

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

In the Matter of

Wireless E911 Location Accuracy Requirements

PS Docket No. 07-114

**COMMENTS OF QUALCOMM INCORPORATED ON THE
“ROADMAP FOR IMPROVING E911 LOCATION ACCURACY”**

Dean R. Brenner
Senior Vice President, Government Affairs

John W. Kuzin
Senior Director, Regulatory

1730 Pennsylvania Avenue, NW
Suite 850
Washington, DC 20006
202-263-0020

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SUMMARY

Qualcomm strongly supports the comprehensive “Roadmap for Improving 911 Location Accuracy” and applauds the successful efforts of the Association of Public-Safety Communications Officials (“APCO”) International, the National Emergency Number Association (“NENA”), and the four national wireless carriers who responded in earnest to the *FNPRM*’s multiple invitations to the public safety community and mobile industry “to propose a consensus approach that would help ensure that consumers placing wireless calls to 911 from indoor environments receive the same protections as callers in outdoor environments.” *FNPRM* at ¶ 26; *see also id.* at ¶¶ 6, 39, 54 & 178. The public safety and wireless carrier Roadmap is a model of public-private collaboration that advances the public interest. It provides a very aggressive yet technically achievable plan to improve wireless 911 call location accuracy for emergency calls placed indoors and outdoors. Qualcomm encourages the Commission to adopt the approach and associated performance goals set out in the Roadmap in toto, as soon as possible. The FCC should disregard the groundless complaints already made by certain vendors seeking to manipulate the Commission’s processes for their own private gain.

The Roadmap relies upon Location Based Service (“LBS”) solutions to provide emergency personnel with a “dispatchable location” for indoor emergency callers, *i.e.*, a street address and floor, suite or apartment number, using Wi-Fi access points and Bluetooth Low Energy (“LE”) beacons — the same wireless technologies used for many LBS solutions deployed today. The Roadmap to integrating these technologies into the 911 location calculus includes the development of new standards where needed, the creation of a reliable and secure database with dispatchable location information and introduction of compatible equipment, and the development of system-wide capabilities to deliver the information to Public Safety Answering Points (“PSAPs”) — each on an aggressive, yet achievable, implementation schedule.

Pursuant to the Roadmap, the four national wireless carriers committed also to improving traditional location technologies via deployment and refinement of A-GNSS and 4G LTE OTDOA technologies, *inter alia*. As Qualcomm has explained, this work is already occurring on an expedited basis, and adoption of the Roadmap will continue to accelerate this important work.

In addition, the signatories to the Roadmap will continue to study on an accelerated basis other technologies that could supplement dispatchable location information based on Wi-Fi and Bluetooth, such as using barometric pressure sensor data to provide vertical location information. As Qualcomm and others explained in response to the *FNPRM*, using barometric pressure sensors to provide a vertical “z-axis” position and floor level information faces major implementation and logistical issues. For example, consumers would need to buy handsets containing barometric sensors, PSAPs would need to upgrade existing systems and install new systems to process and display useful in-building vertical location information, and a reference network for purposes of correlating uncompensated barometric pressure sensor information would need to be deployed ubiquitously; this reference network would have to account for weather and various internal building systems and physical phenomena that can affect air pressure, such as the operation of HVAC systems and the “stack effect” in tall buildings. The Roadmap appropriately recognizes that the work to translate vertical location information provided by air pressure measurements into meaningful information for purposes of public safety response efforts is quite challenging and requires additional study.

Furthermore, under the Roadmap, the four national carriers will work with APCO and NENA (as well as wireless technology companies) to create a technology-neutral test bed to characterize the performance of 911 emergency caller location technologies, so public safety personnel, carriers, and technology vendors can fully vet potential solutions. In addition, the

carriers will collect and report live 911 call data to APCO and NENA to evaluate in real time the efficacy of the various positioning technologies. This data can be used to determine compliance with performance metrics and assess the performance of positioning technologies over time. Indeed, the Roadmap provides for staged implementation of the dispatchable location framework to help ensure the benchmarks established by APCO, NENA and the four carriers are met.

There is no question that the Roadmap is comprehensive and forward looking and, most importantly, achieves the objectives of the *FNPRM*, namely, to improve the accuracy of location determinations of indoor emergency callers. In fact, the Roadmap proposes ambitious implementation timeframes and accuracy measures for locating all emergency callers, in both outdoor and indoor environments, and requires the public safety community and mobile industry to work together to make meaningful improvements in several stages over the next 48 months. Commission acceptance and integration of the Roadmap's performance goals into its E911 regulatory framework is the most appropriate means of finalizing this proceeding.

Accordingly, Qualcomm looks forward to working with the Commission, public safety, and our wireless industry partners to implement the comprehensive Roadmap and continue improving the ability of public safety personnel to locate emergency callers wherever they happen to be.

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QUALCOMM Incorporated respectfully submits these comments¹ on the “Roadmap for Improving 911 Location Accuracy” to applaud the successful efforts of the Association of Public-Safety Communications Officials (“APCO”) International, the National Emergency Number Association (“NENA”), and the four national wireless carriers who developed and presented “a consensus approach” that the Commission specifically solicited in the *FNPRM* to “ensure that consumers placing wireless calls to 911 from indoor environments receive the same protections as callers in outdoor environments.”² The FCC should promptly adopt the goals presented in the Roadmap so the parties can begin work towards full-scale implementation. Indeed, Commission acceptance and integration of the Roadmap’s performance goals into its E911 regulatory framework is the most appropriate means of finalizing this proceeding.

¹ See FCC Public Notice, “Public Safety And Homeland Security Bureau Seeks Comment In The E911 Location Accuracy Proceeding On The Location Accuracy ‘Roadmap’ Submitted By APCO, NENA, and the Four National Wireless Carriers, PS Docket No. 07-114, DA 14-1680 (Nov. 20, 2014); see also Wireless E911 Location Accuracy Requirements, PS Docket No. 07-114, *Third Further Notice of Proposed Rulemaking*, FCC 14-13 (Feb. 21, 2014) (“*FNPRM*”).

² *FNPRM* at ¶ 26; see also *id.* at ¶¶ 6, 39, 54 & 178.

INTRODUCTION

The “Roadmap for Improving 911 Location Accuracy” provides a comprehensive and technically sound path towards improving the means of locating emergency callers wherever they happen to be. The Roadmap seeks to incorporate the tools that are currently used for commercial Location Based Service (“LBS”) with much success, namely Wi-Fi access points and Bluetooth beacons, while continuing to leverage the mobile positioning technologies that wireless carriers use today and plan to use in the near future, namely Assisted Global Navigation Satellite System (“A-GNSS”), Advanced Forward Link Triangulation (“AFLT”), and soon-to-be widely deployed Observed Time Difference Of Arrival (“OTDOA”) technology that takes advantage of the latest 4G LTE carrier networks. The Roadmap also provides a plan for assessing the viability of using barometric pressure sensors to reliably support vertical “z-axis” positioning information, which unlike the aforementioned technologies, requires additional R&D and testing in multiple diverse indoor environments before a system that relies on air pressure data can be deployed commercially.

Integration of the Roadmap’s performance goals into the Commission’s E911 regulatory framework is the most appropriate means of finalizing this proceeding. In the *FNPRM*, the FCC time after time encouraged public safety and wireless industry representatives to work together to develop a plan that provides improved location accuracy information for wireless E911 callers and to “propose consensus-based, voluntary commitments that address the public safety goals of this proceeding and facilitate closing the regulatory gap between indoor and outdoor location accuracy without the need to adopt regulatory requirements.”³ That is precisely what the

³ *FNPRM* at ¶ 54. *See also id.*, Statement of Commissioner Clyburn (“[T]oday’s item asks the wireless industry, the public safety entities, and others to work collaboratively toward developing alternative proposals for our consideration.”).

Roadmap achieves, for it is designed to provide public safety personnel with improved location determination tools that include actionable, dispatchable location information for 911 wireless calls placed from indoor locations and improved position location information for all emergency 911 wireless calls placed both indoors and outdoors.

DISCUSSION

I. The “Roadmap For Improving E911 Location Accuracy” Fully Responds To The Commission’s Call For The Public Safety Community And Wireless Industry To Develop A Consensus Plan To Improves Indoor Location Accuracy

In the *FNPRM*, the FCC repeatedly called for “industry and public safety stakeholders to collaborate to identify alternative proposals for improving indoor location accuracy, including a consensus-based, voluntary proposal to address the public safety goals detailed in this proceeding.”⁴ That is exactly what happened here. After the *FNPRM* was issued, APCO and NENA led a group of both public safety organizations’ representatives and representatives from the four national wireless carriers to develop a consensus plan to attain meaningful, near-term improvements in indoor location accuracy. They worked tirelessly for months to craft a plan that was both aggressive in timing yet technically realizable. The culmination of that effort is the Roadmap for Improving E911 Location Accuracy — an agreement that achieves the essence of FCC’s stated goals in this critically important proceeding.

The Roadmap leverages for 911 emergency caller location purposes both existing and proven positioning technologies, namely A-GPS and AFLT, and integrates the soon-to-be widely

⁴ *FNPRM* at ¶ 34; *see also id.* at ¶¶ 6, 26, 39, 54 & 178.

deployed improved positioning capabilities of A-GNSS⁵ as well as 4G LTE OTDOA.⁶ The Roadmap also leverages existing communications infrastructure, such as Wi-Fi access points and Bluetooth beacons, that are widely used today to provide Location Based Services (“LBS”), particularly in indoor locations. Furthermore, the Roadmap includes an assessment of alternative indoor positioning solutions, such as the use of an integrated barometric sensor to provide a vertical z-axis measurement. As Qualcomm explained in its Comments and Reply Comments in this proceeding,⁷ using a barometric pressure sensor that is integrated in a mobile handset is challenging due to many factors that can affect indoor air pressure, such as the seasonal and intermittent operation of HVAC systems, and thus requires further study.

Under the Roadmap, the four carriers agree to achieve horizontal location accuracy to within 50 meters for all 911 calls, indoor and outdoor, and to rapidly implement a dispatchable location solution for indoor calls that would accurately address horizontal and vertical location. Thus, via close collaborative efforts between the public safety community and wireless carrier community, the Roadmap achieves precisely what the FCC wants: a unified location accuracy

⁵ Assisted-GNSS, or A-GNSS, refers to the use of multiple satellite constellations, in addition to GPS, to provide augmented positioning information. These other satellite constellations may include Galileo and GLONASS, among others.

⁶ Using the 4G LTE cellular network for location is particularly useful because it can provide improved location information for calls placed indoors. OTDOA positioning is based on trusted and accurate cell site location information and uses the LTE handsets being deployed for voice over LTE (“VoLTE”) services. Once VoLTE is deployed on a carrier’s network, any manufacturer’s new VoLTE-capable phone supported by that carrier should support OTDOA; no special handset hardware is needed. Moreover, as T-Mobile has explained, when it implements VoLTE “it will gain the ability to run multiple location technologies simultaneously, rather than sequentially, improving its ability to deliver highly accurate location estimates within a given latency limit.” T-Mobile Comments at 2.

⁷ Qualcomm Comments in PS Docket No. 07-114 at 12-17 (filed May 12, 2014); Qualcomm Reply Comments in PS Docket No. 07-114 at 10-12 (filed July 14, 2014).

standard and means of continually improving indoor location. The Commission should formally approve such productive collaborative efforts to improve location accuracy.

The success of this effort is unsurprising, for the agency “has successfully leveraged such [collaborative efforts] in the past to drive policy forward, particularly in the public safety area, where the Commission’s objectives are clear but the technical path forward requires further research and development before implementation is possible.”⁸ Moreover, many parties who commented on the *FNPRM* agreed that the ongoing efforts by the wireless industry and the public safety community to work together in enhancing existing positioning technologies and developing new indoor location accuracy methods, tools, and testing procedures would provide a successful result,⁹ and it has. The Commission should approve these successful efforts by adopting in short order the performance goals laid out in the Roadmap.

A. The Roadmap Provides The Most Appropriate Path Forward And Should Be Implemented In Place Of The Unrealistic Proposals in the FNPRM

Multiple parties explained in their comments on the *FNPRM* that the Commission’s proposed regulations are unrealistic and unattainable, and, if adopted, would be counterproductive.¹⁰ These commenters noted that the limited data from CSRIC III WG3, on which the FCC based its proposals, is not a proper basis for ordering nationwide implementation

⁸ See *Second Report and Order* at ¶ 38; also see generally Qualcomm Comments and Reply Comments.

⁹ See, e.g., APCO Comments at 5; T-Mobile Comments at 23; Verizon and Verizon Wireless Comments at 4, 8, 22.

¹⁰ See AT&T Comments at 4-10; NTCA Comments at 2-3; Rural Wireless Association Comments at 2; Sprint Comments at 3-19; T-Mobile Comments at 6-20; Verizon and Verizon Wireless Comments at 13; see also Qualcomm Comments at 9-12; iPosi Reply Comments at 7.

by wireless carriers in a two to three year timeframe, particularly when no commercially-available solution can meet the proposed rules.¹¹

At the same time, every commenter supports the Commission’s objective in this proceeding to ensure 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 and reliable location information so that they receive the support they need in times of emergency.”¹² Indeed, Qualcomm and many others within the wireless industry have been working for decades to improve wireless E911 caller location accuracy, refining existing tools and developing new means of locating emergency callers.¹³ The Roadmap simply formalizes the process for achieving that objective in this proceeding to meet the needs of public safety personnel by setting out an aggressive timeframe and technically realizable means for providing actionable location information for 911 emergency callers so first responders can react more quickly and effectively.

B. The Roadmap Plots A Sound Path Towards Providing Public Safety With Useful, Actionable Information: A Dispatchable Location For Each Emergency Caller

The Roadmap leverages today’s successful LBS solutions to provide emergency personnel with a “dispatchable location” for indoor emergency callers, *i.e.*, a street address and floor, suite or apartment number, using Wi-Fi access points and Bluetooth Low Energy (“LE”) beacons. These same wireless technologies have been successfully used for LBS for many years,

¹¹ See *FNPRM* at ¶ 47 (recognizing that the proposed requirements cannot currently be met in all environments).

¹² *FNPRM* at ¶ 6.

¹³ See, *e.g.*, Qualcomm Comments at 4-9.

except now they would be used to provide “actionable” positioning information for 911 emergency callers.

The *FNPRM* noted that dispatchable address is an actionable location for first responders for it provides “the ‘essential’ elements of location accuracy and ‘the ability to provide high reliability and consistency of [location] data’ so that ‘telecommunicators and first responders have confidence in the underlying information.’”¹⁴ In essence, it provides the exact address of the emergency caller, much like wireline telephones do today.

The Roadmap to integrating LBS technologies into the 911 location calculus includes the development of standards, the creation of a reliable and secure database with dispatchable location information and introduction of compatible equipment, and the development of system-wide capabilities to deliver the information to PSAPs — each on an aggressive, yet achievable, implementation schedule.¹⁵ In addition, APCO, NENA and the carriers agree in the Roadmap to jointly conduct an assessment of the progress made in developing and deploying these dispatchable address solutions within three years.¹⁶ Qualcomm is eager to begin working on the Roadmap’s proposals and urges the FCC to adopt the consensus framework without delay.

C. The Roadmap Also Includes A Technology Neutral Test Bed For Purposes Of Assessing And Refining 911 Location Technology Solutions

The Roadmap requires the four national carriers to work with APCO and NENA to design and deploy a technology-neutral test bed within the first year following FCC approval of the plan to characterize the performance of 911 emergency caller location technologies. This

¹⁴ See *FNPRM* at ¶ 12 n.23 (quoting “CSRIC Indoor Location Test Bed Report”).

¹⁵ See Roadmap at 4-6.

¹⁶ See *id.* at 6.

critically important analysis space will allow public safety personnel, carriers, and technology vendors to fully vet potential solutions and encourage innovation in this space.

D. Live 911 Call Data Will Be Used To Assess The Performance Of Positioning Technologies

The four large wireless carriers will collect and, for the first time ever, report live 911 call data to APCO and NENA to evaluate in real time the efficacy of the various positioning technologies.¹⁷ This data can be used to determine compliance with performance metrics in real time and assess the performance of positioning technologies over time, which will encourage technology innovation and can also be used by carriers and public safety to make decisions into which technologies to pursue. Additionally, the Roadmap provides clear timeframes for staged implementation of the dispatchable location framework to help ensure the benchmarks established by APCO, NENA and the four large carriers are met.

E. The Roadmap Also Provides Means For Assessing Potential Future Deployment Of Alternative Vertical Location Solutions

While the dispatchable location solutions outlined above should provide the vertical component necessary to accurately locate 911 emergency callers located indoors, the signatories to the Roadmap agree to concurrently study other vertical location technologies, such as uncompensated barometric pressure sensor data, which may provide a useful “z-axis” component, and to take steps to promote the development of such solutions if they are deemed by the public safety and carrier signatories to the Roadmap to be beneficial to public safety.¹⁸

In our comments and reply comments on the *FNPRM*, Qualcomm explained that barometric sensors offer some promise, but most mobile handsets in use in the U.S. today do not

¹⁷ See *id.* at 8-9.

¹⁸ See *id.* at 10.

include such sensors, so implementing such a solution would require virtually every consumer to acquire a new handset and wireless carriers to deploy new network equipment.¹⁹ The Roadmap appropriately acknowledges the work effort needed to: (i) integrate barometric pressure sensor technology into mobile phones, (ii) develop and integrate a ubiquitously available reference source with which barometric pressure sensor information, weather, and internal building conditions, *e.g.*, heating, cooling, ventilation — each of which affect air pressure — would be correlated, and (iii) support the delivery of vertical location information to PSAPs and support PSAPs’ ability to rationalize the information for purposes of emergency dispatch.²⁰

Furthermore, there are a number of real-world factors and physical phenomena that complicate the use of barometric pressure sensors to determine a 911 caller’s vertical position. The air pressure indoors is often very different from outdoor air pressure at a given height above ground level due to temperature and humidity differences and weather conditions outdoors, such as wind, and because buildings are typically climate controlled and pressurized. In fact, the pressure-gradient indoors typically does not follow a simple relationship, as the building pressure on different floors may be regulated by different HVAC units or controllers. Consider, for example, the effect of air conditioning or heating being cycled on in a room that generates enough extra air pressure to close or even slam a door shut. Additional complicating factors that must be accounted for are outdoor balconies within some buildings and buildings with non-uniform floor heights, such as hotels that have six to ten meter high ceilings in their lobbies and several levels directly above and below the lobbies where there are ballrooms and other large

¹⁹ See Qualcomm Comments at 12-15; Qualcomm Reply Comments at 10-12/

²⁰ See, *e.g.*, CSRIC III WG3 Report at 36, 39 (“Public safety recognizes that additional work remains before actionable altitude measurements can be broadly provided and utilized to aid first responders, including standardization, commercial availability, and deployment of such technologies.”).

meeting rooms. In addition to all of this, the “stack effect” phenomenon can raise or lower air pressure inside a tall building relative to outdoors whenever a significant temperature and corresponding air density differential is uncompensated by a pressure management system.²¹ Use of barometric pressure sensors may well require an extensive survey of many buildings in a variety of cities at different times of year and different times of day in order to fully understand and account for the vicissitudes of air pressure due to these real-world factors.

II. Qualcomm Is Eager To Begin Working With The Wireless Industry And Public Safety Community To Implement The Roadmap

Qualcomm looks forward to working with public safety, our wireless industry partners, and the FCC to implement the comprehensive Roadmap and continue improving the positioning information that public safety personnel use to locate emergency callers.

A. The Commission Should Adopt The Performance Goals Provided In The Roadmap As Soon As Possible So That Work Can Begin In Earnest

Qualcomm, its wireless industry partners and the public safety community are actively discussing the Roadmap and means of implementing its terms, but needs the Commission to adopt the performance goals and framework for achieving those goals as soon as possible so that work can begin earnest. Indeed, the FCC should adopt the Roadmap in its entirety and implement the performance goals in its regulatory framework because the “consensus plan” is comprehensive, forward-looking, and encourages ongoing R&D and innovation in the positioning technology field. Most importantly, the Roadmap achieves the main objective of the *FNPRM*, that is, to improve the accuracy of providing the location of emergency callers located indoors.

²¹ For a more detailed explanation of the “stack effect,” see “The Stack Effect: When Buildings Act Like Chimneys,” available at <http://www.greenbuildingadvisor.com/stack-effect-when-buildings-act-chimneys> (last accessed Dec. 10. 2014).

B. FCC Adoption Of The E911 Roadmap's Performance Goals Is The Appropriate Means Of Finalizing This Proceeding

The Roadmap's consensus-based approach that addresses the public safety goals set forth in the *FNPRM* and closes the regulatory gap between indoor and outdoor location accuracy should be approved without delay.

The Roadmap proposes ambitious implementation timeframes and accuracy measures for locating all emergency callers, in both outdoor and indoor environments, and requires the public safety community and mobile industry to work together to make meaningful improvements in several stages over the next 48 months and beyond. Thus, the FCC should promptly incorporate the Roadmap's performance goals into its wireless E911 regulatory framework.

CONCLUSION

For the reasons detailed above and in Qualcomm's opening and reply comments on the *FNPRM*, the FCC should promptly adopt the performance goals set out in the Roadmap for Improving 911 Location Accuracy. Commission approval of the Roadmap will promptly provide the benefits of improved emergency caller position information and continue to encourage: (i) the ongoing R&D work by Qualcomm and other technology developers to improve all types of positioning technologies; (ii) the extensive integration and verification efforts of wireless carriers, infrastructure vendors, and handset suppliers needed to carry out the framework presented in the Roadmap, and (iii) much-needed continued close interaction between the wireless industry and the public safety community, as they jointly analyze, develop, deploy and refine the multitude of location determination tools that will be implemented over the coming years to successfully locate all wireless E911 emergency callers.

Respectfully submitted,

QUALCOMM INCORPORATED

By: 

Dean R. Brenner
Senior Vice President, Government Affairs

John W. Kuzin
Senior Director, Regulatory

1730 Pennsylvania Avenue, NW
Suite 850
Washington, DC 20006
202-263-0020

Attorneys for QUALCOMM Incorporated

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