchmark, but the result is that Z-axis coverage is provided for single-story residential dwellings, rather than the multi-story buildings where those residents work (but do not live).”²⁵⁶ NextNav argues that focusing deployment on buildings above three stories would reduce costs and increase benefits because such deployment rules “would permit location service providers to focus deployment of their weather calibration reference points where they are most needed to achieve the mission (and correspondingly, to avoid deployment in areas where they do not add significant value).”²⁵⁷ Precision Broadband proposes mandating the provision of both dispatchable location and a z-axis location metric for 911 calls originating from “multi-story” buildings.²⁵⁸

73. Some commenters recommend refining the per-CMA requirement in the rules to measure deployment based on coverage of 80% of the buildings that exceed three stories in each of the top 50 CMAs, rather than based on covering 80% of the population.²⁵⁹ If afforded the option to focus z-axis deployment in dense and dense urban morphologies and buildings above three stories, how would CMRS providers document their deployment? Should the information be provided to the PSAPs so they know which areas and buildings are covered? Should the same information be provided to the public? Would NextNav and Verizon’s proposal reduce compliance costs while preserving or increasing the benefits of the z-axis backstop?²⁶⁰ Would deployment criteria focused on urban and dense urban morphologies as

²⁵³ See *Fifth Report and Order supra*, n.208.

²⁵⁴ 47 CFR § 9.10(i)(2)(ii)(C)(2).

²⁵⁵ See Verizon Comments at 4-5.

²⁵⁶ *Id.* at 5.

²⁵⁷ NextNav Comments at 19.

²⁵⁸ See Letter from Charles H. Simon, Founder & CEO, Precision Broadband LLC, to Marlene H. Dortch, Secretary, FCC, at 2 (Oct. 21, 2019) (Precision Broadband Oct. 21, 2019 *Ex Parte*).

²⁵⁹ See, e.g. NextNav Comments at 19.

²⁶⁰ *Id.* (“Therefore, one factor that might reduce the costs of vertical location compliance while potentially improving the benefit would be requiring compliance based on coverage of 80 percent of the buildings that exceed

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opposed to population coverage promote deployment of handset-based solutions? Should the Commission mandate the provision of both dispatchable location and vertical location data for 911 calls originating from multi-story buildings?

74. *Handset Deployment.* The two z-axis solutions that have already been tested in the test bed (NextNav and Polaris) are handset-based, i.e., the location determination is calculated in the handset, rather than at an external point within a network.²⁶¹ Google also supports focusing on handset-based solutions because such solutions have the advantage that they can be deployed on a nationwide basis so that all wireless users have access to them.²⁶² Accordingly, we seek comment on establishing an option for CMRS providers to deploy z-axis capable handsets nationwide as a means of complying with our z-axis deployment requirements. What are the benefits and costs associated with handset-based z-axis deployment? Would a handset deployment option facilitate more rapid and widespread availability of nationwide z-axis solutions deployment than other options? Is a handset-based approach more-cost effective than a network-based approach? How do the costs change between deploying in the top 50 CMAs and nationwide? Can deployment nationwide be handled approaches that would require additions or modifications to network at the handset level rather than incurring infrastructure costs? We additionally seek comment on the costs and benefits of both deploying z-axis capable handsets in the top 50 CMAs and deploying them nationwide. We seek data on how likely consumers carrying z-axis capable handsets may travel in and out of one of the top 50 CMAs. What do carriers or other industry actors estimate the cost per handset is? Will a nationwide implementation of the instant rules reduce costs per handset? Can deployment nationwide be handled at the handset level rather than incurring infrastructure costs? We seek comment on how a nationwide deployment would impact compliance costs.

75. We also recognize that ensuring meaningful deployment of handset-based solutions requires z-axis capable devices to be widely available to consumers. How should we measure such deployment? Would it be sufficient for CMRS providers to show that they have made a certain percentage of the handset models that they market to customers z-axis capable? If so, what should that percentage be, and should we specify additional criteria to ensure that providers offer a reasonable selection of low-end handset models as well as higher-end models that have z-axis capability? What steps could we take to increase the number of older devices and lifeline phones that are z-axis capable? Alternatively, should we require CMRS providers to demonstrate actual market penetration of z-axis capable handsets, and if so, what penetration level would be sufficient? Should we take handset churn rates into account in setting penetration thresholds, or should we require providers to achieve specified penetration levels regardless of churn, as we did in implementing our Phase II rules?²⁶³

76. Google suggests adopting an approach analogous to that in the European Electronics Communication Code (EECC).²⁶⁴ Google states that “[b]y December 2020, all European Union member

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three stories in each of the top 50 CMAs, rather than based on the residential locations of 80 percent of the population. This could reduce costs while enhancing benefits because it would permit location service providers to focus deployment of their weather calibration reference points where they are most needed to achieve the mission (and correspondingly, to avoid deployment in areas where they do not add significant value).”).

²⁶¹ NextNav Nov. 4, 2019 *Ex Parte* at 2.

²⁶² *Cf.* Google Comments at 11-12 (“Every user that tries to contact 911, no matter what handset they use and how much it cost, should be able to expect an equal level of protection for their life and safety. Thus, mobile operators should achieve the Commission’s chosen z-axis metric for all handsets, as soon as possible.”).

²⁶³ *See Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, Third Report and Order, 14 FCC Rcd 17388, 17412, para. 52 (1999) (requiring CMRS providers to take additional steps necessary “to ensure that the public safety goals of th[e] proceeding are achieved within a reasonable period regardless of normal handset churn.”).

²⁶⁴ *See* Google Comments at 10.

states will be required to use handset-derived location in addition to network-based information for response to emergency calls.”²⁶⁵ By March 17, 2022, “the EECC will require that all smartphones sold in the European Single Market be able to provide handset-based location data.”²⁶⁶ We seek comment on Google’s suggestion that we adopt an approach similar to the EECC. Should we consider this or other international initiatives as we seek to encourage the development and deployment of improved z-axis solutions in the U.S.? What are the costs and benefits of such an approach?

77. *Non-Nationwide CMRS Providers.* As we consider future z-axis requirements for E911 location accuracy nationwide, CCA urges the Commission “to implement a glide path for non-nationwide carriers to comply with any adopted timeframes, particularly if these carriers operate outside of the FNPRM’s proposed benchmark of the top 50 markets.”²⁶⁷ APCO notes that “existing benchmarks in 2022 and 2024 for non-nationwide carriers could be adjusted consistent with [its] suggested revisions for 2021 and 2023.”²⁶⁸ We seek comment on an appropriate timeline for affording new z-axis deployment options to non-nationwide CMRS providers. Non-nationwide CMRS providers already have an additional year to comply with CMA-based deployment metrics under our current rules.²⁶⁹ If we adopt other deployment options based on building type or nationwide deployment of handset-based z-axis solutions, would the extra year already afforded to non-nationwide providers be sufficient to enable them to take advantage of these options?

78. We also seek comment on costs and benefits associated with top 50 CMA and a possible nationwide deployment of z-axis technology, which would effectively result in a nationwide x, y and z location accuracy standard. How do the costs or benefits change between deploying in the top 50 CMAs and nationwide? Does a phased implementation approach change these costs and benefits? In order to reduce the infrastructure costs associated with vertical location, NextNav suggests that the Commission “consider revising its existing requirements regarding the geographic locations where z-axis services must be provided.”²⁷⁰ NextNav argues that “[i]t is unclear . . . whether accurate vertical location information is urgently needed in every portion of the top CMAs, particularly in suburban and rural areas with a large preponderance of one and two story residences,”²⁷¹ and as such, one way to reduce cost would be to require compliance based on “coverage of 80 percent of the buildings that exceed three stories in each of the top 50 CMAs, rather than based on the residential locations of 80 percent of the population.”²⁷² Would such a proposal, for example, minimize carrier compliance costs while directing z-axis coverage to the areas that need it most? We seek comment on this proposal and solicit comments on any other methods to reduce costs while increasing benefits, especially if the Commission opts to implement these rules nationwide.

C. Dispatchable Location and Alternatives to the NEAD

79. In each CMA where dispatchable location is used, our rules require nationwide CMRS providers to “ensure that the NEAD is populated with a sufficient number of total dispatchable location

²⁶⁵ *Id.*

²⁶⁶ *Id.*

²⁶⁷ CCA Comments at 5-6.

²⁶⁸ APCO Oct. 25, 2019 *Ex Parte* at 8.

²⁶⁹ 47 CFR § 9.10(i)(2)(ii)(E).

²⁷⁰ NextNav Comments at 19.

²⁷¹ *Id.*

²⁷² *Id.* See also NextNav June 14, 2019 *Ex Parte* at 1-2 (discussing “permitting carriers to comply with the z-axis requirement by providing vertical location information for 80% of buildings in excess of 3 stories in the top 25 and 50 [CMAs] . . . rather than for 80% of the population in those CMAs.”).

reference points to equal 25 percent of the CMA population.”²⁷³ This requirement precludes carriers from implementing dispatchable location solutions that rely on data sources other than the NEAD, even where such solutions might be more viable and cost-effective. Accordingly, we propose to allow CMRS providers to demonstrate dispatchable location deployment by means other than NEAD reference points. We seek comment on this proposal. As NextNav suggests, we also seek comment on “any procedures that would quantify and verify these improvements, such as requiring the use of address-based (DL) accuracy testing and reporting requirements (including confidence and uncertainty reporting) to ensure that any changes to the NEAD or other address-based DL technologies actually succeed in improving wireless location accuracy to support public safety.”²⁷⁴ How do we account for uncertainty in dispatchable location data? Should we extend C/U requirements to alternative methods of delivery dispatchable location? If, so what should be the required C/U percentage?

80. We recognize the importance to public safety of obtaining dispatchable location information regarding which “door to kick in.”²⁷⁵ However, the record indicates that the NEAD faces challenges that could slow down implementation of dispatchable location.²⁷⁶ Meanwhile, alternatives to the NEAD are emerging that could support dispatchable location. As APCO puts it, “dispatchable location can be provided without the NEAD” and use of the NEAD to provide a caller’s location does not necessarily mean a “dispatchable location has been provided.”²⁷⁷ The Texas 9-1-1 Entities point to location solutions such as Apple’s HELO, Google’s Android ELS, and West Public Safety’s proximity check.²⁷⁸ Texas 9-1-1 Entities state that “[t]o the extent additional issues regarding the NEAD or alternative dispatchable location solutions can be further clarified early in the development process, any such clarifications may enhance the development process.”²⁷⁹ Precision Broadband explains that it will soon propose a fixed broadband alternative dispatchable location solution—independent of the

²⁷³ 47 CFR § 20.18(i)(C)(I).

²⁷⁴ NextNav Nov. 4, 2019 *Ex Parte* at 2.

²⁷⁵ NENA Comments at 14; *see also* APCO Comments at 2 (referring to dispatchable location as the “gold standard”).

²⁷⁶ *See* NENA Comments at 1 (questioning if “the NEAD will continue to keep pace with commercially available location services.”); NENA Oct. 11, 2019 *Ex Parte* at 2 (expressing “continued concerns that the National Emergency Address Database (“NEAD”) could potentially generate dangerously inaccurate results for public safety, and that its compliance regime — which is based merely on the quantity of NEAD-registered access points in a given CMA, not necessarily on the population served by those access points or even whether the system successfully provides accurate location at all — creates the potential for vast swaths of unserved 9-1-1 callers and poor quality of location provided to answering points.”); NCTA Reply at 1-3 (reflecting the reluctance of cable operators to support the NEAD citing concerns about the effectiveness of the NEAD, the cable industry’s ability to populate the NEAD with meaningful data, and potential unintended consequences that would negatively affect cable operators’ customers); Letter from Catherine Bohigian, Executive Vice President, Government Affairs, Charter Communications and Kathryn A. Zachem, Executive Vice President, Regulatory and State Legislative Affairs, Comcast Corporation, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 1 (filed May 24, 2019) (Charter and Comcast *Ex Parte*) (expressing “concerns regarding the substantial risks, including compromising their customers’ privacy, which is of paramount importance to them, and practical challenges that have caused cable operators to exercise caution before sharing information and participating in the NEAD[.]”); Charter and Comcast also “expressed concern that, given the availability and market-driven development of alternative device-based hybrid (DBH) 911 solutions, which appear likely to result in more accurate and reliable location information for

(continued....)

NEAD— which relies on internet service provider interfaces to provide dispatchable location.²⁸⁰

81. Our proposal to expand the range of possible dispatchable location solutions for CMRS providers is also consistent with the approach to dispatchable location that we recently adopted for non-CMRS providers in the Kari’s Law and RAY BAUM’s Act proceeding. In that proceeding, we sought comment on whether database location solutions, including the NEAD, could potentially assist non-CMRS providers in determining the “dispatchable location of MLTS end users.”²⁸¹ Commenters in that proceeding generally expressed skepticism that the NEAD has any near-term utility for MLTS location,²⁸² but commenters suggested that dispatchable location may be achievable if carriers can leverage other data sources, such as third-party databases or crowd-sourced location data.²⁸³ To address concerns about relying on database location solutions, the Commission adopted a more flexible approach to providing dispatchable location for non-CMRS providers.²⁸⁴ In this proceeding, we expect CMRS providers to continue pursuing dispatchable location alternatives, even if they choose not to pursue the NEAD.

82. Because the Commission has applied specific privacy and security safeguards to the NEAD, we propose that any dispatchable location alternative used by CMRS providers should include equivalent safeguards. We seek comment on this tentative conclusion. What are the costs and benefits of employing alternative information sources, either to supplement or replace the NEAD? How reliable are third-party and crowd-sourced location data alternatives? Are there other alternative information sources that we should consider? Should, for example, the Commission consider fixed broadband location data as a NEAD information source? What are the relative costs and benefits of applying NEAD-type security and privacy protections to alternative information sources? How would such sources meet the validation criteria in the definition of dispatchable location applicable to CMRS providers?

83. We also seek comment on the possible costs and benefits associated with dispatchable location alternatives to the NEAD. For example, what are the costs and benefits associated with Precision Broadband’s multi-faceted proposal to require the reporting of both (1) dispatchable location and (2) z-axis information in the top 50 Cellular Market Areas.²⁸⁵ What are the associated costs and benefits of relying on alternative data sources for dispatchable location.²⁸⁶ What are the costs and benefits of alternative methods for delivering dispatchable location?

(Continued from previous page)

more calls, a continued focus on a NEAD-based system could detract from the widespread implementation of innovative and likely more effective location technologies.” *Id.*

²⁷⁷ APCO Oct. 25, 2019 *Ex Parte*, at 8.

²⁷⁸ See Texas 911 Entities Comments at 6-7.

²⁷⁹ *Id.*

²⁸⁰ See Letter from Charles H. Simon, Founder & CEO, Precision Broadband LLC, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, at 2 (Oct. 21, 2019) (Precision Broadband Oct. 21, 2019 *Ex Parte*).

²⁸¹ *Implementing Kari’s Law and Section 506 of RAY BAUM’S Act*, PS Docket No. 18-261, Notice of Proposed Rulemaking, 33 FCC Rcd 8984, 9006, para. 65.

²⁸² See *Kari’s Law/RAY BAUM’S Act Order*, FCC 19-76 at para. 152 n.417.

²⁸³ See generally Precision Broadband Comments at 13-14 (comparison of proposed location methods such as sensor-based applications, and wi-fi, beacon proximity based applications that leverage crowd-sourced databases); *but see* BRETSA Reply at 6 (stating “The development and use of a massive, accurate, “floor-level database” for all multi-story buildings is not likely susceptible to implementation of reliable crowd-sourcing given the absence of reliable elevation reference information.”).

²⁸⁴ See *Kari’s Law/RAY BAUM’S Act Order*, FCC 19-76 at para. 153.

²⁸⁵ Precision Broadband Reply at 6.

²⁸⁶ Precision Broadband Reply at 6. Precision Broadband suggest potential data points for delivering dispatchable location including “(1) WiFi access points and Bluetooth beacons in the NEAD; (2) unique fixed broadband

(continued....)

V. PROCEDURAL MATTERS

84. *Final Regulatory Flexibility Analysis.* As required by the Regulatory Flexibility Act of 1980, as amended (RFA),²⁸⁷ the Commission has prepared a Final Regulatory Flexibility Analysis (FRFA) of the possible significant economic impact on small entities of the policies and rules adopted in the *Fifth Report and Order*. The FRFA is set forth in Appendix C.

85. *Initial Regulatory Flexibility Analysis.* As required by the RFA, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the policies and rules addressed in the *Fifth Further Notice of Proposed Rulemaking*.²⁸⁸ Written public comments are requested on the IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the *Fifth Report and Order* and *Fifth Further Notice of Proposed Rulemaking*. The IRFA is set forth in Appendix D.

86. *Paperwork Reduction Act Analysis.* The requirements in sections 9.10(i)(2)(ii)(C) and (D), 9.10, 9.10(i)(4)(v) and 9.10(j)(4), constitute modified information collections. These requirements solicit information for a certification of z-axis information use, and confidence and confidence and uncertainty data, respectfully. They will be submitted to the Office of Management and Budget (OMB) for review under section 3507(d) of the PRA.²⁸⁹ OMB, the general public, and other Federal agencies are invited to comment on the new information collection requirements contained in this proceeding. This document will be submitted to OMB for review under section 3507(d) of the PRA. In addition, we note that, pursuant to the Small Business Paperwork Relief Act of 2002,²⁹⁰ we previously sought, but did not receive, specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees. The Commission does not believe that the new or modified information collection requirements in sections 9.10(i)(2)(ii)(C) and (D), 9.10(i)(4)(v) and (j)(4), will be unduly burdensome on small businesses.²⁹¹ Applying these new or modified information collections will promote 911 service and emergency response, to the benefit of all size governmental jurisdictions, businesses, equipment manufacturers, and business associations by providing greater confidence in 911 location accuracy and greater consistency between the Commission's horizontal and vertical location rules. We describe impacts that might affect small businesses, which includes most businesses with fewer than 25 employees, in the Final Regulatory Flexibility Analysis in Appendix C.

87. *Congressional Review Act.* The Commission has determined, and the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, concurs that this rule is "major" under the Congressional Review Act, 5 U.S.C. § 804(2). The Commission will send a

(Continued from previous page)

connections identified by Internet Service Provider (ISP)- provisioned customer premise gateways such as cable modems, DSL modems, fiber-to- the-premise devices (Optical Network Terminals or connected routers), and fixed wireless connected modems or routers; (3) locations created from crowd-sourced technology; and (4) locations identified in multi-story building blueprints that can be used to provide reference data capable of converting a vertical z-axis measurement into an actual floor level." *Id.* at 7.

²⁸⁷ 5 U.S.C. § 601 *et seq.*

²⁸⁸ *See id.* § 603

²⁸⁹ 44 U.S.C. § 3507(d).

²⁹⁰ Pub. L. No. 107-198, 116 Stat. 729 (2002) (codified at 44 U.S.C. § 3506(c)(4)).

²⁹¹ The Commission anticipates the burden and cost levels of these two requirements to be similar to the existing collections which OMB approved under OMB Control No. 3060-1210, ICR Reference No: 201801-3060-010. *See generally* Exec. Office of the President, Office of Info. & Regulatory Affairs, View ICR – OIRA Conclusion, https://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201801-3060-010 (OIRA review for Wireless E911 Location Accuracy Requirements, OMB Control No. 3060-1210). The Commission seeks comment on these costs in its upcoming Paperwork Reduction Act comment periods.

copy of this *Fifth Report and Order and Fifth Further Notice of Proposed Rulemaking* to Congress and the Government Accountability Office pursuant to 5 U.S.C. § 801(a)(1)(A).

88. *Ex Parte* Presentations. The proceeding shall be treated as a “permit-but-disclose” proceeding in accordance with the Commission’s *ex parte* rules.²⁹² Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within 2 business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter’s written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission’s *ex parte* rules.

89. *Comment Filing Procedures.* Pursuant to sections 1.415 and 1.419 of the Commission’s rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments and reply comments may be filed using the Commission’s Electronic Comment Filing System (ECFS). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: <http://apps.fcc.gov/ecfs/>.
- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission’s Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission’s Secretary must be delivered to FCC Headquarters at 445 12th St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.

²⁹² 47 CFR §§ 1.1200 *et seq.*

90. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

91. *Further Information.* For further information, contact Nellie Foosaner, Attorney-Advisor, Policy and Licensing Division, Public Safety and Homeland Security Bureau, (202) 418-2925 or via e-mail at Nellie.Foosaner@fcc.gov; or Alex Espinoza, Attorney-Advisor, Policy and Licensing Division, Public Safety and Homeland Security Bureau, (202) 418-0849 or via e-mail at Alex.Espinoza@fcc.gov.

VI. ORDERING CLAUSES

92. Accordingly, IT IS ORDERED, pursuant to Sections 1, 2, 4(i), 7, 10, 201, 214, 222, 251(e), 301, 302, 303, 307, 309, 316, and 332, of the Communications Act of 1934, 47 U.S.C. §§ 151, 152(a), 154(i), 157, 160, 201, 214, 222, 251(e), 301, 302, 303, 307, 309, 316, 332; the Wireless Communications and Public Safety Act of 1999, Pub. L. No. 106-81, 47 U.S.C. §§ 615 note, 615, 615a, 615b; and Section 106 of the Twenty-First Century Communications and Video Accessibility Act of 2010, Pub. L. No. 111-260, 47 U.S.C. § 615c, that this *Fifth Report and Order and Further Notice of Proposed Rulemaking*, is hereby ADOPTED.

93. IT IS FURTHER ORDERED that the amendments of the Commission's rules as set forth in Appendix A ARE ADOPTED, effective sixty days from the date of publication in the Federal Register. Sections 9.10(i)(2)(ii)(C) and (D), (i)(4)(v) and 9.10(j)(4) contain new or modified information collection requirements that require OMB review under the PRA. The Commission directs the Public Safety and Homeland Security Bureau (Bureau) to announce the effective date of those information collections in a document published in the Federal Register after the Commission receives OMB approval, and directs the Bureau to cause section 9.10(s) to be revised accordingly.

94. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Fifth Report and Order and Fifth Further Notice of Proposed Rulemaking*, including the Initial and Final Regulatory Flexibility Analyses, to the Chief Counsel for Advocacy of the Small Business Administration.

95. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Fifth Report and Order and Fifth Further Notice of Proposed Rulemaking*, including the Initial and Final Regulatory Flexibility Analysis, to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

The Federal Communications Commission proposes to amend chapter I of title 47 of the Code of Federal Regulations as follows:

PART 9 – 911 REQUIREMENTS

1. The authority citation for part 9 continues to read as follows:

Authority: 47 U.S.C. 151-154, 152(a), 155(c), 157, 160, 201, 202, 208, 210, 214, 218, 219, 222, 225, 251(e), 255, 301, 302, 303, 307, 308, 309, 310, 316, 319, 332, 403, 405, 605, 610, 615, 615 note, 615a, 615b, 615c, 615a-1, 616, 620, 621, 623, 623 note, 721, and 1471, unless otherwise noted.

2. Section 9.10 is amended by revising paragraphs (i)(2)(ii)(C), (D), (j) and (s); and adding paragraphs (i)(4)(v) and (j)(4) to read as follows:

§ 9.10 911 Service Requirements.

* * * * *

(i) * * *

(2) * * *

(ii) * * *

(C) By April 3, 2021: In each of the top 25 CMAs, nationwide CMRS providers shall deploy either dispatchable location, or z-axis technology in compliance with the following z-axis accuracy metric: within 3 meters above or below (plus or minus 3 meters) the handset for 80% of wireless E911 calls made from the z-axis capable device. CMRS providers must deliver z-axis information in Height Above Ellipsoid. Where available to the CMRS provider, floor level information must be provided in addition to z-axis location information. CMRS providers that deploy z-axis technology must also comply with the compliance certification and call data reporting requirements of paragraphs (i)(2)(iii) and (i)(3).

(1) * * *

(2) * * *

(D) By April 3, 2023: In each of the top 50 CMAs, nationwide CMRS providers shall deploy either dispatchable location, or z-axis technology in compliance with the following z-axis accuracy metric: within 3 meters above or below (plus or minus 3 meters) the handset for 80% of wireless E911 calls made from the z-axis capable device. CMRS providers must deliver z-axis information in Height Above Ellipsoid. Where available to the CMRS provider, floor level information must be provided in addition to z-axis location information. CMRS providers that deploy z-axis technology must also comply with the compliance certification and call data reporting requirements of paragraphs (i)(2)(iii) and (i)(3).

* * * * *

(4) * * *

(i) * * *

(ii) * * *

(iii) * * *

(iv) * * *

(v) *Z-axis use certification.* Prior to use of z-axis information to meet the Commission's 911 vertical location accuracy requirements, CMRS providers must certify that neither they nor any third party they rely on to obtain z-axis information will use z-axis information or associated data for any non-911 purpose, except with prior express consent or as otherwise required by law. The certification must state that CMRS providers and any third party they rely on to obtain z-axis information will provide z-axis location information privacy and security protection equivalent to the NEAD.

* * * * *

(j) *Confidence and uncertainty data.* (1) Except as provided in paragraphs (j)(2)-(4) of this section, CMRS providers subject to this section shall provide for all wireless 911 calls, whether from outdoor or indoor locations, x- and y-axis (latitude, longitude) and z-axis (vertical) confidence and uncertainty information (C/U data) on a per-call basis upon the request of a PSAP. The data shall specify:

(i) * * *

(ii) * * *

(2) * * *

(3) * * *

(4) Upon meeting the timeframes pursuant to paragraph (i)(2)(ii)(C) and (D) of this section, CMRS providers shall provide with wireless 911 calls that have dispatchable location or z-axis (vertical) information the C/U data required under paragraph (j)(1) of this section. Where available to the CMRS provider, floor level information must be provided with associated C/U data in addition to z-axis location information.

* * * * *

(s) *Compliance date(s).* Paragraphs (i)(2)(ii)(C) and (D), (i)(4)(v), (j)(4), and (q)(10)(v) of this section contain information-collection and recordkeeping requirements. Compliance with those individual rule sections will not be required until after approval by the Office of Management and Budget. The Commission will publish a document in the *Federal Register* announcing compliance dates with those sections and revising this paragraph accordingly.

* * * * *

APPENDIX B

Proposed Rules

The Federal Communications Commission proposes to amend chapter I of title 47 of the Code of Federal Regulations as follows:

PART 9 – 911 REQUIREMENTS

1. The authority citation for part 9 continues to read as follows:

Authority: 47 U.S.C. 151-154, 152(a), 155(c), 157, 160, 201, 202, 208, 210, 214, 218, 219, 222, 225, 251(e), 255, 301, 302, 303, 307, 308, 309, 310, 316, 319, 332, 403, 405, 605, 610, 615, 615 note, 615a, 615b, 615c, 615a-1, 616, 620, 621, 623, 623 note, 721, and 1471, unless otherwise noted.

2. Section 9.10 is proposed to be amended by revising paragraph (i)(2)(ii)(C)(1) and (2) to read as follows:

§ 9.10 911 Service Requirements.

* * * * *

(i) * * *

(2) * * *

(ii) * * *

(C) * * *

(1) In each CMA where dispatchable location is used: nationwide CMRS providers ensure that the NEAD is populated with a sufficient number of total dispatchable location reference points to equal 25 percent of the CMA population. CMRS providers may demonstrate dispatchable location deployment by means other than the NEAD reference points, provided that any dispatchable location option that does not rely on the NEAD includes equivalent privacy and security safeguards; or

(2) In each CMA where z-axis technology is used:

(a) nationwide CMRS providers must deploy z-axis technology to cover 80 percent of the CMA population; or

(b) CMRS providers may also demonstrate z-axis deployment to cover 80 percent of the buildings that exceed three stories in the CMA; or

(c) CMRS providers may also demonstrate z-axis deployment by deploying z-axis capable handsets nationwide. By 2021, CMRS providers choosing nationwide deployment shall ensure that 80 percent of handsets on the network are z-axis capable.

(D) * * *

(1) In each CMA where dispatchable location is used: nationwide CMRS providers ensure that the NEAD is populated with a sufficient number of total dispatchable location reference points to equal 25 percent of the CMA population. CMRS providers may demonstrate dispatchable location deployment by

means other than the NEAD reference points, provided that any dispatchable location option that does not rely on the NEAD includes equivalent privacy and security safeguards; or

(2) In each CMA where z-axis technology is used:

(a) nationwide CMRS providers must deploy z-axis technology to cover 80 percent of the CMA population; or.

(b) CMRS providers may also demonstrate z-axis deployment to cover 80 percent of the buildings that exceed three stories in the CMA; or

(c) CMRS providers may also demonstrate z-axis deployment by deploying z-axis capable handsets nationwide. By 2023, CMRS providers choosing nationwide deployment shall ensure that 100 percent of handsets on the network are z-axis capable.

* * * * *

APPENDIX C

Final Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFAs) was incorporated in the *Fourth Further Notice of Proposed Rulemaking (Fourth Further Notice)* adopted in March 2019.² The Commission sought written public comment on the proposals in the *Notice* including comment on the IRFA. No comments were filed addressing the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.³

A. Need for, and Objectives of, the Report and Order

2. The *Fifth Report and Order* advances the Commission's goal of ensuring "that all Americans using mobile phones – whether they are calling from urban or rural areas, from indoors or outdoors – have technology that is functionally capable of providing accurate location information so that they receive the support they need in times of an emergency."⁴ In the *Fifth Report and Order*, the Commission adopts a metric to more precisely identify the location of a 911 wireless caller located in a multi-story building. More specifically, the Commission amends its rules to require the provisioning of vertical location (z-axis) information that would help enable first responders to identify the caller's floor level within 3 meters for most wireless calls to 911 from multi-story buildings, which represents a critical element to achieving the Commission's indoor location accuracy objectives. Consistent with the regulatory framework established in the last major revision of the Commission's wireless location accuracy rules in 2015 and the information developed in the associated docket, the *Fifth Report and Order* adopts a z-axis location accuracy metric of 3 meters above or below a handset for 80 percent of wireless Enhanced 911 (E911) indoor calls from z-axis capable devices as demonstrated in the test bed used to develop and test proposed z-axis accuracy metrics. CMRS providers must deliver z-axis information in Height Above Ellipsoid (HAE). Where available to the CMRS Provider, CMRS providers must deliver floor level information with z-axis location. The Commission will also apply its current Confidence and Uncertainty (C/U) data requirements for x/y location information to z-axis and, where available, floor level information that will be collected and provisioned by Commercial Mobile Radio Service (CMRS) providers. The Commission extends to z-axis location and, where available, floor level information existing compliance certification and live call data reporting requirements applicable to CMRS Providers. Additionally, the Commission extends consumer privacy and data security protections to 911 calls that convey z-axis location and, where available, floor level information in the *Fifth Report and Order*.

3. For z-axis compliance, the *Fifth Report and Order* requires CMRS providers to use a technology proven to meet the 3-meter metric in the test bed. The adopted metric should augment the ability of Public Safety Answering Points (PSAPs) and first responders to more accurately identify the floor level for most 911 calls made from multi-story buildings, reduce emergency response times, and, ultimately, save lives. It also implements the final element of the Commission's existing indoor location accuracy regime, which already includes a timetable for CMRS providers to deliver vertical location information by deploying either dispatchable location or z-axis technology in specific geographic areas. The adopted z-axis metric provides certainty to all parties and establishes a focal point for further testing, development, and implementation of evolving z-axis location technologies. The *Fifth Report and Order* also clarifies that z-axis location and, where available, floor level information may only be used for 911 purposes except as required by law. In addition, the *Fifth Report and Order* amends the location accuracy

¹ See 5 U.S.C. § 603. The RFA, 5 U.S.C. §§ 601–612, was amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

² *Wireless E911 Location Accuracy Requirements*, PS Docket No. 07-114, Fourth Further Notice of Proposed Rulemaking, FCC 19-20 (March 15, 2019) (*Fourth Further Notice*).

³ See 5 U.S.C. § 604.

⁴ *Third Further Notice*, 29 FCC Rcd at 2377, para. 6.

rules to require CMRS providers to deliver confidence and uncertainty data along with z-axis information and, where available, floor level information.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

4. There were no filed comments that specifically addressed the proposed rules and policies presented in the IRFA.

C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration

5. Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the proposed rules as a result of those comments.⁵

6. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities To Which the Rules Will Apply

7. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the rule changes.⁶ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁷ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁸ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.⁹

8. *Small Businesses, Small Organizations, Small Governmental Jurisdictions.* Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.¹⁰ First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the SBA’s Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.¹¹ These types of small businesses represent 99.9% of all businesses in the United States which translates to 28.8 million businesses.¹²

⁵ 5 U.S.C. § 604(a)(3).

⁶ 5 U.S.C. § 603(b)(3).

⁷ 5 U.S.C. § 601(6).

⁸ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small business concern” in Section 3 of the Small Business Act, which is codified at 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.” 5 U.S.C. § 601(3).

⁹ 15 U.S.C. § 632.

¹⁰ See 5 U.S.C. § 601(3)-(6).

¹¹ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 1 – What is a small business?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016)

¹² See SBA, Office of Advocacy, “Frequently Asked Questions, Question 2- How many small businesses are there in the U.S.?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016).

9. Next, the type of small entity described as a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹³ Nationwide, as of August 2016, there were approximately 356,494 small organizations based on registration and tax data filed by nonprofits with the Internal Revenue Service (IRS).¹⁴

10. Finally, the small entity described as a “small governmental jurisdiction” is defined generally as “governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁵ U.S. Census Bureau data from the 2012 Census of Governments¹⁶ indicate that there were 90,056 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.¹⁷ Of this number there were 37,132 General purpose governments (county,¹⁸ municipal and town or township¹⁹) with populations of less than 50,000 and 12,184 Special purpose governments (independent school districts²⁰ and special districts²¹) with populations of less than 50,000. The 2012 U.S. Census Bureau data for most types of governments in the local government category show that the majority of these governments have populations of less than 50,000.²² Based on this data we estimate that at least 49,316 local government jurisdictions fall in the category of “small governmental jurisdictions.”²³

¹³ 5 U.S.C. § 601(4).

¹⁴ Data from the Urban Institute, National Center for Charitable Statistics (NCCS) reporting on nonprofit organizations registered with the IRS was used to estimate the number of small organizations. Reports generated using the NCCS online database indicated that as of August 2016 there were 356,494 registered nonprofits with total revenues of less than \$100,000. Of this number, 326,897 entities filed tax returns with 65,113 registered nonprofits reporting total revenues of \$50,000 or less on the IRS Form 990-N for Small Exempt Organizations and 261,784 nonprofits reporting total revenues of \$100,000 or less on some other version of the IRS Form 990 within 24 months of the August 2016 data release date. See <http://nccs.urban.org/sites/all/nccs-archive/html/tablewiz/tw.php> where the report showing this data can be generated by selecting the following data fields: Report: “The Number and Finances of All Registered 501(c) Nonprofits”; Show: “Registered Nonprofits”; By: “Total Revenue Level (years 1995, Aug to 2016, Aug)”; and For: “2016, Aug” then selecting “Show Results.”

¹⁵ 5 U.S.C. § 601(5).

¹⁶ See 13 U.S.C. § 161. The Census of Government is conducted every five (5) years compiling data for years ending with “2” and “7.” See also Program Description Census of Government <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=program&id=program.en.CO G#>.

¹⁷ See U.S. Census Bureau, 2012 Census of Governments, Local Governments by Type and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG02.US01>. Local governmental jurisdictions are classified in two categories - General purpose governments (county, municipal and town or township) and Special purpose governments (special districts and independent school districts).

¹⁸ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>. There were 2,114 county governments with populations less than 50,000.

¹⁹ See U.S. Census Bureau, 2012 Census of Governments, Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States – States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>. There were 18,811 municipal and 16,207 town and township governments with populations less than 50,000.

²⁰ See U.S. Census Bureau, 2012 Census of Governments, Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. There were 12,184 independent school districts with enrollment populations less than 50,000.

1. Telecommunications Service Providers

a. Wireless Telecommunications Providers

11. Pursuant to 47 CFR § 20.18(a), the Commission's 911 service requirements are only applicable to Commercial Mobile Radio Service (CMRS) "[providers], excluding mobile satellite service operators, to the extent that they: (1) Offer real-time, two way switched voice service that is interconnected with the public switched network; and (2) Utilize an in-network switching facility that enables the provider to reuse frequencies and accomplish seamless hand-offs of subscriber calls. These requirements are applicable to entities that offer voice service to consumers by purchasing airtime or capacity at wholesale rates from CMRS licensees."

12. Below, for those services subject to auctions, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

13. *All Other Telecommunications.* The "All Other Telecommunications" category is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation.²⁴ This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems.²⁵ Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.²⁶ The SBA has developed a small business size standard for All Other Telecommunications, which consists of all such firms with annual receipts of \$32.5 million or less.²⁷ For this category, U.S. Census Bureau data for 2012 shows that there were 1,442 firms that operated for the entire year.²⁸ Of those firms, a total of 1,400 had annual receipts less than \$25 million and 42 firms had

(Continued from previous page)

²¹ See U.S. Census Bureau, 2012 Census of Governments, Special District Governments by Function and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG09.US01>. The U.S. Census Bureau data did not provide a population breakout for special district governments.

²² See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>; Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>; and Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. While U.S. Census Bureau data did not provide a population breakout for special district governments, if the population of less than 50,000 for this category of local government is consistent with the other types of local governments the majority of the 38, 266 special district governments have populations of less than 50,000.

²³ *Id.*

²⁴ See U.S. Census Bureau, 2017 NAICS Definitions, NAICS Code "517919 All Other Telecommunications", <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517919&search=2017+NAICS+Search&search=2017>.

²⁵ *Id.*

²⁶ *Id.*

²⁷ See 13 CFR § 121.201, NAICS code 517919.

²⁸ U.S. Census Bureau, 2012 *Economic Census of the United States*, Table EC1251SSSZ4, Information: Subject Series - Estab and Firm Size: Receipts Size of Firms for the United States: 2012, NAICS code 517919, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4/naics~517919.

annual receipts of \$25 million to \$49,999,999.²⁹ Thus, the Commission estimates that the majority of “All Other Telecommunications” firms potentially affected by our action can be considered small.

14. *AWS Services (1710–1755 MHz and 2110–2155 MHz bands (AWS-1); 1915–1920 MHz, 1995–2000 MHz, 2020–2025 MHz and 2175–2180 MHz bands (AWS-2); 2155–2175 MHz band (AWS-3)).* For the AWS-1 bands,³⁰ the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million. For AWS-2 and AWS-3, although we do not know for certain which entities are likely to apply for these frequencies, we note that the AWS-1 bands are comparable to those used for cellular service and personal communications service. The Commission has not yet adopted size standards for the AWS-2 or AWS-3 bands but proposes to treat both AWS-2 and AWS-3 similarly to broadband PCS service and AWS-1 service due to the comparable capital requirements and other factors, such as issues involved in relocating incumbents and developing markets, technologies, and services.³¹

15. *Competitive Local Exchange Carriers (Competitive LECs). Competitive Access Providers (CAPs), Shared-Tenant Service Providers, and Other Local Service Providers.* Neither the Commission nor the SBA has developed a small business size standard specifically for these service providers. The appropriate NAICS Code category is Wired Telecommunications Carriers and under that size standard, such a business is small if it has 1,500 or fewer employees.³² U.S. Census Bureau data for 2012 indicate that 3,117 firms operated during that year.³³ Of that number, 3,083 operated with fewer than 1,000 employees.³⁴ Based on these data, the Commission concludes that the majority of Competitive LECs, CAPs, Shared-Tenant Service Providers, and Other Local Service Providers, are small entities. According to Commission data, 1,442 carriers reported that they were engaged in the provision of either competitive local exchange services or competitive access provider services.³⁵ Of these 1,442 carriers, an estimated 1,256 have 1,500 or fewer employees.³⁶ In addition, 17 carriers have reported that they are Shared-Tenant Service Providers, and all 17 are estimated to have 1,500 or fewer employees.³⁷ Also, 72

²⁹ *Id.*

³⁰ The service is defined in section 90.1301 *et seq.* of the Commission’s Rules, 47 CFR § 90.1301 *et seq.*

³¹ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Report and Order, 18 FCC Rcd 25162, Appx. B (2003), modified by *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Order on Reconsideration, 20 FCC Rcd 14058, Appx. C (2005); *Service Rules for Advanced Wireless Services in the 1915–1920 MHz, 1995–2000 MHz, 2020–2025 MHz and 2175–2180 MHz Bands*; *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Notice of Proposed Rulemaking, 19 FCC Rcd 19263, Appx. B (2005); *Service Rules for Advanced Wireless Services in the 2155–2175 MHz Band*, Notice of Proposed Rulemaking, 22 FCC Rcd 17035, Appx. (2007).

³² See 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>.

³³ See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517110.s

³⁴ *Id.*

³⁵ See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, *Trends in Telephone Service* at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

³⁶ *Id.*

³⁷ *Id.*

carriers have reported that they are Other Local Service Providers.³⁸ Of this total, 70 have 1,500 or fewer employees.³⁹ Consequently, based on internally researched FCC data, the Commission estimates that most providers of competitive local exchange service, competitive access providers, Shared-Tenant Service Providers, and Other Local Service Providers are small entities.

16. *Incumbent Local Exchange Carriers (LECs).* Neither the Commission nor the SBA has developed a small business size standard specifically for incumbent local exchange services. The closest applicable NAICS Code category is Wired Telecommunications Carriers.⁴⁰ Under the applicable SBA size standard, such a business is small if it has 1,500 or fewer employees.⁴¹ U.S. Census Bureau data for 2012 indicate that 3,117 firms operated the entire year.⁴² Of this total, 3,083 operated with fewer than 1,000 employees.⁴³ Consequently, the Commission estimates that most providers of incumbent local exchange service are small businesses that may be affected by our actions. According to Commission data, one thousand three hundred and seven (1,307) Incumbent Local Exchange Carriers reported that they were incumbent local exchange service providers.⁴⁴ Of this total, an estimated 1,006 have 1,500 or fewer employees.⁴⁵ Thus using the SBA's size standard the majority of incumbent LECs can be considered small entities.

17. *Narrowband Personal Communications Services.* Two auctions of narrowband personal communications services (PCS) licenses have been conducted. To ensure meaningful participation of small business entities in future auctions, the Commission has adopted a two-tiered small business size standard in the Narrowband PCS Second Report and Order. Through these auctions, the Commission has awarded a total of 41 licenses, out of which 11 were obtained by small businesses.⁴⁶ A "small business" is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million. A "very small business" is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million. The SBA has approved these small business size standards.⁴⁷

18. *Offshore Radiotelephone Service.* This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.⁴⁸ The closest applicable SBA size standard is for Wireless Telecommunications Carriers

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ See 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>

⁴¹ *Id.*

⁴² See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517110.

⁴³ *Id.*

⁴⁴ See *Trends in Telephone Service*, Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*).

⁴⁵ *Id.*

⁴⁶ *Amendment of the Commission's Rules to Establish New Personal Communications Services, Narrowband PCS*, GEN Docket No. 90-314, ET Docket No. 92-100, PP Docket No. 93-253, Second Report and Order and Second Further Notice of Proposed Rulemaking, 15 FCC Rcd 10456 (2000).

⁴⁷ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

⁴⁸ This service is governed by Subpart I of Part 22 of the Commission's Rules. See 47 CFR §§ 22.1001-22.1037.

(except Satellite), which is an entity employing no more than 1,500 persons.⁴⁹ U.S. Census Bureau data in this industry for 2012 show that there were 967 firms that operated for the entire year.⁵⁰ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁵¹ Thus, under this SBA category and the associated small business size standard, the majority of Offshore Radiotelephone Service firms can be considered small. There are presently approximately 55 licensees in this service. However, the Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA's small business size standard for the category of Wireless Telecommunications Carriers (except Satellite).

19. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.⁵² Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.⁵³ The SBA has established a small business size standard for this industry of 1,250 employees or less.⁵⁴ U.S. Census Bureau data for 2012 shows that 841 establishments operated in this industry in that year.⁵⁵ Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.⁵⁶ Based on this data, we conclude that a majority of manufacturers in this industry are small.

20. *Rural Radiotelephone Service.* The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.⁵⁷ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (BETRS).⁵⁸ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.⁵⁹ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁶⁰ Of this total, 955 firms had

⁴⁹ 13 CFR § 121.201, NAICS codes 517210.

⁵⁰ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~5172100.

⁵¹ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁵² The NAICS Code for this service is 334220. 13 CFR § 121.201. *See also* U.S. Census Bureau, 2012 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing” <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN.NAICS2012.334220#>.

⁵³ *Id.*

⁵⁴ 13 CFR § 121.201, NAICS Code 334220.

⁵⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012, NAICS Code 334220, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2/naics~334220.

⁵⁶ *Id.*

⁵⁷ The service is defined in 47 CFR § 22.99.

⁵⁸ BETRS is defined in 47 CFR §§ 22.757 and 22.759.

⁵⁹ 13 CFR § 121.201, NAICS codes 517210.

employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁶¹ Thus under this category and the associated size standard, the Commission estimates that the majority of Rural Radiotelephone Services firms are small entities. There are approximately 1,000 licensees in the Rural Radiotelephone Service, and the Commission estimates that there are 1,000 or fewer small entity licensees in the Rural Radiotelephone Service that may be affected by the rules and policies herein.

21. *Wireless Communications Services.* This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (WCS) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁶² The SBA has approved these small business size standards.⁶³ In the Commission’s auction for geographic area licenses in the WCS there were seven winning bidders that qualified as “very small business” entities, and one that qualified as a “small business” entity.

22. *Wireless Telecommunications Carriers (except Satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular services, paging services, wireless internet access, and wireless video services.⁶⁴ The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.⁶⁵ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁶⁶ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁶⁷ Thus under this category and the associated size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small entities.

23. *Wireless Telephony.* Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite).⁶⁸ Under the SBA small business size standard,

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⁶⁰ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517210.

⁶¹ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁶² *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁶³ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

⁶⁴ U.S. Census Bureau, 2012 NAICS Definitions, “517210 Wireless Telecommunications Carriers (Except Satellite),” See <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN.NAICS2012.517210>.

⁶⁵ 13 CFR § 121.201, NAICS code 517210.

⁶⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517210.

⁶⁷ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁶⁸ 13 CFR § 121.201, NAICS code 517210.

a business is small if it has 1,500 or fewer employees.⁶⁹ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁷⁰ Of this total, 955 firms had fewer than 1,000 employees and 12 firms had 1000 employees or more.⁷¹ Thus under this category and the associated size standard, the Commission estimates that a majority of these entities can be considered small. According to Commission data, 413 carriers reported that they were engaged in wireless telephony.⁷² Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁷³ Therefore, more than half of these entities can be considered small.

24. *700 MHz Guard Band Licensees.* In 2000, in the *700 MHz Guard Band Order*, the Commission adopted size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits and installment payments.⁷⁴ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁷⁵ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁷⁶ SBA approval of these definitions is not required.⁷⁷ An auction of 52 Major Economic Area licenses commenced on September 6, 2000, and closed on September 21, 2000.⁷⁸ Of the 104 licenses auctioned, 96 licenses were sold to nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses commenced on February 13, 2001 and closed on February 21, 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁷⁹

25. *Lower 700 MHz Band Licenses.* The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁸⁰ The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40

⁶⁹ *Id.*

⁷⁰ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

⁷¹ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁷² See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, Trends in Telephone Service at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

⁷³ *Id.*

⁷⁴ See *Service Rules for the 746–764 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (*746–764 MHz Band Second Report and Order*). Service rules were amended in 2007, but no changes were made to small business size categories. See *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, WT Docket No. 06-150, Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephones, WT Docket No. 01-309, Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services, WT Docket 03-264, Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules, WT Docket No. 06-169, Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229, Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010, WT Docket No. 96-86, *Report and Order and Further Notice of Proposed Rulemaking*, 22 FCC Rcd 8064 (2007).

million for the preceding three years.⁸¹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸² Additionally, the lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (MSA/RSA) licenses—“entrepreneur”—which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸³ The SBA approved these small size standards.⁸⁴ An auction of 740 licenses (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)) commenced on August 27, 2002, and closed on September 18, 2002. Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business or entrepreneur status and won a total of 329 licenses.⁸⁵ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses: 5 EAG licenses and 476 Cellular Market Area licenses.⁸⁶ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁷ On July 26, 2005, the Commission completed an auction of 5 licenses in the Lower 700 MHz band (Auction No. 60). There were three winning bidders for five licenses. All three winning bidders claimed small business status.

26. In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁸⁸ An auction of 700 MHz licenses commenced January 24, 2008, and closed on March 18, 2008, which included: 176 Economic Area licenses in the A-Block, 734 Cellular Market Area licenses in the B-Block, and 176 EA licenses in the E-Block.⁸⁹ Twenty winning bidders, claiming small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years) won 49 licenses. Thirty-three winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) won 325 licenses.

27. *Upper 700 MHz Band Licenses.* In the *700 MHz Second Report and Order*, the

(Continued from previous page)

⁷⁵ See *id.* at 5343, para. 108.

⁷⁶ See *id.*

⁷⁷ See *id.* at 5343, para. 108 n.246 (for the 746–764 MHz and 776–794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁷⁸ See *700 MHz Guard Bands Auction Closes: Winning Bidders Announced*, Public Notice, 15 FCC Rcd 18026 (WTB 2000).

⁷⁹ See *700 MHz Guard Bands Auction Closes: Winning Bidders Announced*, Public Notice, 16 FCC Rcd 4590 (WTB 2001).

⁸⁰ See *Reallocation and Service Rules for the 698–746 MHz Spectrum Band (Television Channels 52–59)*, Report and Order, 17 FCC Rcd 1022 (2002) (*Channels 52–59 Report and Order*).

⁸¹ See *id.* at 1087–88, para. 172.

⁸² See *id.*

⁸³ See *id.*, at 1088, para. 173.

⁸⁴ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

⁸⁵ See *Lower 700 MHz Band Auction Closes*, Public Notice, 17 FCC Rcd 17272 (WTB 2002).

⁸⁶ See *id.*

⁸⁷ See *id.*

Commission revised its rules regarding Upper 700 MHz licenses.⁹⁰ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹¹ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

28. *Wireless Resellers.* The SBA has not developed a small business size standard specifically for Wireless Resellers. The SBA category of Telecommunications Resellers is the closest NAICS code category for wireless resellers.⁹² The Telecommunications Resellers industry comprises establishments engaged in purchasing access and network capacity from owners and operators of telecommunications networks and reselling wired and wireless telecommunications services (except satellite) to businesses and households.⁹³ Establishments in this industry resell telecommunications; they do not operate transmission facilities and infrastructure. Mobile virtual network operators (MVNOs) are included in this industry.⁹⁴ Under the SBA's size standard, such a business is small if it has 1,500 or fewer employees.⁹⁵ U.S. Census Bureau data for 2012 show that 1,341 firms provided resale services for the entire year.⁹⁶ Of that number, all operated with fewer than 1,000 employees.⁹⁷ Thus, under this category and the associated small business size standard, the majority of these resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.⁹⁸ Of these, an estimated 211 have 1,500 or fewer employees.⁹⁹ Consequently, the Commission estimates that the majority of Wireless Resellers are small entities.

b. Equipment Manufacturers

29. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* This industry comprises establishments primarily engaged in manufacturing radio and

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⁸⁸ *Service Rules for the 698–746, 747–762 and 777–792 MHz Band; Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones; Biennial Regulatory Review—Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services; Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission's Rules; Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band; Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010; Declaratory Ruling on Reporting Requirement under Commission's Part 1 Anti-Collusion Rule*, WT Docket Nos. 07-166, 06-169, 06-150, 03-264, and 96-86, PS Docket No. 06-229, CC Docket No. 94-102, Second Report and Order, 22 FCC Rcd 15289, 15359 n.434 (2007) (*700 MHz Second Report and Order*).

⁸⁹ *See Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁹⁰ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹¹ *See Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁹² *See* 13 CFR § 121.201; NAICS Code 517911.

⁹³ U.S. Census Bureau, *North American Industry Classification System, 2017 NAICS Definition, 517911 Telecommunications Resellers*, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517911&search=2017> (last visited Dec. 7, 2018).

⁹⁴ *Id.*

⁹⁵ 13 CFR § 121.201; NAICS Code 517911.

television broadcast and wireless communications equipment.¹⁰⁰ Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.¹⁰¹ The SBA has established a small business size standard for this industry of 1,250 employees or less.¹⁰² U.S. Census Bureau data for 2012 show that 841 establishments operated in this industry in that year.¹⁰³ Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.¹⁰⁴ Based on this data, we conclude that a majority of manufacturers in this industry can be considered small.

30. *Semiconductor and Related Device Manufacturing.* This industry comprises establishments primarily engaged in manufacturing semiconductors and related solid state devices.¹⁰⁵ Examples of products made by these establishments are integrated circuits, memory chips, microprocessors, diodes, transistors, solar cells and other optoelectronic devices.¹⁰⁶ The SBA has developed a small business size standard for Semiconductor and Related Device Manufacturing, which consists of all such companies having 1,250 or fewer employees.¹⁰⁷ U.S. Census Bureau data for 2012 show that there were 862 establishments that operated that year.¹⁰⁸ Of this total, 843 operated with fewer than 1,000 employees.¹⁰⁹ Thus, under this size standard, the majority of firms in this industry can be considered small.

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⁹⁶ See U.S. Census Bureau, *North American Industry Classification System, 2017 NAICS Definition, 517911 Telecommunications Resellers*, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517911&search=2017> (last visited Dec. 7, 2018).

⁹⁷ *Id.*

⁹⁸ See *Trends in Telephone Service*, at tbl. 5.3.

⁹⁹ *Id.*

¹⁰⁰ U.S. Census Bureau, 2012 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing” <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en./ECN.NAICS2012.334220#>.

¹⁰¹ *Id.*

¹⁰² 13 CFR § 121.201, NAICS Code 334220.

¹⁰³ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012, NAICS Code 334220, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334220.

¹⁰⁴ *Id.*

¹⁰⁵ See U.S. Census Bureau, 2017 NAICS Definition, NAICS Code 334413 “Semiconductor and related device Manufacturing,” <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en./ECN.NAICS2012.334413#>.

¹⁰⁶ *Id.*

¹⁰⁷ 13 CFR § 121.201.

¹⁰⁸ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012 https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334413.

¹⁰⁹ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,250 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

31. The *Fifth Report and Order* enacts a z-axis (vertical) location accuracy metric that will affect the reporting, recordkeeping and/or other compliance requirements of small and other size CMRS providers – both nationwide and non-nationwide. Under the current E911 location accuracy rules, by 2021, nationwide CMRS providers must deploy either (1) dispatchable location, or (2) z-axis technology that achieves the Commission-adopted z-axis metric in each of the top 25 Cellular Market Areas. If z-axis technology is used, CMRS providers must deploy z-axis technology to cover 80 percent of the Cellular Market Areas population. By 2021, nationwide CMRS providers must deploy dispatchable location or z-axis technology complying with the Commission-adopted z-axis metric in each of the top 50 Cellular Market Areas. Small entities that are non-nationwide carriers, including resellers, that serve any of the top 25 or 50 CMAs will have an additional year to meet the two benchmarks (i.e., until 2022 for the top 25 Cellular Market Areas and 2024 for the top 50 Cellular Market Areas). CMRS providers must deliver z-axis information in Height Above Ellipsoid. Where available, CMRS providers must deliver floor level information with z-axis location.

32. The *Fifth Report and Order* requires nationwide and non-nationwide CMRS providers that deploy z-axis technology to provide vertical location information within a 3 meters metric under the Commission's existing location accuracy requirements timelines. While the Commission does not mandate a specific technology for z-axis compliance, we require CMRS providers to use a technology proven to meet the 3-meters metric in the test bed. In order to be deemed in compliance, CMRS providers using z-axis technology for vertical location must certify that the z-axis technology is deployed consistently with the manner in which it was tested in the test bed. The *Fifth Report and Order* also requires CMRS providers to comply with the Commission's current confidence and uncertainty (C/U) requirements for x/y location information for z-axis location information in addition to horizontal location, for 911 calls in the top 50 CMAs. As we stated in the *Fifth Report and Order*, we anticipate this data "can be furnished to PSAPs at minimal cost to CMRS providers given that they already provide C/U data for x/y calls." Where available, CMRS providers must provide floor level information and associated C/U data in addition to z-axis location information.

33. In order to be deemed in compliance under our existing rules, we clarify that nationwide CMRS providers electing to use z-axis technology for vertical location shall certify for purposes of the April 2021 and April 2023 compliance deadlines that z-axis technology is deployed consistent with the manner in which it was tested in the test bed. Non-nationwide providers will have an additional year to make each certification. In addition, to more fully inform the Commission's understanding of location accuracy progress, we extend the live data calling reporting obligations existing in the rules to z-axis. The Commission live call data reporting rules require nationwide CMRS providers to file quarterly reports of their aggregate live 911 call location data for each location technology used within four geographic morphologies within six representative cities (Test Cities). Non-nationwide CMRS providers must report the aggregate live 911 call data collected in one or more of the Test Cities or the largest county in their footprint, depending on the area served by the provider. We extend these reporting requirements to include z-axis information and, where available, floor level information in the live call data reporting already in the Commission's rules for our informational purposes.

34. The Commission clarifies in the *Fifth Report and Order* that CMRS providers may only use z-axis location and floor level information for 911 purposes except with prior express consent or as required by law. Prior to use of z-axis information and floor level information contained in the NEAD, CMRS providers are required to certify that they will not use z-axis, floor level, or associated data for any non-911 purpose, except with prior express consent or as otherwise required by law. The certification must state that the CMRS provider will provide z-axis location and floor level information privacy and security protection equivalent to the NEAD. This requirement is necessary to ensure the privacy and security of any personally identifiable information that may be collected in generating z-axis and floor level data. Additionally, we require CMRS providers to certify that neither they nor any third party they rely on to obtain z-axis and floor level information for 911 purposes will use such information for any

non-911 purpose, except with prior express consent or as required by law.

35. In the *Fourth Further Notice*, the Commission tentatively concluded based on the z-axis solution test results and other comments, that a metric of 3 meters for 80% of indoor calls is technically achievable and that z-axis solutions capable of meeting this metric can be deployed within the timeframes established in the E911 location accuracy rules. We also tentatively concluded that the cost of compliance with the 3-meter metric is relatively low. We affirm these conclusions with our adoption of the 3-meters metric requirement in the *Fifth Report and Order*. In order to comply with the 3-meters metric requirement, small entities may incur costs associated with software and/or hardware changes and may need to employ engineers or other experts. While the Commission cannot quantify the cost of compliance with the requirements, the technology solution a small entity chooses to implement the requirement will ultimately determine the nature of the costs it incurs.

36. Evidence in the record indicates that small entities have a choice of vendors with z-axis technology solutions, which will allow them to manage their costs. Moreover, having a competitive market for such solutions should lessen the costs for small entities to comply with the rules. In the proceeding, parties provided examples of various technology solutions that are currently available to small entities and other CMRS providers and general information on the implementation requirements. NextNav a vendor that participated in Stage Z testing indicated that its z-axis solution which only requires software changes to be made to each handset, could be made available for a nominal cost that amounts to significantly less than a penny per month per handset. Another test vendor, Polaris, indicated that its solution is instantly available and deployable throughout a carrier's nationwide network. Polaris also asserted that its solution is "objectively affordable" because it is software-based, does not require hardware in networks or markets, and "does not require anything special in devices beyond implementation of adopted 3GPP and OMA standards." Google who announced development and deployment of its Emergency Location System (ELS) in the U.S. for Android devices and testing in Stage Za, indicated that ELS is "a supplemental service that sends enhanced location directly from Android handsets to emergency services when an emergency call is placed." Google also indicated that ELS is part of the Android operating system and does not require any special hardware or updates. Apple has announced that it will use new technology to quickly and securely share Hybridized Emergency Location information with 911 call centers. The HELO "solution has offered z-axis estimates and uncertainties beginning in 2013, and those estimates have been consumed by carriers since its first adoption in 2015." Apple has committed to improving its vertical, as well as horizontal, location accuracy and will participate in CTIA's z-axis testing by the end of 2020. With the addition of other vertical location technologies and vendors into the market, the Commission expects small entities will have more implementation options and that technology costs will decline as demand grows, which could further reduce their cost of compliance.

37. The Commission does not believe that the new or modified information collection requirements in sections 9.10(i)(2)(ii)(C) and (D), 9.10(i)(4)(v) and 9.10(j)(4), will be unduly burdensome on small businesses. Applying these new or modified information collections will promote 911 service and emergency response, to the benefit of all size governmental jurisdictions, businesses, equipment manufacturers, and business associations by providing greater confidence in 911 location accuracy and greater consistency between the Commission's horizontal and vertical location rules. We provide the following analysis:

38. The Commission amends Section 9.10(i)(2)(ii)(C) and (D) to require the provisioning of dispatchable location or z-axis location information. As stated in the *Fifth Report and Order*, where available to CMRS Providers, floor level information must be reported with z-axis location information. The Commission adopts Section 9.10(i)(4)(v) to require all CMRS providers to "certify that they will not use z-axis information or associated data for any non-911 purpose, except with prior express consent or as otherwise required by law. The certification must state that CMRS providers will provide z-axis location information privacy and security protection equivalent to the NEAD." Additionally, under section 9.10(i)(4)(v), we require CMRS providers to certify that neither they nor any third party they rely on to

obtain z-axis location information for 911 purposes will use such information for any non-911 purpose, except with prior express consent or as required by law. This requirement is necessary to ensure the privacy and security of any personally identifiable information that may be collected in generating z-axis data. The Commission adopts section 9.10(j)(4) to extend confidence and uncertainty (C/U) requirements to wireless E911 calls that provide z-axis and floor level information in the top 50 CMAs, for CMRS providers, in addition to horizontal location. As we stated in the *Fifth Report and Order*, we also anticipate this data “can be furnished to PSAPs at minimal cost to CMRS providers given that they already provide C/U data for x/y calls.” The Commission anticipates the burden and cost levels of these requirements to be similar to the existing collections which OMB approved under OMB Control No. 3060-1210, ICR Reference No: 201801-3060-010.¹¹⁰ Additionally, the Commission anticipates extending the burden and cost burdens associated with extending the existing compliance certification and live call data report requirements to CMRS Providers that deploy z-axis information to be similar to the existing collections which OMB approved under OMB Control No. 3060-1210, ICR Reference No: 201801-3060-010. The Commission seeks comment on these costs in its upcoming Paperwork Reduction Act comment periods.

F. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

39. The RFA requires an agency to describe any significant, specifically small business alternatives that it has considered in reaching its approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for such small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.¹¹¹

40. Based on a comparison of the benefits and costs to alternatives metrics, the Commission believes that the 3-meter metric adopted in the *Fifth Report and Order* is the most cost-effective option for achieving the Commission’s location accuracy and public safety objectives in this proceeding while avoiding placing undue burdens on small entities and other CMRS providers. While the rules adopted in the *Fifth Report and Order* will apply to all nationwide and non-nationwide CMRS in the same manner, the Commission has taken steps to accommodate non-nationwide CMRS providers by supplying additional time to comply with the adopted vertical location accuracy benchmarks. Non-nationwide CMRS providers which tend to be small entities have an additional year to comply with the Commission’s z-axis benchmarks. The Commission also declined to mandate a specific technological solution but instead, nationwide and non-nationwide CMRS providers may choose to provide a dispatchable location solution or deploy z-axis technology. Thus, small entities have the freedom to choose a solution that best fits their financial situation rather than being subjected to a specific z-axis technology solution, which should minimize the economic impact on these entities.

41. In implementing the z-axis metric, there were several alternatives considered by the Commission but not adopted that may have presented an increased economic impact for small entities. Specifically, the Commission declined to adopt a more stringent z-axis metric or a requirement to convey “floor level” information. Small entities will benefit as a result of the certainty provided by the Commission’s adoption of 3 meters metric requirement. The Commission also declined to mandate the application of the 3-meters for barometric pressure sensor capable handsets but instead applied the requirement only to z-axis capable devices. This action by the Commission will allow small entities and

¹¹⁰ See generally Exec. Office of the President, Office of Info. & Regulatory Affairs, View ICR – OIRA Conclusion, https://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201801-3060-010 (OIRA review for Wireless E911 Location Accuracy Requirements, OMB Control No. 3060-1210).

¹¹¹ See 5 U.S.C. § 603(c)(1)-(4).

other CMRS providers to avoid having to retrofit older devices that may not have barometric sensors and avoid incurring the associated costs. Additionally, the Commission declined to adopt a less stringent 5 meter metric, which could increase emergency response time. Lastly, the Commission declined to adopt a specific measurement standard that must be used to report vertical location information and declined to adopt or require proof of performance testing to measure compliance with the z-axis metric.

42. The Commission believes the adoption of the 3 meters metric and allowing CMRS providers the flexibility to choose a compliant technology solution rather than mandating a one size fits all solution is the best approach to meet its public safety and location accuracy objectives and should minimize some economic impact for small entities. The Commission's action also provides CMRS providers a level of certainty which should benefit providers in their selection of a complaint technology solution. In addition, by adopting a single metric, small entities and other CMRS providers should benefit from the economies of scale equipment manufacturers will incur from the ability to provision devices uniformly using 3-meters standard.

43. *Report to Congress.* The Commission will send a copy of the *Fifth Report and Order*, including this FRFA, in a report to Congress pursuant to the Congressional Review Act.¹¹² In addition, the Commission will send a copy of the *Fifth Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Fifth Report and Order*, and FRFA (or summaries thereof) will also be published in the *Federal Register*.¹¹³

¹¹² See 5 U.S.C. § 801(a)(1)(A).

¹¹³ See 5 U.S.C. § 604(b).

APPENDIX D

Initial Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ the Commission has prepared this Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in the *Fifth Further Notice of Proposed Rule Making (Fifth Further Notice)*. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines in this *Fifth Further Notice*. The Commission will send a copy of the *Fifth Further Notice*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).² In addition, the *Fifth Further Notice* and IRFA (or summaries thereof) will be published in the *Federal Register*.³

A. Need for, and Objectives of, the Proposed Rules

2. In the *Fifth Further Notice*, we propose changes to, and seek comment on, our E911 location accuracy rules to expand options for z-axis deployment and provisioning of dispatchable location, in order to address long term public safety requirements in the Commission's indoor location framework, while balancing technological neutrality and flexibility. More specifically, we seek comment on a timeline for narrowing the z-axis metric and requiring carriers to deliver floor level information to Public Safety Answering Points (PSAPs) in conjunction with a wireless indoor 911 call. We inquire whether a five-year timeline is sufficient to achieve floor level accuracy, and, if so, what actions should the Commission take in order to ensure that CMRS providers can provide floor level information. For z-axis deployment, we seek comment on providing alternative ways for carriers to demonstrate that they have deployed z-axis technology, such as deploying z-axis capable handsets nationwide. With respect to dispatchable location, the Commission seeks comment on expanding dispatchable location solutions, provided that any new sources of dispatchable locations would be subject to privacy and security protection equivalent to those in effect for the National Emergency Address Database (NEAD).

B. Legal Basis

3. The proposed action is authorized under Sections 1, 2, 4(i), 7, 10, 201, 214, 222, 251(e), 301, 302, 303, 307, 309, 316, and 332, of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 152(a), 154(i), 157, 160, 201, 214, 222, 251(e), 301, 302, 303, 307, 309, 316, 332; the Wireless Communications and Public Safety Act of 1999, Pub. L. No. 106-81, 47 U.S.C. §§ 615 note, 615, 615a, 615b; and Section 106 of the Twenty-First Century Communications and Video Accessibility Act of 2010, Pub. L. No. 111-260, 47 U.S.C. § 615c.

C. Description and Estimate of the Number of Small Entities To Which the Proposed Rules Will Apply

4. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if adopted.⁴ The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."⁵ In addition, the term "small business" has the

¹ 5 U.S.C. § 603. The RFA, 5 U.S.C. §§ 601–612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

² See 5 U.S.C. § 603(a).

³ See *id.*

⁴ 5 U.S.C. § 603(b)(3).

⁵ 5 U.S.C. § 601(6).

same meaning as the term “small business concern” under the Small Business Act.⁶ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.⁷

5. *Small Businesses, Small Organizations, Small Governmental Jurisdictions.* Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.⁸ First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the SBA’s Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.⁹ These types of small businesses represent 99.9% of all businesses in the United States which translates to 28.8 million businesses.¹⁰

6. Next, the type of small entity described as a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹¹ Nationwide, as of August 2016, there were approximately 356,494 small organizations based on registration and tax data filed by nonprofits with the Internal Revenue Service (IRS).¹²

7. Finally, the small entity described as a “small governmental jurisdiction” is defined generally as “governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹³ U.S. Census Bureau data from the 2012 Census of Governments¹⁴ indicate that there were 90,056 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.¹⁵ Of this number there were 37,132 General purpose governments (county,¹⁶ municipal and town or township¹⁷) with populations of less than 50,000 and 12,184 Special purpose governments (independent school districts¹⁸ and special districts¹⁹) with populations of less than 50,000. The 2012 U.S. Census Bureau data for most types of governments in the local government category show that the majority of these governments have

⁶ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small business concern” in Section 3 of the Small Business Act, which is codified at 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.” 5 U.S.C. § 601(3).

⁷ 15 U.S.C. § 632.

⁸ See 5 U.S.C. § 601(3)-(6).

⁹ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 1 – What is a small business?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016)

¹⁰ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 2- How many small businesses are there in the U.S.?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016).

¹¹ 5 U.S.C. § 601(4).

¹² Data from the Urban Institute, National Center for Charitable Statistics (NCCS) reporting on nonprofit organizations registered with the IRS was used to estimate the number of small organizations. Reports generated using the NCCS online database indicated that as of August 2016 there were 356,494 registered nonprofits with total revenues of less than \$100,000. Of this number, 326,897 entities filed tax returns with 65,113 registered nonprofits reporting total revenues of \$50,000 or less on the IRS Form 990-N for Small Exempt Organizations and 261,784 nonprofits reporting total revenues of \$100,000 or less on some other version of the IRS Form 990 within 24 months of the August 2016 data release date. See <http://nccs.urban.org/sites/all/nccs-archive/html/tablewiz/tw.php> where the report showing this data can be generated by selecting the following data fields: Report: “The Number and Finances of All Registered 501(c) Nonprofits”; Show: “Registered Nonprofits”; By: “Total Revenue Level (years 1995, Aug to 2016, Aug)”; and For: “2016, Aug” then selecting “Show Results.”

populations of less than 50,000.²⁰ Based on this data we estimate that at least 49,316 local government jurisdictions fall in the category of “small governmental jurisdictions.”²¹

1. Telecommunications Service Providers

a. Wireless Telecommunications Providers

8. Pursuant to 47 CFR § 9.10(a), the Commission’s 911 service requirements are only applicable to Commercial Mobile Radio Service (CMRS) “[providers], excluding mobile satellite service operators, to the extent that they: (1) Offer real-time, two way switched voice service that is interconnected with the public switched network; and (2) Utilize an in-network switching facility that enables the provider to reuse frequencies and accomplish seamless hand-offs of subscriber calls. These requirements are applicable to entities that offer voice service to consumers by purchasing airtime or capacity at wholesale rates from CMRS licensees.”

9. Below, for those services subject to auctions, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

10. *All Other Telecommunications.* The “All Other Telecommunications” category is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation.²² This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems.²³ Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.²⁴ The SBA has developed a small business size standard for All Other

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¹³ 5 U.S.C. § 601(5).

¹⁴ See 13 U.S.C. § 161. The Census of Government is conducted every five (5) years compiling data for years ending with “2” and “7.” See also Program Description Census of Government <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=program&id=program.en.COG#>.

¹⁵ See U.S. Census Bureau, 2012 Census of Governments, Local Governments by Type and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG02.US01>. Local governmental jurisdictions are classified in two categories - General purpose governments (county, municipal and town or township) and Special purpose governments (special districts and independent school districts).

¹⁶ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>. There were 2,114 county governments with populations less than 50,000.

¹⁷ See U.S. Census Bureau, 2012 Census of Governments, Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States – States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>. There were 18,811 municipal and 16,207 town and township governments with populations less than 50,000.

¹⁸ See U.S. Census Bureau, 2012 Census of Governments, Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. There were 12,184 independent school districts with enrollment populations less than 50,000.

¹⁹ See U.S. Census Bureau, 2012 Census of Governments, Special District Governments by Function and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG09.US01>. The U.S. Census Bureau data did not provide a population breakout for special district governments.

Telecommunications, which consists of all such firms with annual receipts of \$32.5 million or less.²⁵ For this category, U.S. Census Bureau data for 2012 shows that there were 1,442 firms that operated for the entire year.²⁶ Of those firms, a total of 1,400 had annual receipts less than \$25 million and 42 firms had annual receipts of \$25 million to \$49,999,999.²⁷ Thus, the Commission estimates that the majority of “All Other Telecommunications” firms potentially affected by our action can be considered small.

11. *AWS Services (1710–1755 MHz and 2110–2155 MHz bands (AWS-1); 1915–1920 MHz, 1995–2000 MHz, 2020–2025 MHz and 2175–2180 MHz bands (AWS-2); 2155–2175 MHz band (AWS-3)).* For the AWS-1 bands,²⁸ the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million. For AWS-2 and AWS-3, although we do not know for certain which entities are likely to apply for these frequencies, we note that the AWS-1 bands are comparable to those used for cellular service and personal communications service. The Commission has not yet adopted size standards for the AWS-2 or AWS-3 bands but proposes to treat both AWS-2 and AWS-3 similarly to broadband PCS service and AWS-1 service due to the comparable capital requirements and other factors, such as issues involved in relocating incumbents and developing markets, technologies, and services.²⁹

12. *Competitive Local Exchange Carriers (Competitive LECs). Competitive Access Providers (CAPs), Shared-Tenant Service Providers, and Other Local Service Providers.* Neither the Commission nor the SBA has developed a small business size standard specifically for these service providers. The appropriate NAICS Code category is Wired Telecommunications Carriers and under that size standard, such a business is small if it has 1,500 or fewer employees.³⁰ U.S. Census Bureau data for 2012 indicate that 3,117 firms operated during that year.³¹ Of that number, 3,083 operated with fewer than 1,000 employees.³² Based on these data, the Commission concludes that the majority of Competitive LECs, CAPs, Shared-Tenant Service Providers, and Other Local Service Providers, are small entities. According to Commission data, 1,442 carriers reported that they were engaged in the provision of either

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²⁰ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>; Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>; and Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. While U.S. Census Bureau data did not provide a population breakout for special district governments, if the population of less than 50,000 for this category of local government is consistent with the other types of local governments the majority of the 38,266 special district governments have populations of less than 50,000.

²¹ *Id.*

²² See U.S. Census Bureau, 2017 NAICS Definitions, NAICS Code “517919 All Other Telecommunications”, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517919&search=2017+NAICS+Search&search=2017>.

²³ *Id.*

²⁴ *Id.*

²⁵ See 13 CFR § 121.201, NAICS code 517919.

²⁶ U.S. Census Bureau, 2012 *Economic Census of the United States*, Table EC1251SSSZ4, Information: Subject Series - Estab and Firm Size: Receipts Size of Firms for the United States: 2012, NAICS code 517919, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4/naics~517919.

²⁷ *Id.*

²⁸ The service is defined in section 90.1301 *et seq.* of the Commission’s Rules, 47 CFR § 90.1301 *et seq.*

²⁹ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Report and Order, 18 FCC Rcd 25162, Appx. B (2003), modified by *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz* (continued....)

competitive local exchange services or competitive access provider services.³³ Of these 1,442 carriers, an estimated 1,256 have 1,500 or fewer employees.³⁴ In addition, 17 carriers have reported that they are Shared-Tenant Service Providers, and all 17 are estimated to have 1,500 or fewer employees.³⁵ Also, 72 carriers have reported that they are Other Local Service Providers.³⁶ Of this total, 70 have 1,500 or fewer employees.³⁷ Consequently, based on internally researched FCC data, the Commission estimates that most providers of competitive local exchange service, competitive access providers, Shared-Tenant Service Providers, and Other Local Service Providers are small entities.

13. *Incumbent Local Exchange Carriers (LECs).* Neither the Commission nor the SBA has developed a small business size standard specifically for incumbent local exchange services. The closest applicable NAICS Code category is Wired Telecommunications Carriers.³⁸ Under the applicable SBA size standard, such a business is small if it has 1,500 or fewer employees.³⁹ U.S. Census Bureau data for 2012 indicate that 3,117 firms operated the entire year.⁴⁰ Of this total, 3,083 operated with fewer than 1,000 employees.⁴¹ Consequently, the Commission estimates that most providers of incumbent local exchange service are small businesses that may be affected by our actions. According to Commission data, one thousand three hundred and seven (1,307) Incumbent Local Exchange Carriers reported that they were incumbent local exchange service providers.⁴² Of this total, an estimated 1,006 have 1,500 or fewer employees.⁴³ Thus using the SBA's size standard the majority of incumbent LECs can be considered small entities.

14. *Narrowband Personal Communications Services.* Two auctions of narrowband personal communications services (PCS) licenses have been conducted. To ensure meaningful participation of small business entities in future auctions, the Commission has adopted a two-tiered small business size standard in the Narrowband PCS Second Report and Order. Through these auctions, the Commission has awarded a total of 41 licenses, out of which 11 were obtained by small businesses.⁴⁴ A "small business" is an entity that, together with affiliates and controlling interests, has average gross revenues for the three

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Bands, Order on Reconsideration, 20 FCC Rcd 14058, Appx. C (2005); *Service Rules for Advanced Wireless Services in the 1915–1920 MHz, 1995–2000 MHz, 2020–2025 MHz and 2175–2180 MHz Bands*; *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Notice of Proposed Rulemaking, 19 FCC Rcd 19263, Appx. B (2005); *Service Rules for Advanced Wireless Services in the 2155–2175 MHz Band*, Notice of Proposed Rulemaking, 22 FCC Rcd 17035, Appx. (2007).

³⁰ See 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>.

³¹ See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517110.s

³² *Id.*

³³ See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, Trends in Telephone Service at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

³⁴ *Id.*

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

³⁸ See 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>

preceding years of not more than \$40 million. A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million. The SBA has approved these small business size standards.⁴⁵

15. *Offshore Radiotelephone Service.* This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.⁴⁶ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.⁴⁷ U.S. Census Bureau data in this industry for 2012 show that there were 967 firms that operated for the entire year.⁴⁸ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁴⁹ Thus, under this SBA category and the associated small business size standard, the majority of Offshore Radiotelephone Service firms can be considered small. There are presently approximately 55 licensees in this service. However, the Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite).

16. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.⁵⁰ Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.⁵¹ The SBA has established a small business size standard for this industry of 1,250 employees or less.⁵² U.S. Census Bureau data for 2012 shows that 841 establishments operated in this industry in that year.⁵³ Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.⁵⁴ Based on this data, we conclude that a majority of

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³⁹ *Id.*

⁴⁰ See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517110.

⁴¹ *Id.*

⁴² See *Trends in Telephone Service*, Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*).

⁴³ *Id.*

⁴⁴ *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS*, GEN Docket No. 90-314, ET Docket No. 92-100, PP Docket No. 93-253, Second Report and Order and Second Further Notice of Proposed Rulemaking, 15 FCC Rcd 10456 (2000).

⁴⁵ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

⁴⁶ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 CFR §§ 22.1001-22.1037.

⁴⁷ 13 CFR § 121.201, NAICS codes 517210.

⁴⁸ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, *Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210* (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~5172100.

⁴⁹ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁵⁰ The NAICS Code for this service is 334220. 13 CFR § 121.201. See also U.S. Census Bureau, 2012 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”

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manufacturers in this industry are small.

17. *Rural Radiotelephone Service.* The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.⁵⁵ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (BETRS).⁵⁶ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.⁵⁷ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁵⁸ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁵⁹ Thus under this category and the associated size standard, the Commission estimates that the majority of Rural Radiotelephone Services firm are small entities. There are approximately 1,000 licensees in the Rural Radiotelephone Service, and the Commission estimates that there are 1,000 or fewer small entity licensees in the Rural Radiotelephone Service that may be affected by the rules and policies proposed herein.

18. *Wireless Communications Services.* This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (WCS) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁶⁰ The SBA has approved these small business size standards.⁶¹ In the Commission’s auction for geographic area licenses in the WCS there were seven winning bidders that qualified as “very small business” entities, and one that qualified as a “small business” entity.

19. *Wireless Telecommunications Carriers (except Satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular services, paging services, wireless internet access, and

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<https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en./ECN.NAICS2012.334220#>.

⁵¹ *Id.*

⁵² 13 CFR § 121.201, NAICS Code 334220.

⁵³ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012, NAICS Code 334220, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334220.

⁵⁴ *Id.*

⁵⁵ The service is defined in 47 CFR § 22.99.

⁵⁶ BETRS is defined in 47 CFR §§ 22.757 and 22.759.

⁵⁷ 13 CFR § 121.201, NAICS codes 517210.

⁵⁸ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517210.

⁵⁹ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁶⁰ *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁶¹ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

wireless video services.⁶² The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.⁶³ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁶⁴ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.⁶⁵ Thus under this category and the associated size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small entities.

20. *Wireless Telephony.* Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite).⁶⁶ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁶⁷ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.⁶⁸ Of this total, 955 firms had fewer than 1,000 employees and 12 firms had 1000 employees or more.⁶⁹ Thus under this category and the associated size standard, the Commission estimates that a majority of these entities can be considered small. According to Commission data, 413 carriers reported that they were engaged in wireless telephony.⁷⁰ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁷¹ Therefore, more than half of these entities can be considered small.

21. *700 MHz Guard Band Licensees.* In 2000, in the *700 MHz Guard Band Order*, the Commission adopted size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits and installment payments.⁷² A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁷³ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁷⁴ SBA approval of these definitions is not required.⁷⁵ An auction of 52 Major Economic Area licenses commenced on September

⁶² U.S. Census Bureau, 2012 NAICS Definitions, “517210 Wireless Telecommunications Carriers (Except Satellite),” See <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN.NAICS2012.517210>.

⁶³ 13 CFR § 121.201, NAICS code 517210.

⁶⁴ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

⁶⁵ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁶⁶ 13 CFR § 121.201, NAICS code 517210.

⁶⁷ *Id.*

⁶⁸ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

⁶⁹ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁷⁰ See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, Trends in Telephone Service at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

⁷¹ *Id.*

6, 2000, and closed on September 21, 2000.⁷⁶ Of the 104 licenses auctioned, 96 licenses were sold to nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses commenced on February 13, 2001 and closed on February 21, 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁷⁷

22. *Lower 700 MHz Band Licenses.* The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁷⁸ The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁷⁹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸⁰ Additionally, the lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (MSA/RSA) licenses—“entrepreneur”—which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸¹ The SBA approved these small size standards.⁸² An auction of 740 licenses (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)) commenced on August 27, 2002, and closed on September 18, 2002. Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business or entrepreneur status and won a total of 329 licenses.⁸³ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses: 5 EAG licenses and 476 Cellular Market Area licenses.⁸⁴ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁵ On July 26, 2005, the Commission completed an auction of 5 licenses in the Lower 700 MHz band (Auction No. 60). There were three winning bidders for five licenses. All three winning bidders claimed small business status.

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⁷² See *Service Rules for the 746–764 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (*746–764 MHz Band Second Report and Order*). Service rules were amended in 2007, but no changes were made to small business size categories. See *Service Rules for the 698–746, 747–762 and 777–792 MHz Bands*, WT Docket No. 06-150, Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephones, WT Docket No. 01-309, Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services, WT Docket 03-264, Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules, WT Docket No. 06-169, Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229, Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010, WT Docket No. 96-86, *Report and Order and Further Notice of Proposed Rulemaking*, 22 FCC Rcd 8064 (2007).

⁷³ See *id.* at 5343, para. 108.

⁷⁴ See *id.*

⁷⁵ See *id.* at 5343, para. 108 n.246 (for the 746–764 MHz and 776–794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁷⁶ See *700 MHz Guard Bands Auction Closes: Winning Bidders Announced*, Public Notice, 15 FCC Rcd 18026 (WTB 2000).

⁷⁷ See *700 MHz Guard Bands Auction Closes: Winning Bidders Announced*, Public Notice, 16 FCC Rcd 4590 (WTB 2001).

⁷⁸ See *Reallocation and Service Rules for the 698–746 MHz Spectrum Band (Television Channels 52–59)*, Report and Order, 17 FCC Rcd 1022 (2002) (*Channels 52–59 Report and Order*).

23. In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁸⁶ An auction of 700 MHz licenses commenced January 24, 2008, and closed on March 18, 2008, which included: 176 Economic Area licenses in the A-Block, 734 Cellular Market Area licenses in the B-Block, and 176 EA licenses in the E-Block.⁸⁷ Twenty winning bidders, claiming small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years) won 49 licenses. Thirty-three winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) won 325 licenses.

24. *Upper 700 MHz Band Licenses.* In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁸⁸ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁸⁹ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

25. *Wireless Resellers.* The SBA has not developed a small business size standard specifically for Wireless Resellers. The SBA category of Telecommunications Resellers is the closest NAICS code category for wireless resellers.⁹⁰ The Telecommunications Resellers industry comprises establishments engaged in purchasing access and network capacity from owners and operators of telecommunications networks and reselling wired and wireless telecommunications services (except satellite) to businesses and households.⁹¹ Establishments in this industry resell telecommunications; they do not operate transmission facilities and infrastructure. Mobile virtual network operators (MVNOs) are included in this industry.⁹² Under the SBA's size standard, such a business is small if it has 1,500 or fewer employees.⁹³ U.S. Census Bureau data for 2012 show that 1,341 firms provided resale services for

(Continued from previous page)

⁷⁹ See *id.* at 1087-88, para. 172.

⁸⁰ See *id.*

⁸¹ See *id.*, at 1088, para. 173.

⁸² See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (filed Dec. 2, 1998) (*Alvarez Letter 1998*).

⁸³ See *Lower 700 MHz Band Auction Closes*, Public Notice, 17 FCC Rcd 17272 (WTB 2002).

⁸⁴ See *id.*

⁸⁵ See *id.*

⁸⁶ *Service Rules for the 698–746, 747–762 and 777–792 MHz Band; Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones; Biennial Regulatory Review—Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services; Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission's Rules; Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band; Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010; Declaratory Ruling on Reporting Requirement under Commission's Part 1 Anti-Collusion Rule*, WT Docket Nos. 07-166, 06-169, 06-150, 03-264, and 96-86, PS Docket No. 06-229, CC Docket No. 94-102, Second Report and Order, 22 FCC Rcd 15289, 15359 n.434 (2007) (*700 MHz Second Report and Order*).

⁸⁷ See *Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁸⁸ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

the entire year.⁹⁴ Of that number, all operated with fewer than 1,000 employees.⁹⁵ Thus, under this category and the associated small business size standard, the majority of these resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.⁹⁶ Of these, an estimated 211 have 1,500 or fewer employees.⁹⁷ Consequently, the Commission estimates that the majority of Wireless Resellers are small entities.

b. Equipment Manufacturers

26. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.⁹⁸ Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.⁹⁹ The SBA has established a small business size standard for this industry of 1,250 employees or less.¹⁰⁰ U.S. Census Bureau data for 2012 shows that 841 establishments operated in this industry in that year.¹⁰¹ Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.¹⁰² Based on this data, we conclude that a majority of manufacturers in this industry can be considered small.

27. *Semiconductor and Related Device Manufacturing.* This industry comprises establishments primarily engaged in manufacturing semiconductors and related solid state devices.¹⁰³ Examples of products made by these establishments are integrated circuits, memory chips, microprocessors, diodes, transistors, solar cells and other optoelectronic devices.¹⁰⁴ The SBA has developed a small business size standard for Semiconductor and Related Device Manufacturing, which consists of all such companies having 1,250 or fewer employees.¹⁰⁵ U.S. Census Bureau data for 2012 show that there were 862 establishments that operated that year.¹⁰⁶ Of this total, 843 operated with fewer

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⁸⁹ See *Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁹⁰ See 13 CFR § 121.201; NAICS Code 517911.

⁹¹ U.S. Census Bureau, *North American Industry Classification System, 2017 NAICS Definition, 517911 Telecommunications Resellers*, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517911&search=2017> (last visited Dec. 7, 2018).

⁹² *Id.*

⁹³ 13 CFR § 121.201; NAICS Code 517911.

⁹⁴ See U.S. Census Bureau, *North American Industry Classification System, 2017 NAICS Definition, 517911 Telecommunications Resellers*, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517911&search=2017> (last visited Dec. 7, 2018).

⁹⁵ *Id.*

⁹⁶ See *Trends in Telephone Service*, at tbl. 5.3.

⁹⁷ *Id.*

⁹⁸ U.S. Census Bureau, 2012 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing” <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en./ECN.NAICS2012.334220#>.

⁹⁹ *Id.*

¹⁰⁰ 13 CFR § 121.201, NAICS Code 334220.

than 1,000 employees.¹⁰⁷ Thus, under this size standard, the majority of firms in this industry can be considered small.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

28. The *Fifth Further Notice* proposes and seeks comment on E911 location accuracy rule changes that may affect reporting, recordkeeping, and other compliance requirements for small entities. In particular, the *Fifth Further Notice* seeks comment on: (1) timelines for requiring carriers to provide floor-level emergency caller information (whether 5 years or an alternative number) to Public Safety Access Points (PSAP); (2) focusing z-axis technology deployment on building size vs. population coverage, and; (3) use of alternative information—third party and crowd sourced information—to provide dispatchable location.

29. The proposed rules in the *Fifth Further Notice* if adopted may require small entities to hire engineers, consultants, or other professionals for compliance. The Commission cannot however, quantify the cost of compliance with the potential rule changes and obligations that may result in this proceeding. In our discussion of the proposals in the *Fifth Further Notice* we have sought comments from the parties in the proceeding, including cost and benefit analyses, and expect the information we received in the comments to help the Commission identify and evaluate relevant matters for small entities, including any compliance costs and burdens that may result from the matters raised in the *Fifth Further Notice*.

E. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

30. The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for such small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.¹⁰⁸

(Continued from previous page)

¹⁰¹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012, NAICS Code 334220, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334220.

¹⁰²

http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2012_US_31SG2&prodType=table.

¹⁰³ See U.S. Census Bureau, 2017 NAICS Definition, NAICS Code 334413 “Semiconductor and related device Manufacturing,” <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN.NAICS2012.334413#>.

¹⁰⁴ *Id.*

¹⁰⁵ 13 CFR § 121.201.

¹⁰⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1231SG2, Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012 https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334413.

¹⁰⁷ *Id.*

¹⁰⁸ See 5 U.S.C. § 603(c)(1)-(4).

31. The Commission determined in the *Fifth Report and Order* that benefit floor from the enhanced horizontal and vertical location accuracy requirements adopted for wireless phones is expected to be \$97 billion and far exceeds its costs. In the *Fifth Further Notice* the Commission continues to refine its indoor location accuracy framework to meet long term public safety objectives and seeks comment on a variety of proposals to best implement its objectives, while ensuring information privacy and security. While doing so, the Commission is mindful that small entities and other CMRS providers will incur costs should the proposals we make, and the alternatives upon which we seek comment in the *Fifth Further Notice*, be adopted. We believe however that the economic costs of compliance for small entities will be reduced by some of the steps we have taken in the *Fifth Further Notice* such as our proposals, (1) to expand options for the z-axis deployment, (2) to expand options for the dispatchable location portion of our rules, provided that any new sources of dispatchable locations would be subject to privacy and security protection equivalent to those in currently in effect.

32. To assist in the Commission's evaluation of the economic impact on small entities and other CMRS providers, the Commission seeks comment on the costs and benefits of various proposals and alternatives in the *Fifth Further Notice* and specifically on how to reduce compliance costs and increase benefits.

33. In particular, the Commission seeks comment on the costs and benefits of narrowing the z-axis metric from 3 meters to 1 meter and information on the costs to carriers and public safety to develop database solutions that can be used to convert altitude measurements to an actual floor-level. The Commission also seeks comment on the costs and benefits as applied to a nationwide deployment of the z-axis metric, resulting in a nationwide x, y and z location accuracy standard and associated with a phased-in, nationwide deployment of the z-axis metric; and on how a nationwide deployment would impact compliance costs. Further, the Commission seeks comment on alternatives to the NEAD including the costs and benefits of requiring the reporting of both (1) dispatchable location and (2) z-axis information in the top 50 Cellular Market Areas, and the associated costs and benefits of relying on alternative data sources for dispatchable location.

34. Aside from the costs and benefits information in the *Fifth Further Notice*, the Commission seeks comment on the appropriate timeline for requiring carriers to provide floor level information—or more granular requirements—and considers a five-year timeline for doing so. In the alternative, the Commission seeks comment on whether other timelines would better account for the time needed to achieve technical feasibility and the associated costs for the provision of floor level information rather than meeting the 3-meter vertical location accuracy standard. To help secure E911 location information, the *Fifth Further Notice* also seeks comment on whether alternative sources of caller location information would best help provide timely and accurate dispatchable location information, and queries whether such information can be secured by applying security and privacy requirements similar to those of the NEAD.

35. The Commission expects to consider more fully the economic impact on small entities following its review of comments filed in response to the *Fifth Further Notice*, including costs and benefits analyses. The Commission's evaluation of the comments filed in this proceeding will shape the final alternatives it considers, the final conclusions it reaches, and any final actions it ultimately takes in this proceeding to minimize any significant economic impact that may occur on small entities.

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rules

36. None.

APPENDIX E**List of Commenting Parties****Comments**

ADT LLC d/b/a ADT Security Services (“ADT”)
Airwave Developers LLC (AWD)
Association of Public-Safety Communications Officials-International, Inc. (APCO)
AT&T Services, Inc. (AT&T)
Alliance for Telecommunications Industry Solutions (ATIS)
Boulder Emergency Telephone Service Authority (BRETSA)
Competitive Carriers Association (CCA)
CTIA
Google LLC (Google)
International Association of Fire Chiefs (IAFC), *et al.*
International Association of Fire Fighters (IAFF)
NENA: The 9-1-1 Association (NENA)
NextNav, LLC (NextNav)
Precision Broadband LLC (Precision Broadband)
Public Knowledge
Qualcomm Inc. (Qualcomm)
State of Florida Department of Management Services, Division of Telecommunications, Bureau of Public Safety (Florida)
Texas 9-1-1 Alliance, the Texas Commission on State Emergency Communications (“CSEC”), and the Municipal Emergency Communication Districts Association (Texas 9-1-1 Entities)
T-Mobile
Verizon

Reply Comments

AT&T
BRETSA
CTIA
IAFC
IAFF
NCTA – The Internet & Television Association (NCTA)
NENA
NextNav
Polaris Wireless (Polaris)
Precision Broadband
T-Mobile

**STATEMENT OF
CHAIRMAN AJIT PAI**

Re: *Wireless E911 Location Accuracy Requirements*, PS Docket No. 07-114.

When you dial 911 for help, every second counts. That's why first responders need to be able to find you as quickly as possible.

But when you call 911 from a wireless phone in a multi-story building, this can be a challenge. First responders may know what building address you're calling from, but they may find it difficult if not impossible to figure out which floor you're on.

Today, we aim to close this gap. We do this by adopting a vertical, or "z-axis," location accuracy metric of plus or minus 3 meters for 80% of wireless E911 calls from z-axis capable handsets. In English, this means that first responders will now be able to more accurately identify the floor level for most 911 calls and reduce emergency response time.

Perhaps the best verdict on what this 3-meter metric means comes directly from the public safety community. In a recent joint statement, the International Association of Fire Chiefs, International Association of Fire Fighters, International Association of Chiefs of Police, National Sheriffs' Association and National Association of State EMS Officials state: "A three meter z-axis metric not only provides emergency responders with actionable location information, but it also gives the public greater assurance that when they dial 9-1-1 from their cell phones, emergency responders can find them more quickly." The National Association of EMS Physicians says that our action today will "provide faster medical attention, ideally improving outcomes and saving lives." And NENA, The 9-1-1 Association says that "We're pleased with the ± 3 m standard, and we're not alone. It's safe to say that public safety stands behind the FCC's draft rules." And the National Association of State 911 Administrators says, "With these rules and proposals, the FCC demonstrates the importance of accurate wireless 911 location information and its critical role in public safety." The National Sheriffs' Association says, "This [rule] will enable 911 callers to be located more quickly, will greatly improve response times and will save lives." And just yesterday, I visited the Cambridge, Massachusetts Emergency Communications Department, where I met David Harmon. This public safety hero was the police dispatcher who was on call in 2013 following the Boston Marathon bombings, when MIT Officer Sean Collier was shot and killed, and the suspects raised mayhem across the metropolitan area. As David put it, this z-axis metric "will make all the difference in the world. . . . It's gigantic." I'm grateful for the service of the public safety heroes who sacrifice so much every day to protect Americans. I'm honored to have their strong support of our decision today. And I'm proud to stand on the side of public safety.

In adopting a z-axis metric, we also take steps to protect data privacy and security. First, we amend our rules to ensure that 911 call z-axis information is used only for 911 purposes. And we require that any z-axis information that is stored before or after the 911 call also will be subject to the same consumer privacy and security protections that apply to data for purposes of the National Emergency Address Database. These measures are consistent with our longstanding approach to protection of 911 location data and consumer privacy.

As important as today's action is, we also recognize that as technology evolves, so too should our z-axis metric. And so we're looking at tightening the z-axis metric over time, and even ultimately requiring wireless carriers to report the caller's specific floor level. We also seek input on alternative deployment milestones for z-axis and dispatchable location technologies.

I would like to express my personal gratitude to Harold Schaitberger, the General President of the International Association of Fire Fighters, for joining us today to express his organization's support for this bold measure. The International Association of Fire Fighters represents 320,000 professional fire fighters and paramedics. These are the men and women who rush into buildings when there is an emergency and they are the ones who best understand what information they need to find someone

quickly and save lives.

We also wouldn't have reached this milestone without the commitment of our own dedicated staff on the front lines: Dr. Kenneth Carlberg, Rochelle Cohen, Alex Espinoza, John Evanoff, Nellie Foosaner, Lisa Fowlkes, David Furth, Erika Olsen, Dr. Rasoul Safavian, and Michael Wilhelm from the Public Safety and Homeland Security Bureau; Chana Wilkerson and Sanford Williams from the Office of Communications Business Opportunities; Eric Burger, Jonathan Campbell, Giulia McHenry, Chuck Needy, and Emily Talaga from the Office of Economics and Analytics; Brian Butler and Ira Keltz from the Office of Engineering and Technology; David Horowitz, William Richardson, and Anjali Singh from the Office of General Counsel; and Nicole Ongele from the Office of Managing Director.

**STATEMENT OF
COMMISSIONER BRENDAN CARR**

Re: *Wireless E911 Location Accuracy Requirements*, PS Docket No. 07-114.

Fairfax Center Fire Station 40 is a showcase firehouse for the county in suburban Virginia. The immaculately-maintained facilities house Fairfax's primary hazmat response team and a continuing education center for first responders. Equally celebrated is the firehouse's 100-gallon fish tank, which a shift built using spare parts and pieces ordered online. The fish tank is more than a decoration. As one firefighter told me, it's a way that she and her teammates decompress—a way to relieve the stress of saving lives.

I spent a morning last week with about a dozen firefighters at Station 40 to understand how location technology assists them in their jobs. It was eye-opening. A firefighter who has been at it for decades described what it's like to charge into a burning building. It's chaos. Fire and smoke, adrenaline racing. Sometimes you can't tell what floor you're on. Other times it's no use telling because the floors have collapsed.

Two use cases for height sensors immediately came to the veteran firefighter's mind. He said that knowing the vertical location of a 911 caller could cut search and rescue time. And knowing the height of a lost or unresponsive teammate could save a first responder's life.

What first responders want is actionable information. Sometimes they want to know what door to kick in or what floor to climb to. And so today we require that floor-level information be provided when it's available. We seek to know the state of the science so that as technology can more regularly and accurately identify floors or even units, we can send that data to those trying to save lives.

At other times, though, floor information isn't what's needed. The floor from which the 911 call came won't matter if the floor has collapsed. A floor estimate isn't relevant to rescuing someone stuck on a cliff—an example with which the Fairfax firefighters have first-hand experience in Great Falls Park. And in the heat of the moment, rushing into a burning building, surrounded by smoke, it's easy for a first responder to become disoriented and lose track of exactly what floor she's on. Telling her to go to Floor 9 is less actionable in those cases than telling her that the 911 call originated 20 meters above her current location—and that is information that no PSAP needs to translate or convert before providing it to their fellow first responders.

The true height—or HAE—approach we adopt has promise and is technically feasible today. But I think we all agree that we shouldn't put all of our chips on one particular technology. That's why the further notice presses carriers, handset makers, and software companies to keep working on this data challenge so we can raise the standard as technology evolves. At the same time, we certainly shouldn't put all of our chips on another technology, the makers of which say is not ready for prime time. And that's particularly true when we can foresee that the technology won't work in so many emergency circumstances—for example, when the power is off.

Everyone on this dais supports sending height information to first responders. Everyone wants to press the technologists and inventors to make that data more and more precise. Today's item gives us a choice. Do we send the best height information that's technically possible to first responders now, or do we wait until better height information is available later? The companies that have been lobbying for the FCC to depend on a particular technology—which, to repeat, they say is not ready to be used—previously called on the Commission to hit the pause button on updating our vertical location requirements. I, for one, don't think we should wait. I think we should send the best information now and continue sending better information as the technology improves. And that is the same view that first responders from

across the country wrote to the FCC in support of.

So I want to thank the overwhelming majority of the public safety community for its endorsement of this item, and I want to thank the Public Safety and Homeland Security Bureau for its work. The item has my support.

**STATEMENT OF
COMMISSIONER JESSICA ROSENWORCEL,
APPROVING IN PART, DISSENTING IN PART**

Re: *Wireless E911 Location Accuracy*, PS Docket No. 07-114, Fifth Report and Order and Fifth Further Notice of Proposed Rulemaking (November 22, 2019)

You may only make one 911 call in your life, but it will be the most important call you ever make. Before any police radio crackles, fire engine blares, or ambulance races—you need to reach a 911 operator. These professionals represent the front line of our nation’s public safety systems. They know that in emergencies every second counts. To find you, they need actionable and accurate information.

That’s our north star in this proceeding: making sure every 911 operator has the facts they need—in a format they can use—to help keep us safe.

Five years ago, after visiting 911 operators in more than two dozen call centers, I wrote an editorial calling on the Federal Communications Commission to improve the location information that comes with every 911 call. That’s because our policies were behind the times. Our rules were a hodgepodge of standards for indoor and outdoor calling that reflected communications from decades ago. Today over 80 percent of calls to 911 come from wireless phones. So I pressed the agency to kick off a proceeding to address this problem in our policies.

We got started. We set up a course to update location information for 911 calls made from wireless phones, with a mix of benchmarks and deadlines. Today the FCC tries to bring that effort to closure by adopting rules regarding vertical location data. In doing so, I am afraid we fall short. The information we require does not go as far as we need for true public safety. We make progress, but ultimately we miss the mark because the information we require is not in any format that is presently useful for those who take our 911 calls. That’s a problem—and we owe it to 911 operators and everyone who makes a 911 call—to be honest about it.

In light of this, there are three things I want to discuss regarding this order and rulemaking: the need for truly actionable location information, the need for a nationwide approach, and the need to put privacy front and center in our efforts.

First, actionable location information should have been required.

Today, the FCC adopts a requirement that carriers must meet if they provide vertical location information using a z-axis solution. Specifically, the agency requires that wireless carriers offer public safety an indoor caller’s vertical location within plus or minus 3 meters.

The truth is a 3-meter policy does not provide public safety with precise floor location. That’s a problem. We should choose standards that without fail provide for floor-level accuracy. When police or firefighters show up in an emergency, the last thing they should have to do is take out a measuring tape. They need a standard that tells them precisely where you are. We fall short of that with the standard we adopt today. And the result—according to those who take our 911 calls—is going to be a problem.

Richard Napolitano, the Commanding Officer of the New York Police Department’s Communications Division, which handled nearly 9 million 911 calls last year, has warned us that “location information must be actionable, meaning that Police Communications Technicians can quickly use it to assist the caller and direct responders to the scene.” For this reason he cautioned that if you want z-axis information to work—and provide meaningful information for 911 operators—it needs to be

accompanied by an estimated floor number.

Karima Holmes, the Director of the District of Columbia Office of Unified Communications, responsible for 911 right here in Washington, also made clear that “having more specific location that can be translated in lay terms” for call takers and first responders is important for ensuring help arrives at the right location. She asked that we develop a method to provide a floor number or wing specification. She cautioned that a generic number above sea level, or the like, would not be actionable or useful.

Jeff Streeter is the Executive Director of the Jefferson County Communications Center Authority in Denver, Colorado which processes over 200,000 911 calls from mobile phones each year. In our record he put it plainly: “[i]n order for 911 professionals to have the information they need to ensure that responders arrive as quickly as possible, carriers should at least provide a floor number estimate.” He went on to caution that a standard of plus or minus 3 meters is not that and it will cause delay in emergencies when seconds matter.

William Pierson, the Chief of Police at the Auburn Police Department in King County, Washington, which handles 450,000 911 calls a year, warned that a plus or minus 3-meter standard is “not a helpful description of a caller’s location.” According to Chief Pierson, “seconds count. If first responders in the 911 center or in the field must spend any time trying to cross reference a location . . . the impact is seconds or minutes lost in influencing a positive outcome for the caller.” Put simply, this is why having truly actionable information—like a floor number—is so important.

We should listen to these voices from 911. We should listen to those charged with identifying our emergency and working to send assistance. We should provide them with truly actionable information when you dial 911.

Regrettably, today the FCC does not do that. Because instead of requiring a floor number or setting up a system for useful and actionable information, we require data in height above ellipsoid format. So when calls come tumbling in to 911 in a crisis, the operator on the other end of the line is supposed to figure out where you are because they have a string of numbers representing raw height above ellipsoid data that reflects coordinates measured from the center of the earth’s mass. Let’s be clear: this data is not meaningful. It will need to be calibrated, translated, and reworked to be actionable for 911. What is the detailed plan for that? Comb through the text of today’s decision. You won’t find one.

Remember that there are over 6000 public safety answering points across the country. There are more than 100,000 911 professionals who work in them, day-in, and day-out taking every call with steely calm. They’ve been told they need to upgrade their systems to next generation 911. This is going to cost over \$12 billion. No one knows where this funding is going to come from and yet today we are tacking on a brand new obligation for 911 centers to take raw height above ellipsoid data and hope and pray they will be able to translate it into something actionable.

But Commanding Officer Napolitano from New York has told us in no uncertain terms that “a raw vertical estimate is of little operational value if it is relative to ‘height above ellipsoid’ . . . because our 911 center does not have the equipment to translate” z-coordinates into anything actionable. If it does not work in New York—one of the cities where the case for vertical location is the clearest—it calls to question how this will work anywhere.

In fact, this is not an issue just for the biggest cities. Kimberly Burdick, Director of the 911 Communications Center in rural Chouteau County, Montana warns that “centers like mine do not have the resources to create and maintain indoor maps for buildings in our jurisdiction” or even the “ability to translate [height above ellipsoid] to floor or “a three dimensional point in space.”

Of course, it is worth recognizing that even if 911 operators cannot translate height above ellipsoid data they can relay it to a responding paramedic, fire fighter, or police officer at the scene, who may be able to take action. But the same problem emerges. Because a height above ellipsoid set of numbers will be meaningless unless it is calibrated and translated into something actionable by the first responder. But again there is no requirement here that ensures that happens. Instead, we have to hope that every first responder will be outfitted with the right technology to translate height above ellipsoid data on the fly. That's a huge assumption and a glaring hole in the policies we adopt today. Do public safety officials in every town, city, county, and state have the budget to do this? How much will it cost? Who will pay for it? Is it even possible? Does this even work, as the New York Police Department questions, during a building fire or active shooter situation when the last thing you want is first responders wasting precious minutes fumbling with this data on a specialized device. On all of this our decision is silent. We should do better.

Putting aside these problems with data processing, it is important to peel back and take a look at the details that led the FCC to this standard. The new rules require that wireless carriers relying on z-axis satisfy their vertical location obligation with data accurate at plus or minus 3 meters height above ellipsoid for 80 percent of their wireless E911 calls made from a z-axis- capable device. This standard is based entirely on results from a testbed. That testbed was a controlled environment. It does not reflect widespread, real-world use. This, too, is a problem with this requirement.

Second, a nationwide approach would have been the right call.

The approach taken today proceeds on a pathway set up a few years ago to require vertical location information for 911 calls made in the top 25 metropolitan areas by 2021 and the largest 50 metropolitan areas by 2023. However, it has become clear that a nationwide approach would better serve the public interest. Because by limiting our efforts here, too many people in too many places—especially in rural America—will never see the benefits of any policy designed to provide a caller's vertical location. That's a shame because there are multi-story office parks, town homes, and other structures across the country. I regret my colleagues did not agree to my request to be more ambitious and ensure our rules cover all. Any policy designed to improve 911 location accuracy should benefit every 911 caller nationwide. Not just those who dial from the biggest cities and most populated areas.

Third, privacy is paramount.

Finally, I'd like to discuss an aspect of today's decision I support because the FCC is clearly on the right path—and that involves the privacy and data security protections extended to 911 vertical location data. The agency rightly concludes that 911 vertical location data should only be used for 911 purposes. While I would have preferred that we go one step further to require a report to see how these requirements are working in practice, I do support this aspect of today's decision. The vertical location data associated with your 911 call should be private and protected.

This is especially important because this agency has been unacceptably silent about press reports about the sale of our wireless geolocation data. Last year, it was first revealed that wireless carriers were selling our private data about when and where we are using our devices to third-party location aggregators. Then, earlier this year, it was revealed that this data was still for sale—and ending up in the hands of bounty hunters. It turns out that for a few hundred dollars, shady middlemen could use this information to track where we are at any moment within a few hundred meters.

I don't recall consenting to have my wireless location data sold this way—and yet it happened. I don't see how this is permissible under the law. But to date, the agency has been silent. It's been close to

a year and a half since this mess was first uncovered and this agency has nothing to say? I hope that silence ends soon because this, like 911 location data, involves the security and safety of the public.

In closing, I'd like to note that even though we have some fundamental disagreements today, I appreciate my colleagues' history working to improve 911 policy. From my efforts with Commissioner O'Rielly to end 911 fee diversion in the states to Chairman Pai's passion to fix 911 problems in multi-line telephone systems, I am still optimistic about what this agency can accomplish.

Kurt Vonnegut once said there is no better symbol of humanity than a firetruck. I think that is true. In an emergency, whether you are a trained professional or a good Samaritan, there is a reflex in all of us that compels us to act, to ease suffering, and to save lives. That same reflex exists in those of us in Washington setting policy when we see that our public safety officials are lacking the tools they need to do their jobs. So I appreciate what is driving this agency to act. But as any trained professional will tell you, sometimes you have to look up from the immediate problem and take in the big picture. You have to pause and make sure that the actions you are taking truly will have the impact you want them to have. So I do not support the standard we adopt today for vertical location accuracy. By any measure, it falls short of what is actionable. It does not provide floor-level information and instead just offers a series of numbers reflecting height above ellipsoid. I believe our 911 operators deserve data that is truly useful if we want to help them help keep us safe. And on that score, we have work to do.

I will support the rulemaking here because I hope it provides us with a path to fix these problems. I also will support the decisions we make regarding 911 privacy. But in all other respects, I regretfully dissent.

**STATEMENT OF
COMMISSIONER GEOFFREY STARKS**

Re: *Wireless E911 Location Accuracy Requirements*, PS Docket No. 07-114

A call to 911 is one we all hope we never have to make. With today's Order and NPRM, we take the next step in deploying lifesaving location technology for mobile phone users that will improve the ability of first responders to send help where it is needed.

This is a step in the right direction, but it is not the final one. The three-meter metric we adopt today will get first responders close to those in distress but, as I have noted in the past, floor-level accuracy is needed to ensure they get to the right place every time. I am pleased that the NPRM seeks comment on transitioning to a more stringent metric. This is literally a life-or-death issue, and we need to move fast.

The increasingly accurate location data that we can provide to first responders increases safety, but it also increases our responsibility to protect user privacy. This is sensitive personal information that is vulnerable to abuse outside the 911 context. I suggested edits to the item to foreclose any possibility that vertical location details could be abused by third-party vendors that CMRS providers work with. I appreciate that the Chairman worked with me to close that loophole.

We must also continue to work to ensure that the benefits of enhanced 911 reach all Americans, including Lifeline recipients. Though today's NPRM, we ask important questions about how to increase the stock of Lifeline phones that are z-axis capable. I am pleased the Order adopts a technology-neutral approach to z-axis support, and that it appears that some providers are working toward solutions that do not require special hardware and may more readily work with Lifeline phones. Because Lifeline provides an essential connection to our most vulnerable, we must ensure that they are not left behind as we work towards improved location accuracy for emergency response. I look forward to robust comments on these issues.

Many thanks for the dedicated staff of the Public Safety and Homeland Security Bureau. Your tireless efforts on this issue are saving lives.