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**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

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

PETITION FOR CLARIFICATION

The Association of Public-Safety Communications Officials-International, Inc. (APCO)¹ submits this Petition for Clarification in response to the Federal Communications Commission’s (Commission) Fifth Report and Order regarding wireless E9-1-1 location accuracy requirements.²

I. Introduction and Summary

APCO seeks clarification of the Commission’s Fifth Report and Order regarding wireless E9-1-1 location accuracy requirements. APCO’s intent is to clarify the rules, within the framework of the Order as adopted, so that wireless carriers provide the 9-1-1 location information expected for the benefit of public safety on the timeline established by the Commission. Emergency communications centers (ECCs) will be in the best position to know if carriers are providing z-axis information that complies with the metric, but clarification is needed so that, in the event of non-compliance, ECCs can raise appropriate concerns with the carriers and Commission.

¹ Founded in 1935, APCO is the nation’s oldest and largest organization of public safety communications professionals. APCO is a non-profit association with over 35,000 members, primarily consisting of state and local government employees who manage and operate public safety communications systems – including 9-1-1 Emergency Communications Centers (ECCs), emergency operations centers, radio networks, and information technology – for law enforcement, fire, emergency medical, and other public safety agencies.

² Wireless E911 Location Accuracy Requirements, Fifth Report and Order and Fifth Further Notice of Proposed Rulemaking, FCC 19-124 (rel. Nov. 25, 2019) amended by Erratum (rel. Jan 15, 2020) (“Z-Axis Order”).

As described in this Petition, several aspects of the Order require clarification. For example, which phones should consumers expect to provide vertical location information with 9-1-1 calls? How do carriers ensure that they have deployed z-axis technology in a manner that will achieve the accuracy demonstrated in the test bed? What additional z-axis technology testing is required, given that the testing described in CTIA's Stage Z Test Report was not sufficient to demonstrate compliance with the z-axis metric? When must carriers provide floor level information in addition to the altitude of a 9-1-1 caller?

APCO respectfully requests swift action by the Commission to ensure there is no risk of delay to the location accuracy benchmarks.

II. How can public safety hold the carriers accountable for compliance with the z-axis metric?

The Commission requires carriers to convey either dispatchable location or coordinate-based location information to PSAPs.³ In providing z-axis information, carriers must "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."⁴ The Commission should clarify what it means to deploy z-axis technology consistent with the manner in which it was tested, when retesting is required, and how ECCs should seek enforcement of the vertical location accuracy requirements.

A. What does it mean to deploy z-axis technology consistent with the manner in which it was tested?

The Order is unclear concerning how to certify that z-axis technology has been deployed consistent with the manner in which it was tested. The Commission should clarify that carriers must take a detailed, multi-factor approach when certifying that real-world performance

³ See *id.* para 4.

⁴ 47 CFR 9.10(i)(2)(iii)(A).

complies with the metric and expectations set by performance in the test bed. This is especially important given the potential that unquantified sources of error will be added to the location information.⁵ Carriers' compliance certifications should take into account factors such as handset capabilities, handset behavior, morphology and weather conditions, and objective measures of how technology has been deployed to ensure that the standard for +/- 3 meter accuracy will be achieved in the real world.

i. What handsets must be tested?

The z-axis metric requires an accuracy level of +/- 3 meters for 80% of wireless E9-1-1 calls made from a z-axis capable device.⁶ The Commission defined z-axis devices to include all handsets that have the capability to measure and report vertical location information without a hardware upgrade, regardless of technology, handset age, or having a barometric pressure sensor.⁷ How must carriers demonstrate that they comply with these requirements?

Must carriers ensure that, for their respective networks, *all* z-axis capable devices will be capable of achieving +/- 3 meter accuracy for 80% of calls made by those devices? If carriers are not required to demonstrate that all types of z-axis capable devices in use on their networks comply with the z-axis metric, the Commission's rules would be unlikely to result in 3 meter accuracy for 80% of calls and the purpose of broadly defining "z-axis capable devices" would be unclear.

⁵ For example, the Commission assumes that, although ECCs lack the resources to operationalize HAE, field responders will be able to match their own altitude measurements to the HAE from a 9-1-1 caller. However, testing didn't evaluate accuracy in terms of first responders matching caller altitude. How will responders match the altitude of a 9-1-1 caller when one firefighter is searching a fire floor with high heat, another is in a stairwell, and another is ascending a ladder on the outside – all of them trying to match a caller's HAE in conditions that differ from the caller?

⁶ See Z-Axis Order Appendix A, Final Rules, 9.10(i)(2)(ii)(C).

⁷ See *id.* para. 25.

If carriers are not required to achieve the z-axis metric for all z-axis capable devices, what do the Commission's rules require? How do those requirements translate into testing of z-axis capable devices and technologies that carriers must perform in the test bed? For example, if carriers only need to test a subset of z-axis capable devices, must those devices be representative of the z-axis capable devices in use on their networks? How should carriers ensure representativeness? What would prevent carriers from selecting devices or deploying z-axis technology that only achieves the z-axis accuracy requirements for a small fraction of z-axis capable devices in circulation? Note that the results from devices selected for the Stage Z Test Report were admittedly not representative of real-world performance because testing was limited to a small number of smartphone models, none more than 1.5 years old, and variation across sensors even for this relatively homogenous selection of devices was a dominant error source.⁸

APCO supports the Commission's broad definition of z-axis capable devices. Failing to clarify that carriers must ensure all z-axis capable devices comply with the z-axis metric could effectively render the definition of z-axis capable devices meaningless; contrary to the Commission's intent,⁹ the z-axis requirement could end up limited to devices with barometric sensors. This would mean that a large portion of 9-1-1 calls would lack vertical location information.¹⁰

⁸ See 9-1-1 Location Technologies Test Bed, LLC, Report on Stage Z (2018), p. 119 (Stage Z Test Report). See also, *id.* p. 122 ("Given that mobile device barometric sensor biases were found to be a dominant error source, additional effort is needed to understand the extent and nature of these biases, using a larger and more diverse sample of mobile devices.").

⁹ See Z-Axis Order para. 29 ("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.").

¹⁰ See Letter from Matthew Gerst, Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114, p. 6 (filed Nov. 5, 2019) (indicating that a substantial proportion of smartphones in the U.S. could lack a barometric pressure sensor).

Setting aside the scope of devices carriers must test in the test bed, are carriers required to certify that z-axis handsets and technology perform consistently across various communities, meaning that the use and quality of z-axis capable devices does not vary by factors such as socioeconomic status or area morphology?

- ii. Must carriers ensure z-axis performance is not limited by handset battery, privacy, and other constraints?

Handset behavior is a key factor for ensuring that a real-world technology deployment is consistent with performance demonstrated in the test bed. It's unclear whether carriers are required to ensure that handset behavior in the test bed does not deviate from realistic user patterns and constraints.¹¹ The Commission must clarify that when carriers certify that they have deployed technology consistent with the manner in which it was tested, they are taking into account consistency in any handset constraints that could impact location accuracy.

The test bed can evaluate technologies in different stages of development (e.g. production-ready, proof-of-concept, in-use). The Commission must clarify that carriers may only use test bed results for compliance purposes if the testing was of a fully integrated solution that will perform in the real world the same way it did in the test bed.

- iii. To what extent must testing include representative morphologies and weather conditions affecting z-axis technology performance?

¹¹ See Z-Axis Order para. 19 (“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.’”) (citing Letter from Paul Margie, Counsel for Apple Inc., to Marlene H. Dortch, Secretary, FCC, PS Docket No. 07-114 at 3 (filed Oct. 29, 2019)). While the Commission is correct that the test bed procedures were designed to evaluate calls based on representative locations for real-world 9-1-1 calls (Z-Axis Order para. 19), realistic test locations must be distinguished from other factors that have to do with realistic test conditions. The Stage Z Test Report presented several unanswered questions regarding real-world performance, including the accuracy and yield of z-axis information. See Stage Z Test Report pp. 121-22.

The Stage Z Test Report indicates that a key remaining question is how devices would have performed in rural morphologies, cold weather, and high winds.¹² While the Commission determined that insufficient cold weather testing was not an adequate reason to delay adoption of a z-axis metric,¹³ it should clarify that such testing remains necessary to ensure real-world performance will be consistent with test bed performance.

iv. How should carriers measure deployment of z-axis technology?

The Order is unclear regarding how carriers should measure deployment of z-axis technology. Simply describing technology deployment in terms of the geographic area covered could leave out important factors that impact the performance of location accuracy technologies. For example, the concentration of beacons can have a significant impact on vertical location accuracy,¹⁴ and any barometric sensor-based location technology would presumably vary with the concentration of weather stations available for calibration.¹⁵ How could carriers certify that test bed results represent real-world performance without taking weather station and beacon concentration into account?

The Commission should also clarify its definitions of handset-based and network-based technologies, and any implications these classifications have for carriers' certifications and testing requirements. Does the Commission consider technologies to be handset-based when the location determination is calculated on the handset despite, for example, the importance of

¹² *Id.* p. 122.

¹³ Z-Axis Order para. 17.

¹⁴ See Stage Z Test Report p. 47 (“NextNav Beacons, where deployed, broadcast a variety of information required for the device to compute its location accurately including: location, time, and other measurements useful for the computation of barometric-based altitude to mobile devices. Certain Beacon information and device measurements are also sent back to the NextNav location server. NextNav combines these sources of information to generate a Z-location estimate.”).

¹⁵ As noted in the Stage Z Test Report, a relatively small number of nearby weather reference stations is a likely explanation for poor performance of z-axis technology. See Stage Z Test Report p. 100, describing a test location with a 15-meter bias.

beacon and weather station concentration and the handsets' ability to contact proprietary location servers?¹⁶ When handset-based technologies are deployed, are factors other than the handsets themselves irrelevant for the carriers' indoor location technology certifications? The Commission should clarify that, for any technology, carriers are required to take into account handset- and network-based factors that impact location accuracy when certifying that technology has been deployed consistent with the manner in which it was tested.

B. When is retesting required?

The Commission has indicated that, following establishment of the z-axis metric, carriers must test and validate z-axis technologies for compliance purposes.¹⁷ As discussed throughout this Petition, several important issues require clarification before the test bed can produce results that should be used for compliance purposes. Accordingly, the Commission should clarify that the testing described in the Stage Z Test Report was not sufficient to demonstrate compliance with the z-axis metric.

In terms of ongoing testing, guidance is lacking regarding when carriers must repeat testing of a location technology in the test bed. The rules specify that a carrier must update its certification of compliance with the location accuracy requirements upon introduction of a new technology or modification of its network such that previous performance in the test bed would no longer be consistent with the technology's deployment.¹⁸

¹⁶ Classifying technologies according to where the location determination is calculated could result in confusion regarding the factors that should be considered when carriers certify that a technology has been deployed consistent with the manner in which it was tested. *See Z-Axis Order* para. 74 (“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.”). *But see* Stage Z Test Report, p. 47 (“All interaction between the mobile device and the NextNav location server to produce Z-axis positions occurred in test transactions (simulated test calls)” and p. 51 (“measurements [from the handset] are collected in the Polaris Wireless location Server where these sources are combined, and proprietary algorithms are applied to generate a hybrid Z-location estimate”).

¹⁷ *See Z-Axis Order* fn 64, “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.”

¹⁸ 47 CFR 9.10(i)(2)(iii)(A).

One of the key remaining questions coming out of the Stage Z Test Report is how z-axis accuracy degrades with the age of the device.¹⁹ Further, because there was variation in the accuracy of barometric sensors in new devices of the same model,²⁰ comparing old devices to new devices may not sufficiently quantify the impact of age on a device's accuracy. Must carriers retest the same devices in the test bed at regular intervals to measure the impact of age and factor this into certifications that real-world deployments are consistent with conditions in the test bed?

To what extent can "reprocessed" test bed results be used for compliance? While APCO does not object to the Commission's consideration of reprocessed data when determining whether +/- 3 meters was an achievable metric,²¹ only the test results produced by the test bed administrator should be acceptable for compliance purposes.

C. How should ECCs raise complaints that carriers are not meeting the vertical accuracy requirements?

ECCs may seek enforcement of the location accuracy rules within their geographic service area.²² When can ECCs report that a carrier is falling short of the vertical location requirements? For an ECC filing a complaint, is it sufficient to demonstrate that less than 80% of 9-1-1 calls from indoor locations are being delivered with z-axis information accurate within 3 meters?

III. What steps must device manufacturers, operating system providers, and others take to ensure z-axis technologies perform as expected?

¹⁹ Stage Z Test Report pp. 121-22.

²⁰ *See id.* p. 91.

²¹ Z-Axis Order para. 12.

²² Wireless E911 Location Accuracy Requirements, Fourth Report and Order, 30 FCC Rcd 1259 (2015) paras. 147-49 (2015 Order). *See also*, 47 CFR 9.10(i)(2)(iv).

The Commission states it will “take all appropriate action against any company that obstructs the effective deployment of [z-axis] technologies in a timely manner.”²³ Does this mean that device manufacturers and operating system providers will be subject to enforcement action if they refuse to permit z-axis technologies from engaging in battery-intensive processes that interfere with a consumer’s user experience or for any other reason? To take this action, will the Commission need to first revise its rules to make these additional entities subject to the location accuracy requirements?

IV. When must carriers deliver floor level information?

The new rules require carriers to provide floor level information where available in addition to z-axis information.²⁴ As an initial matter, the Commission should clarify that floor level information can be derived without first obtaining an HAE and then using a 3D map or other resource to convert the HAE to a floor level. Floor level information can be derived separately, without converting HAE.²⁵ Confusion over how floor level information can or must be derived will complicate the question of when such information is available to carriers.

The Commission should clarify that floor level information is considered to be available to carriers if it is technically feasible to obtain the information from a z-axis technology being used by the device, carrier-provisioned WiFi and in-home products,²⁶ new 5G technologies, or

²³ Z-Axis Order para. 25.

²⁴ 47 CFR 9.10(i)(2)(ii)(C).

²⁵ See Letter from Megan Anne Stull, Counsel to Google LLC, to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket 07-114, p. 2 (Nov. 18, 2019) (“For Android Emergency Location Services, for example, floor labeling information provided to public safety would be calculated separately, not simply converted from HAE.”). See also, E911 Location Test Bed Dispatchable Location Summary Report, ATIS Test Bed Program Management, p. 10 (Apr. 2019) (demonstrating that even a limited NEAD-based approach to vertical location is capable of identifying the correct floor level (+/- 1 floor) for nearly 40% of calls).

²⁶ As the Commission noted in the 2015 Order, there are a growing number of residential products that could easily be used as a source of location in a comprehensive dispatchable location solution. 2015 Order, para. 47. As APCO pointed out, carriers can make use of technologies and services they offer today, such as in-home Wi-Fi, to identify the floor level (if not a dispatchable location). See Letter from Jeffrey S. Cohen, APCO International, to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket No. 07-114 (filed Oct. 25, 2019).

other sources. For example, if floor level information is available on Android devices via Google ELS, a carrier's failure to make technical changes necessary to receive the information and deliver it to ECCs cannot constitute a lack of availability. The Commission should clarify that carriers are expected to make business arrangements and technical changes where necessary to be able to receive floor level information and deliver it to ECCs.²⁷

The Commission should clarify that confidence and uncertainty data should be provided along with the floor level information. This appears to be required,²⁸ but the FNPRM asks whether the Commission should require C/U with floor level information.²⁹

V. What must carriers include in their quarterly reports?

The Commission expanded the carriers' live call data reporting obligations to include z-axis data and, where available, floor level information.³⁰ The Commission should clarify that the live call data reports should include the number of calls delivered with HAE and floor level, and the technology source for that information. Today the reports might use the label of "device based hybrid" to track calls delivered with Apple's Hybridized Emergency Location or Google's Android Emergency Location Service. Going forward, more granular information will be required to indicate whether a technology like Google ELS is providing x/y, HAE, and/or floor level information.

VI. Conclusion

²⁷ Wireless carriers, cable companies, and other entities offer products and services that have (or with slight modification could have) associated floor level information (if not dispatchable location) that any carrier could access through reasonable business arrangements. The Commission has recognized that carriers "are capable of negotiating requirements with [handset manufacturers and operating system providers] and establishing contractual timelines that will enable timely deployment of z-axis solutions in time to meet the deadlines in the rules." Z-Axis Order para. 30. APCO would therefore expect that the Commission would find that floor level information is "available" to carriers if the caller is using a product or service offered by another carrier, cable company, or similar entity that has this information.

²⁸ See *id.* para. 41.

²⁹ See *id.* para. 70.

³⁰ *Id.* para. 47.

APCO's purpose for seeking these clarifications with the Commission is to best ensure the intended benefits of the 9-1-1 location accuracy rules are realized for public safety professionals and the public they serve. Throughout the entirety of the Commission's work on wireless 9-1-1 location accuracy, APCO has actively contributed to the formulation of reasonable rules that improve the information available to ECCs. APCO is committed to continuing in this spirit as the Commission navigates a path toward solving the indoor 9-1-1 location problem.

Respectfully submitted,

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