Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

COMMENTS OF GOOGLE LLC

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Google applauds the Commission's demonstrated and continuing commitment to helping first responders locate individuals in distress.[1] In particular, utilizing vertical location technologies to pinpoint user location more accurately is critical to further reducing emergency response times. Minutes or seconds saved in locating a user who contacts 911 can be the difference between life and death.

INTRODUCTION & SUMMARY

Like the Commission, Google is striving to improve wireless location technology. Android's Emergency Location Service (ELS), which is a feature on any Android handset with Google Play Services and an Android 4.0/Ice Cream Sandwich or later operating system (OS), can provide faster and more accurate location data to emergency communications centers when an emergency call or text is initiated. ELS currently delivers more precise user latitude and longitude coordinates than traditional

[1] *See In the Matter of Wireless E911 Location Accuracy Requirements*, Fourth Further Notice of Proposed Rulemaking, PS Docket No. 07-114, FCC 19-20 (rel. Mar. 18, 2019) (*FNPRM*).

technologies, and Google is committed to offering high-quality z-axis information through ELS as well. Google therefore appreciates this opportunity to comment on appropriate vertical accuracy requirements, realistic implementation timelines, and reliable and scalable test procedures.

Specifically, the Commission should use an incremental approach for the z-axis metric. The Commission could begin by requiring a four-meter z-axis metric, with steady and frequent improvements in granular accuracy consistent with the progress of geolocation technologies, until the market identifies a scalable solution to make floor-level reporting the norm. Carriers should be expected to achieve compliance with the Commission's chosen z-axis metric across all handsets on their networks, on the phase-in date. The Commission should not presume that the upcoming Stage Za testbed will necessarily resolve all issues with verifying z-axis reporting capability. While testing procedures remain in development, however, the Commission should begin phasing in vertical location requirements that can be reliably tested using available techniques.

I. ELS ENHANCES LOCATION INFORMATION WITHOUT REQUIRING USER INTERACTION

Google introduced ELS in 2016 to offer faster, more accurate location data to emergency communications centers when an Android device user contacts an emergency service provider.[2] ELS is a supplemental service that makes handset

[2] Akshay Kannan, *Helping Emergency Services Find You When You Need It Most*, The Keyword (July 25, 2016), at https://www.blog.google/around-the-globe/google-europe/helping-emergency-services-find-you/.

location from Android phones available to emergency service providers when an emergency call or text is initiated.[3] ELS works on more than 99% of current Android devices—all those that have Android OS 4.0/Ice Cream Sandwich or a later version, and access to Google Play Services—and does not require users to download or install an app, get additional OS updates, or have special hardware. Google makes ELS available *for free* to emergency services dispatchers, carriers, and other partners in the emergency services space,[4] and ELS is easy to integrate with existing emergency service infrastructure.

ELS activates when an Android user dials or texts an emergency number on an Android device.[5] Once the communication is commenced, the ELS location is computed on the device and transmitted directly to an ELS endpoint via Data SMS, which uses the open Advanced Mobile Location (AML) standard, and/or HTTPS. ELS requires at least one endpoint to receive location data directly from the handset. The ELS partner, be it a mobile network operator, public safety vendor, or an entity already responsible for handling emergency location in a given region, is responsible for implementing and maintaining the endpoint, which can be an SMS Center and/or HTTPS server, and for making ELS location available to emergency services dispatchers. The data flow is from the handset to the end point, without passing through Google servers; accordingly,

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[3] Google, *Android ELS: FAQs*, https://crisisresponse.google/emergencylocation service/faqs/ (last visited May 20, 2019).
[4] Google, *Android ELS: How It Works*, https://crisisresponse.google/emergencylocation service/how-it-works/ (last visited May 20, 2019).
[5] *See id*.

Google does not receive any personally identifiable information during or after ELS activation and transmission.

Google created ELS on its own initiative to make users safer and improve the state of emergency services around the world. Google is continually working to improve ELS, including by providing accurate altitude and floor location and enhancing location quality for challenging environments such as urban canyons and indoors. ELS currently has the capability to report Z-axis for ELS HTTPS location messages; Google intends to further measure ELS's vertical location functionality by participating in CTIA's Stage Za testbed later this year.

II. THE COMMISSION SHOULD SPEED THE DELIVERY OF VERTICAL LOCATION INFORMATION TO FIRST RESPONDERS BY USING A PHASED-IN APPROACH

Transmitting accurate vertical location information is complex and challenging, as demonstrated by the limitations of various technologies. For instance, while signals from cell towers can provide the rough location of a user who contacted emergency services, they do not convey any information about the user's altitude. While Global Positioning System (GPS) altitude can prove useful to helping find emergency callers outdoors, Global Navigation Satellite System elevation data is often inaccurate or inconsistent, especially indoors where GPS signals may not penetrate. Barometric pressure sensor-based vertical location solutions also have drawbacks for safety applications, particularly changes in performance due to weather conditions, weather effects (e.g., outside temperature versus inside, barometric pressure variation with weather fronts,

strong winds, etc.), ventilation systems, air conditioning, and calibration differences from device to device. For these sensor solutions to be scalable, they would require further standardization and retesting in a production configuration.[6]

In light of these challenges, clear benchmarks and timelines for achieving z-axis reporting capabilities will be useful to help companies focus their testing, development, and implementation on concrete objectives. To ensure that vertical location accuracy parameters are ambitious but achievable, the Commission should use a phased-in approach directed toward ultimately achieving floor-level reporting.

A. To Get Improved Tools Into First Responders' Hands Quickly, the Commission Should Phase In Vertical Location Accuracy Requirements

It has been four years since the Commission established benchmarks and timetables for deployment of z-axis technology or dispatchable location (which includes a vertical location component) in the top 50 Cellular Market Areas (CMAs).[7] Since then, essential work has occurred on development of z-axis location technologies and testing methodologies. While 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. Without this information, it is simply too soon to set an

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[6] *See* 9-1-1 Location Technologies Test Bed, LLC, *Report on Stage Z*, 4-5 (filed Aug. 3, 2018), *available at* https://www.fcc.gov/ecfs/filing/10803074728956 (attachment to Letter from Scott K. Bergmann, Senior Vice President, Regulatory Affairs, CTIA, *et al.*, to Marlene H. Dortch, Sec'y, FCC, in PS Docket No. 07-114, at 4-5 (filed Aug. 3, 2018) (*Stage Z Report Cover Letter*)).

[7] *In the Matter of Wireless E911 Location Accuracy Requirements*, Fourth Report and Order, 30 FCC Rcd. 1259 ¶¶ 116-117 (2015) (*Fourth Report & Order*).

ultimate accuracy metric, such as two or three meters, or to require reporting of floor-level data. Setting the bar too high may delay getting beneficial vertical location information into the hands of first responders, and may discourage work on technologies that hold long-term promise but require substantial development to achieve that promise. The Commission therefore should avoid focusing excessively on a long-term vertical location accuracy value. Instead, the Commission should adopt a well-communicated, phased-in approach to get reliable and usable vertical location information into first responders' hands as soon as possible, with a steady trajectory set to enhance the precision and utility of that data over time. Phasing in more stringent metrics over time would best offer "certainty to all parties and establish a focal point for further testing, development, and implementation of evolving z-axis location technologies."[8]

Phasing-in z-axis requirements over time would maintain an approach that has worked well to date, and allowed valuable vertical location technologies to evolve. When the Commission first adopted rules in 1996 to require CMRS providers to implement E911 services, it relied on a two-stage implementation strategy.[9] By the end of Phase I in April 1998, CMRS providers were required to transmit a 911 caller's telephone number and the location of the cell site or base station that received the call.[10] By the

[8] *FNPRM* ¶ 10.
[9] *See In the Matter of Revision of the Comm'n's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, Report and Order and Further Notice of Proposed Rulemaking, 11 FCC Rcd. 18676 ¶ 10 (1996) (*First E911 Report and Order*).
[10] *See id.* ¶¶ 63-66.

conclusion of Phase II, which was eventually extended to January 2019,[11] CMRS providers were to transmit latitude and longitude within specific accuracy and reliability parameters, depending on the carriers' chosen location technology.[12]

Over time, technology evolved to allow more wireless emergency calls to be successfully connected from indoors. Because the Commission had not imposed inflexible location accuracy requirements at the outset, it was well positioned to reexamine and update its approach in light of technological improvements. In 2010's *E911 Location Accuracy Further Notice and Notice of Inquiry*, the Commission sought comment on improving location accuracy in indoor settings and challenging environments.[13] Recognizing that substantial additional work needed to be done because location accuracy technology at the time "would only identify the city block in which a building is located," the Commission decided against imposing an immediate solution.[14] Instead, the Commission sought comment on the prudence of mandating

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[11] *See* 48 C.F.R. § 20.18(h).
[12] *See First E911 Report and Order*, 11 FCC Rcd. 18676 ¶ 71. In response to testing guidelines for wireless licensees published in 2000 by the Office of Engineering and Technology, the Commission clarified in 2010 that Phase II requirements apply to outdoor measurements only. *See* OET Bulletin No. 71, Guidelines for Testing and Verifying the Accuracy of Wireless E911 Location Systems (Apr. 12, 2000), *available at* http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet71/oet71.pdf; *In the Matter of Wireless E911 Location Accuracy Requirements,* Second Report and Order, 25 FCC Rcd. 18909 ¶¶ 29, 48-49 (2010).
[13] *See In the Matter of Wireless E911 Location Requirements, et al.*, Further Notice of Proposed Rulemaking and Notice of Inquiry, 25 FCC Rcd. 18957 ¶¶ 17-18 (2010).
[14] *See In the Matter of Wireless E911 Location Accuracy Requirements, et al.*, Notice of Proposed Rulemaking, Third Report and Order, and Second Further Notice of Proposed Rulemaking, 26 FCC Rcd. 10074 ¶ 86 (2011) (*E911 Location Accuracy Second Further Notice*).

indoor location accuracy testing and whether standards and testing methodologies for outdoor and indoor location accuracy testing should be identical.[15] In developing requirements, the Commission also relied on the expertise of the Communications Security, Reliability, and Interoperability Council (CSRIC) to evaluate the performance of various location technologies in indoor environments.[16] Results from a CSRIC testbed from 2012-2013 helped inform the Commission's proposed changes to the original Phase II location accuracy rules in 2014.[17]

Similarly, the Commission should take a measured and data-driven approach to establishing and rolling out a vertical location accuracy metric. With regard to the z-axis, most commenters addressing the issue in 2011 "agreed that no technology with sufficiently developed z-axis location capabilities existed."[18] But now, in the *Third Further Notice of Proposed Rulemaking*, the Commission was able to indicate that proposing "specific measures in [its] E911 location accuracy rules to ensure accurate indoor location information" is timely.[19] As in the past, in proposing its regulatory framework, the Commission chose a strategy with "both near- and long-term components."[20]

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[15] *See id.* ¶ 87.
[16] *See id.* ¶¶ 87-88.
[17] *In the Matter of Wireless E911 Location Accuracy Requirements*, Third Further Notice of Proposed Rulemaking, 29 FCC Rcd. 2374, ¶¶ 12-17 (2014) (*Third Further Notice of Proposed Rulemaking*).
[18] *See id.* ¶ 69.
[19] *See id.* ¶ 2.
[20] *See id.*

The results of this flexible, evolutionary approach thus far have greatly exceeded expectations from a technological standpoint. For instance, in early 2015, TruePosition asserted that it would "be more than a decade before there is significant penetration of the z-axis capable handsets throughout the U.S."[21] That prediction proved incorrect, in part because the Commission allowed flexibility to innovate. The *Fourth Report & Order* in this proceeding in 2015 established benchmarks and timetables clear enough to signal that development of z-axis capability should be a top priority, but deferred a decision on a specific z-axis metric until the Commission received additional testing data.[22] In a few short years, industry has risen to the challenge with manifold options to enable z-axis capability. In addition to the barometric pressure sensor-based solutions developed by NextNav and Polaris Wireless and analyzed in the Stage Z testbed, handset-based solutions like ELS have been widely deployed around the world.

Consistent with its previously successful approach, the Commission should rely on a phased-in approach here. The Commission could begin by establishing a clear z-axis metric of four meters, with a timetable for increasingly demanding z-axis call coverage and/or geographic coverage requirements. For instance, rather than requiring plus or minus three-meter accuracy for 80% of calls, 80% of the time in the top 25 CMAs by 2021 as proposed, the Commission could adopt an approach that better reflects the current abilities and future promise of vertical location technologies, such as:

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[21] *See* Letter from James Arden Barnett, Jr., Venable LLP, Counsel for TruePosition, to Marlene H. Dortch, Sec'y, FCC, in PS Docket No. 07-114 at 2 (filed Jan. 21, 2015).
[22] *Fourth Report & Order* ¶¶ 116-117.

- Mandate implementation by 2021 of plus or minus four-meter accuracy for 70% of calls, 70% of the time and report vertical uncertainty as part of the location with a confidence level of 90% (i.e., one side of the two-sided range above and below the estimated altitude of the position within which there is a 90% probability of finding the true altitude).
- Require implementation by 2022 of plus or minus four-meter accuracy for 80% of calls, 80% of the time and retain requirement to report vertical uncertainty as part of the location with a confidence level of 90%; and
- Require implementation by 2023 of plus or minus three-meter accuracy for 80% of calls, 80% of the time, with stricter requirements to follow as technologies allow and retain requirement to report vertical uncertainty as part of the location with a confidence level of 90%.

Alternatively, the Commission could consider adopting an approach analogous to that in the new European Electronics Communication Code (EECC).[23] By December 2020, all European Union member states will be required to use handset-derived location in addition to network-based information for response to emergency calls.[24] And, as of March 17, 2022, the EECC will require that all smartphones sold in the European Single Market be able to provide handset-based location data. The Commission could augment this type of approach with a z-axis metric requirement or could rely on the market to generate additional advancements in vertical location accuracy.

Ultimately, transmission of floor-level information to first-responders should be required. Unfortunately, however, there is now no sufficiently reliable solution to pinpoint

[23] Már Másson Maack, *This Location Tracking Tech Could Save Your Life Across the EU in 2020*, TNW.com (Apr. 16, 2019), https://thenextweb.com/eu/2019/04/16/aml-eu-2020-save-your-life/ (last visited May 20, 2019).
[24] *See id*.

user location on a floor-by-floor basis. The user's height within a building is not a proxy for floor number, because floors may differ in height within a building or from building to building. Like the imprecision APCO identified with the proposed five-meter z-axis metric,[25] differences in floor height could translate to communicating too wide of a range of floors above or below the actual floor where a user may be located. Even information collected from building owners about the number of floors in their structures could prove unreliable due to a lack of a standard floor numbering system or nomenclature. For instance, some entry-level floors are "ground" or "lobby levels," while others are the "first floor." Some superstitious building owners "skip" the thirteenth floor. Indeed, FCC headquarters inserts "Maine Avenue," "Twelfth Street," and "Courtyard" levels to achieve a top-level "Eighth Floor". Thus, until the market identifies a solution for transmitting floor-level data, any required transmission of floor-level information holds the risk of complicating rather than expediting rescue efforts, and endangering rather than promoting public safety. Nevertheless, the Commission should fully consider any floor-level vertical accuracy solutions as they emerge in the future.

B. Z-Axis Reporting Requirements Should Apply to All Customers and Handsets on a Network

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

[25] Comments of Ass'n. of Pub.-Safety Commc'ns Officials-Int'l, Inc. in PS Docket No. 07-114 at 1 (filed Oct. 1, 2018) (stating that a five-meter metric would translate to a "range of up to two floors below, or up to two floors above, the actual floor where a 9-1-1 caller may be located, and some lesser degree of accuracy for one in five calls to 9-1-1").

safety. Thus, mobile operators should achieve the Commission's chosen z-axis metric for all handsets, as soon as possible.[26] Because the Commission established benchmarks and timetables for deployment of z-axis technology or dispatchable location in the top 50 CMAs four years ago,[27] no wireless carrier could reasonably claim to be surprised by being required to have vertical location accuracy capabilities. Thus, as of the phase-in date for the Commission's chosen z-axis metric, wireless carriers should take into account every customer—and accordingly every handset—on their networks when assessing compliance. Sufficient breathing space to sunset support for any older devices with lesser capabilities would be implicit in the percentage metric and phase-in period for vertical location accuracy obligations.

III. A SCALABLE, RELIABLE TESTING METHODOLOGY THAT ADDRESSES THE ACTUAL CHALLENGES FACED BY FIRST RESPONDERS IS NEEDED

The Stage Z testbed conducted by CTIA in 2018 demonstrated the technical feasibility of measuring achievement of a z-axis metric in some circumstances.[28] However, Stage Z did not produce a reliable, scalable testing methodology for all Z-axis solutions (or even the solutions that were tested) that could be used to demonstrate achievement of the required frequency (e.g., 80% of the time) across networks and geographies (e.g., 80% coverage of the CMA). In particular, for barometric solutions, CTIA identified testing deficiencies in the Stage Z testbed including lack of performance

[26] *FNPRM* ¶ 14.
[27] *Fourth Report & Order* ¶¶ 116-117.
[28] *See Stage Z Report Cover Letter* at 4-5 (explaining that NextNav "testing produced 80% of fixes at 1.8 meters or less" and Polaris Wireless testing "produced 80% of fixes at 4.8 meters or less").

data for extreme cold-weather environments or rural morphologies, and sensor bias as an error source for estimating altitude.[29] Furthermore, CTIA made clear that the Stage Z testing methodology would not be scalable for barometric solutions because each individual mobile device was subject to its own sensor bias, and required active individualized calibration and use of a dedicated app.[30] Finally, Stage Z failed to test real-world conditions faced by first responders. Actual calls were not placed to produce z-axis fixes, and standardized 911 signaling was not used.[31] Due to these shortfalls, CTIA itself characterized the 2018 Stage Z testing as being best viewed as a mere "proof of concept."[32]

With lives and property, as well as potentially large penalties on the line, testing in which all stakeholders have confidence is imperative. The Stage Za testbed slated to begin in July 2019 holds promise to overcome the limitations of last year's Stage Z testing, and to demonstrate the feasibility of testing non-barometric-centric z-axis solutions like ELS. The Commission, however, should not presuppose Stage Za's success. While Google expects its ELS technology to perform well in z-axis testing, too little is known about Stage Za's testing particulars to predict whether deficiencies will exist.

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[29] *Stage Z Report Cover Letter* at 3.
[30] *See id*. Testing of ELS will not require active individualized calibration or use of a dedicated app.
[31] *See id.* at 4.
[32] *See id*.

The testing methodology that the Commission ultimately endorses must be scalable and inclusive of a representative subset of scenarios that first responders will encounter in the real world. For instance, testing should use accurate terrain models reflective of the actual distribution of surface elevations in first-responder scenarios. Furthermore, any limitations in testing methodology should be reflected in the substantive standard the Commission adopts. If it is not feasible to reliably measure compliance with a standard based on a specific number of vertical meters a defined percentage of the time, that would be reason to employ, on an interim basis, a more flexible substantive requirement that can be implemented with certainty, or even an alternate approach like that found in the EECC. Although not ideal, such flexibility would be better than delaying the delivery of potentially life-saving vertical location data into first responders' hands, due to legal or practical failure of the Commission's regulatory regime.

CONCLUSION

Commission action on a vertical location accuracy metric is timely to establish clear benchmarks and timelines to enhance testing, development, and implementation of z-axis solutions. The Commission should use a phased-in approach, which would pave the way toward eventual floor-level reporting capability after the market develops a reliable reporting solution. In setting compliance benchmarks, the Commission should require that carriers report on every customer and every mobile device that uses their

networks. It also may be necessary for the Commission to tailor its substantive z-axis standard to what can be tested with certainty.

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