**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
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| Wireless E911 Location Accuracy Requirements | ) | WT Docket No. 07-114 |
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# COMMENTS OF NEXTNAV, LLC


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## SUMMARY

The Commission's E911 wireless location accuracy rules have been in place for nearly two decades. In that time, the way in which consumers use their wireless devices—and call for help—has changed dramatically. Despite steady improvements and diligent work by the Commission and wireless carriers, the nation's E911 system has not kept pace with the revolutionary changes in the wireless communications landscape since the 1990s. The Commission's proposed indoor wireless location accuracy rules provide a long-needed update to the E911 system and will help ensure that consumers can rely on E911 to reach help, and have help reach them, wherever they are located.

The 50-meter horizontal accuracy and 3-meter vertical accuracy requirements proposed in the Commission's *Notice* represent a reasonable compromise between the location technology currently available and the urgent needs of public safety for highly accurate location information for indoor callers. Reports from the Commission's Communications Security, Reliability, and Interoperability Council ("CSRIC") as well as independently-conducted tests indicate that technologies capable of meeting these requirements are now feasible. Presentations from the Commission's E911 Location Accuracy Workshop further indicate that technologies to meet these requirements are constantly improving, available from multiple vendors, and in many cases are already deployed today.

The proposed two year implementation period for horizontal indoor location accuracy is sufficient to substantially deploy indoor location infrastructure and handsets, with complete nationwide indoor location capabilities within five years. The amount of new infrastructure construction required to support indoor location technology systems can be reduced substantially by leveraging existing location accuracy technologies such as A-GPS that achieve good indoor

accuracy in less dense suburban and rural areas. The majority of the new infrastructure construction can therefore be focused on the urban areas where improved horizontal and vertical location is most needed and will provide the most benefit.

Vertical accuracy is equally necessary to facilitate effective public safety response, and can also be achieved in the proposed three and five year timeframes using currently available technologies. The CSRIC Test Bed results confirmed NextNav's ability to achieve floor-level accuracy using inexpensive and readily available barometric pressure sensors, and information presented in the CSRIC Location Based Services report and the Commission's E911 Location Accuracy Workshop establishes that multiple other technologies are capable of providing vertical location information, including floor-level accuracy, in the near future.

PSAPs will be able to immediately utilize location information generated by indoor location services, both horizontal and vertical, without significant system or software changes, because location service vendors are providing information in a manner consistent with existing E-911 call delivery processes and PSAP computer aided dispatch software. There are no requirements for NG-911 costs or modifications to accept the improved horizontal and vertical information, thereby facilitating the ability of PSAPs to make use of this information with minimal effort. Although the value of vertical information will eventually be further improved by context available through indoor mapping services, the tremendous benefits of vertical location can already be realized through existing means as soon as it is available to PSAPs and first responders.

The CSRIC test results and the broad deployment of many of the components of indoor location systems demonstrate that it is not necessary to delay indoor location accuracy rules for additional rounds of testing. The public safety community has explained at length the

tremendous benefits obtainable from newly available technology, and the Commission has acknowledged that the adoption of clear, near-term requirements will remove regulatory uncertainty, add needed impetus to carrier adoption, and hasten the eventual development of long term solutions capable of delivering the dispatch-able address-level information that is ultimately sought by public safety. Indeed, the adoption of indoor location accuracy rules is likely to facilitate associated improvements in outdoor location accuracy as well, further advancing the Commission's goals of a reliable E911 system for all callers. Given the substantial technical and standards groundwork already in place, the proposed indoor location accuracy rules can be achieved within the proposed timeframe at reasonable cost to wireless carriers and consumers.

Feasible, near-term, cost-effective indoor location capability has not arrived a moment too soon. Currently, more than 70 percent of 911 calls are placed from wireless phones, and more than half of those calls are placed from indoor locations, where existing E911 location technologies are often unable to report accurate information quickly, if at all. This gap between the Commission's rules and the day to day reality of 911 use has already had negative impacts on public safety, measurable both in quantitatively slower emergency response and in agonizing anecdotes of victims unable to receive assistance because they could not be found with the available technology. Public safety has demonstrated the need for clear improvements over the existing E911 requirements, and the proposed 50 meter horizontal and 3 meter vertical rules represent an appropriate near-term balance between the capabilities of current technology and the desire of public safety for the most accurate information possible.

The use of representative test beds to demonstrate compliance with indoor location requirements can ensure location accuracy at reasonable cost. The 2012 CSRIC test bed established a format and key attributes for rigorous test beds. By employing the use of

independent test houses, representative testing environments, measurement of key criteria (accuracy, latency, and yield), and emulation of actual deployment, carriers can economically and flexibly carry out joint or individual tests that can provide the Commission a high level of confidence that the performance demonstrated will match real world conditions. Carriers that demonstrate compliance through such test beds should not be required to retest unless they make material changes to their networks, report deterioration in key performance indicators, are presented by PSAPs with documented evidence of substandard performance, or rely upon location technologies that are not subject to centralized control (such as unmanaged Wi-Fi access points). In such a circumstance, the Commission should permit carriers to resolve indentified issues prior to enforcement action.

Finally, the adoption of concrete E911 indoor location accuracy rules is appropriate because market forces have not and cannot produce commercial location services that can replace dedicated E911 location systems. E911 location implementations have different operational parameters, including appropriately configured handsets (cold/warm start), very high yield and ubiquitous coverage that commercial location services alone are typically not designed to satisfy.

The Commission, wireless carriers, and public safety all agree that 911 is the most important call a consumer can make, and consumers expect that when they dial 911, responders will be able to find them. The Commission's rules today do not fulfill this expectation, but the technology to close the gap is proven, cost effective, and available today. The proposed indoor location accuracy rules are not the last step in fulfilling the Commission's commitment to reliable E911 for every caller in every location, but they are a reasonable, substantial, and

appropriate next step. NextNav strongly supports the proposed rules, and urges the Commission to adopt them without delay.

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**COMMENTS OF NEXTNAV, LLC**

NextNav, LLC ("NextNav"), by its attorneys, hereby responds to the Commission's Third Further Notice of Proposed Rulemaking ("*Notice*") seeking comment on the adoption of indoor location accuracy requirements to support emergency first responders and the public.[1]

The proposed rules in the *Notice* represent a culmination of nearly two decades of work by the Commission, public safety, and the wireless industry in addressing the persistent problem of how to reliably locate wireless 911 callers. The Commission first proposed its wireless E911 rules in 1996 based on the recognition that one of the Commission's core statutory mandates is to "promot[e] safety of life and property through the use of wire and radio communication."[2] Even in 1996, the Commission and public safety recognized that the capability to accurately locate callers in the X, Y, and Z dimensions was a core necessity of the E911 system, even if technology was not then available to fulfill this need.[3]

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[1] *Wireless E911 Location Accuracy Requirements*, WT Docket No. 07-114, Further Notice of Proposed Rulemaking, FCC 14-13 (Feb. 21, 2014) ("*Notice*").

[2] *See Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, RM-8143, Report and Order and Further Notice of Proposed Rulemaking, FCC 96-264 at Section II.A.3 (July 26, 1996) ("*E911 First Report & Order*") (citing 47 U.S.C. § 151).

[3] *Id.* at Section V.B.1 and n.284 (citing Comments of APCO and TX-ACSEC seeking horizontal and vertical accuracy).

Since that time, the technology available for mobile phones has changed dramatically and the usage of mobile devices in the United States has changed even more. In 1996, the total number of cellular subscribers in the United States was 33 million; today, wireless usage is ten times that, with more wireless subscriber connections than there are people living in the country.[4] 911 calls that in 1996 were placed from landlines are today placed overwhelmingly from wireless devices by callers indoors or in urban areas.[5] The need for accurate location information for all wireless 911 calls was clear in 1996; today it is crucial.

Fortunately, in parallel with the growth of wireless devices, the technology to locate 911 callers has also improved dramatically. Once a largely intractable problem, reports from the Commission's Communications Security Reliability and Interoperability Council ("CSRIC") and from industry indicate that indoor location technologies which can satisfy the Commission's requirements and the needs of public safety are today either already commercially available or in advanced development and deployment by multiple providers.[6] This was demonstrated by the field tests conducted in 2012 by CSRIC Working Group 3 and subsequent independent tests conducted by location technology vendors, the results of which indicate that existing "location technology, with further advancements, could satisfy [the] proposed accuracy requirement within [the two year] timeframe."[7]

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[4] *Notice*, ¶ 28.

[5] *Id.*

[6] *See, e.g.*, CSRIC Working Group 3 LBS Report at 21, 26, 33, 54 (discussing technologies available from Navizon, Skyhook's, NextNav, and CSR) ("*CSRIC LBS Report*"); Remarks of Kirk Burroughs, Qualcomm, during the Commission's Workshop on E911 Phase II Location Accuracy, at 3:12:52 (Nov. 18, 2013) ("*Burroughs Remarks*") (remarks of all participants in the Workshop are available at http://www.youtube.com/ watch?v=Kt3lWv_oXNY).

[7] *Notice*, ¶ 57.

The time is right for the Commission to update its rules to ensure that the nation's emergency response system can meet the expectations of the public and the needs of public safety. The Commission's proposal in its *Notice* establishes a significant advancement towards the ultimate needs of the public safety community and balances in a reasonable manner the costs of deploying such capabilities and the public interest benefits they can achieve.

## I. THE COMMISSION'S PROPOSED INDOOR LOCATION RULES ARE REASONABLE AND ACHIEVABLE USING MULTIPLE LOCATION TECHNOLOGIES

The 50-meter horizontal accuracy and 3-meter vertical accuracy requirements proposed in the Commission's *Notice* represent a reasonable compromise between the location technology currently available and the urgent needs of public safety for highly accurate location information for indoor callers. The results from CSRIC's Indoor Location Accuracy Test Bed and its Location Based Services report indicate that indoor location technologies capable to meeting the proposed requirements are now feasible and demonstrated, and development by technology vendors has continued since the CSRIC III test bed concluded. Today, multiple providers assert their ability to meet the proposed rules within the objective timeframes.[8] Adopting 50-meter horizontal accuracy and 3-meter vertical accuracy requirements for indoor calls will provide a clear near-term goal and expectation for all stakeholders, will improve public safety response and efficiency, and will help ensure steady progress toward the Commission's long-term goal of ensuring highly accurate location information to all 911 callers.

[8] *Id.*, ¶ 25 (explaining that "it is likely that location technologies can begin to be deployed in the near term that would deliver 50-meter location accuracy for many indoor environments with a high degree of reliability"); *see also id.*, ¶ 22 n.50-51 (noting comments by location service vendors that their services either can or soon will be able to provide accurate indoor location information).

### A. Horizontal Accuracy of Within 50 Meters is Achievable Within a Reasonable Period of Time Using Available Location Technologies

The record strongly demonstrates that the Commission's proposed horizontal accuracy requirements can be achieved in the near term with existing technologies. The Commission should therefore proceed with its proposed timeline of two years, which represents a well-founded and reasonable requirement that will ensure that the wireless industry continues to progress on this important issue.

#### 1. Independently Conducted Tests Demonstrate that Horizontal Accuracy of Within 50 Meters is Achievable Using Competitive Technologies

As the Commission acknowledges in the *Notice*, 50-meter or better search rings can already be achieved by existing A-GPS technology in suburban and rural environments.[9] In more challenging urban and dense urban environments, four major vendors of indoor location services have indicated that their technologies can or will in the near future be able to meet, in indoor locations, the Commission's existing outdoor wireless E911 location accuracy rules of 50 meters for 67 percent of emergency calls and 150 meters for 90 percent of emergency calls.[10] Thus, the Commission's proposal to initially require compliance with only the first element of this requirement (50 meters for 67 percent of calls) seems readily achievable by multiple competitive vendors of indoor location services.

As one of these vendors has explained, "[t]here are no technological or monetary barriers to achieving the location accuracy and yield requirements in the Commission's Phase II E911

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[9] *Id.*, ¶ 47.

[10] *See, e.g.*, Remarks of Robert Anderson, True Position, at 3:24:00 ("*Anderson Remarks*"); Remarks of Ganesh Pattabiraman, NextNav at 3:06:40 ("*Pattabiraman Remarks*"); *Burroughs Remarks* at 3:12:52; Remarks of David De Lorenzo, Polaris Wireless, at 3:44:15 ("*De Lorenzo Remarks*").

location mandate."[11] Given that multiple technologies are currently either deployed or in advanced development to satisfy the proposed 50-meter accuracy requirements in indoor environments, the time is right to adopt requirements for indoor location accuracy, plus a realistic timeframe for implementation.[12] As the Commission notes, clear performance standards and timelines would permit CMRS providers to deploy the appropriate technology to ensure compliance with the proposed requirement.[13]

During the 2012 CSRIC Working Group 3 indoor location test bed, NextNav demonstrated its initial deployment of Metropolitan Beacon System ("MBS") technology where it achieved significant improvements in indoor location accuracy over legacy technologies.[14] The demonstrated performance of MBS technology in the CSRIC Test Bed led the Commission to note that one technology had already demonstrated both horizontal and vertical performance "close to achieving…indoor accuracy…equivalent to the existing outdoor handset-based location requirement (50 meters for 67 percent of calls)."[15] Since the test bed, NextNav has continued to refine its MBS technology, and subsequently submitted for the record the results of additional third party tests utilizing not only identical testing methodologies, but also the identical test

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[11] Comments of Polaris Wireless, Inc., PS Docket No. 07-114 (Nov. 18, 2013).

[12] *Notice*, ¶ 47.

[13] *Id.*, ¶¶ 46, 58.

[14] NextNav's MBS technology is NextNav's version of a broader class of location technology that employ terrestrial beacons and are being standardized by major standardization bodies as Terrestrial Beacon Systems ("TBS") for potential use by any interested local services vendor using any available frequency band. *See, e.g.*, Study on inclusion of Terrestrial Beacon Systems (TBS) in LTE, RP-140446, 3GPP TSG RAN (3-6 March 2014); *included as an attachment to* Letter from John W. Kuzin, Senior Director, Government Affairs – Regulatory, Qualcomm, to Marlene Dortch, Secretary, Federal Communications Commission, PS Docket No. 07-114 (May 1, 2014) ("*3GPP Paper on TBS Standardization*").

[15] *Notice*, ¶ 56.

points and third party test house utilized by CSRIC. NextNav's Rev-2 MBS results consistently surpassed the initial requirements proposed in the *Notice*, both horizontally and vertically, in each of the critical morphologies—dense urban, urban and suburban. In county-wide or PSAP-wide testing, the results for individual counties will reflect differing mixes of morphologies and building types to appropriately match the performance results of the compliance test beds proposed in the *Notice*.

In addition to NextNav's deployed MBS system, multiple other location technology vendors have indicated that their technology can satisfy the proposed requirements. The CSRIC Working Group 3 LBS Report canvassed numerous technology providers and reported to the Commission that many of those vendors indicated their technologies could satisfy its Phase II handset-based accuracy requirements in indoor locations, including Navizon's Wi-Fi Access Point location technology,[16] Skyhook's Wi-Fi location technology,[17] NextNav's beacon technology,[18] and CSR's hybrid A-GPS/Wi-Fi technology.[19] Further, Qualcomm, Polaris and TruePosition have each submitted for the record their technologies' ability to meet the initial horizontal accuracy requirement either immediately or in the near future.[20]

The 2012 CSRIC Working Group 3 Test Bed validated the current status of horizontal and vertical accuracy, leading to the Commission finding that existing "location technology, with further advancements, could satisfy [the] proposed accuracy requirement within [the two year]

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[16] *CSRIC LBS Report* at 21.

[17] *See id.* at 26.

[18] *See id.* at 33.

[19] *See id.* at 54.

[20] *Anderson Remarks* at 3:24:00, *Pattabiraman Remarks* at 3:06:40; *Burroughs Remarks* at 3:12:52; *De Lorenzo Remarks* at 3:44:15.

timeframe.[21] As the Commission has acknowledged, at least two of the indoor location technologies tested in the CSRIC Test Bed are commercially available already.[22] In addition to increasing commercial deployment, location vendors are also improving their system performance to achieve more precise performance.[23] As a result, the Commission can expect continued improvements in location accuracy performance across a wide range of indoor morphologies and a wide range of technologies.

Given the strong results already addressed in the LBS Report and documented in the CSRIC Test Bed Report, the expected near-term improvements in the various technologies, and the documented statements of multiple location technology vendors of expected future performance, it is now appropriate to adopt the 50-meter horizontal accuracy requirement as proposed in the *Notice*. As the Commission recognizes, requiring 50-meter accuracy for indoor calls would crystallize attention on this issue by location vendors and carriers, and would drive implementation of new advances.[24] Prompt adoption of requirements would provide a clear goal and expectation for all stakeholders, and would help ensure steady progress in location technology and ultimately in the reliability of indoor location capabilities for public safety.

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[21] *Notice*, ¶ 57.

[22] *Id*.

[23] *Id*., ¶ 56; *CSRIC III WG3, Indoor Test Report to CSRIC III WG3 Bay Area Stage-1 Test Bed* at 40 (Jan. 31, 2013), available at http://transition.fcc.gov/bureaus/pshs/advisory/csric3/WG3_Indoor_Test_Report_Bay_Area_Stage_1_Test_Bed_Jan_31%20_2013.pdf (last visited Feb. 3, 2014) ("*CSRIC Test Bed Report*").

[24] *Notice*, ¶ 46.

### 2. A Two Year Implementation Period is Sufficient to Substantially Deploy Indoor Location Infrastructure, With Complete Nationwide Coverage Within Five Years

Acknowledging the current or near-term availability of numerous competitive indoor location technologies, the *Notice* appropriately inquires as to the timeframe in which these technologies could be implemented to meet the proposed horizontal requirement of 50-meter accuracy for at least 67 percent of indoor calls.[25] NextNav concurs that firm timeframes, like clear accuracy requirements, will promote regulatory certainty, set expectations for consumers and public safety, and incent the investment required to bring these capable technologies into use.[26] A two year initial implementation period will provide adequate time to complete deployment of the necessary indoor positioning infrastructure to cover significant portions of the population, and the Commission should adopt this timeline in order to encourage prompt availability of this important service.

There are two primary elements to consider with any location technology – the network component, discussed here, and the handset component, discussed below. Some technical approaches require development of one component, some require the other, and some require both. In any case, both of these components require time for deployment or implementation, which affects the time frame appropriate for requiring compliance with the proposed location accuracy rules.

In the case of technologies where infrastructure construction is required, the time and cost necessary to construct is reduced to the extent currently-deployed technologies can satisfy the proposed requirements in some morphologies. For instance, roughly thirty percent of the

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[25] *Id.*, ¶ 57.

[26] *Id.*, ¶ 58.

population resides in areas designated by the U.S. Census Bureau as either "non-urban" (rural), or "urbanized clusters", which consist predominantly of low-rise buildings with minimal building density. Based on the CSRIC Test Bed results for the rural morphology of Hollister, California, which typifies an urbanized cluster in a rural area, the Commission appropriately concluded that existing satellite-based technologies such as A-GPS might provide sufficient performance for these areas, even meeting the initial horizontal accuracy requirement of 50 meters for 67 percent of calls.[27]

Based upon the CSRIC Test Bed results, Qualcomm has noted that A-GPS alone can satisfy the 50 meter requirement for at least 67 percent of calls in rural areas.[28] Given that this technology has already been deployed, this result implies that the Commission's initial requirement can now be met in large geographic areas of the country. More recent chip implementations include the ability to receive satellite constellations such as GLONASS, in addition to GPS. These multi-constellation chipsets are designated as Assisted Global Navigation Satellite System ("AGNSS") capable, and recent testing data clearly demonstrates 50 meter compliant performance across rural and urbanized cluster environments even at the 80th percentile.[29] As a result, potentially only areas of more significant urban density might require terrestrial infrastructure in order for CMRS providers to comply with the proposed initial indoor accuracy requirement. Consequently, from a horizontal accuracy perspective, an appropriate

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[27] *Notice*, ¶ 47.

[28] *Burroughs Remarks* at 3:09:55 (citing *CSRIC Test Bed Report* at 36 fig.7.4-3 Indoor Location Accuracy by Morphology for Qualcomm).

[29] *See* GNSS Indoor Test Report, Urban Cluster – Hollister, CA at 25 (providing Table 2, which demonstrates that AGNSS produced compliant fixes in 22 of 27 test sites); *included as attachment to* Letter from Bruce A. Olcott, Counsel to NextNav, LLC, to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket 07-114 (May 12, 2014).

implementation timetable need only be based on bringing coverage to the subset of areas where current satellite technologies such as AGNSS are insufficient and terrestrial augmentation of capabilities is required. As previously noted, four major wide-area location service providers presenting at the E911 Location Accuracy Workshop confirmed that their most advanced location technologies can be deployed and in commercial operation within two years.[30] Certain carriers noted, however, that carrier adoption and deployment of such advanced location services may require additional time for comprehensive or ubiquitous implementation.

From an MBS perspective, NextNav has deployed its initial network capability in 47 of the largest urban markets in the country, and deployed a comprehensive network capability in the San Francisco, San Jose and Silicon Valley areas. Because MBS beacons and antennas are small, broadcast only, omnidirectional installations, they are relatively easy to deploy in scale. Construction of comprehensive network capability in most urban markets would require 15-18 months to substantially complete, with initial deployment likely focused on the largest urban markets where the need is greatest and existing technologies have proven to be inadequate.

As the carriers have noted, with any network construction, some level of staged rollout is preferred for cost effective implementation. Therefore, NextNav believes it would be reasonable for the Commission to establish some programmatic milestones for population coverage between years two and five. For example, if A-GNSS can be expected to provide compliant coverage for counties representing 30 percent of the population, then urban counties representing an additional 30 percent of the population might represent a reasonable objective for the initial year two milestone for terrestrial augmentation. An initial 60 percent population coverage in the second year could then increase in stages to 100 percent compliant coverage for all counties by

[30] *See, e.g.*, *Anderson Remarks* at 3:24:00; *Pattabiraman Remarks* at 3:06:45; *Burroughs Remarks* at 3:12:52; *De Lorenzo Remarks* at 3:44:15.

the fifth year. It is important to note that because A-GNSS will also provide compliant coverage for portions of urban counties, even if it is not compliant across an entire county, an initial second year compliance milestone for counties representing 60 percent of the population translates into greater than 60 percent of the population actually receiving compliant coverage at the initial second year milestone.

### 3. A Two Year Implementation Period is Sufficient to Make Indoor Location-Capable Handsets Initially Available to Consumers

Some indoor location technologies are only network based, such as UTDOA, and do not require upgrades to handsets, only infrastructure construction as discussed above. Other indoor location technologies, including MBS and, to an extent, OTDOA, will require upgrades to current handset designs, which can be readily incorporated into new handset models. The Commission's proposed two-year deadline for achieving 50 meter accuracy for 67 percent of wireless E911 calls placed indoors should provide sufficient time to make initial handsets that are capable of supporting indoor location technologies commercially available.[31]

As noted in the CSRIC Working Group 3 report, NextNav has been working with GPS chipset manufacturers to modify existing designs to enable their GPS chips to receive MBS beacon signals and calculate their horizontal and vertical location based on this information.[32] The most significant handset modification is a fairly straight-forward process of providing an RF signal path to route NextNav's 900 MHz beacon signals to the GPS chip. In addition, some vertical location capabilities, such as those based on MBS technology, require a barometric

[31] *See Notice*, ¶ 57 (seeking comment on "how long would providers need to obtain the hardware necessary for upgrading handsets to work with newly deployed location accuracy systems?").

[32] *See CSRIC Test Bed Report* at 42.

pressure sensor in each handset. Some handset designs, such as the Samsung Galaxy,[33] already include such sensors and other makers are expected to follow suit. A vertical location requirement for E911 location purposes could expedite the process for handset manufacturers who do not already provide such a capability.

The *Notice* further inquires about the time required to develop standards for indoor location handsets.[34] NextNav believes that standardization should not pose a significant impediment to the introduction of new handset models that incorporate indoor location capabilities. As a threshold matter, many technologies are implemented commercially well before they receive final standardization through industry bodies, including technologies used for E911 Phase II systems such as A-GPS[35] and TruePosition's UTDOA.[36]

CSRIC Working Group 3 specifically noted the priority that all stakeholders should place on commercializing and standardizing all of the tested technologies to facilitate their rapid

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[33] Jason Dorrier, Sensors in Smartphones: Galaxy S4 adds Pressure, Temperature, and Humidity Sensors, Singularity Hub, http://singularityhub.com/2013/04/01/sensors-in-smartphones-galaxy-s4-adds-pressure-temperature-and-humidity-sensors (April 1, 2013); Dan Nosowitz, So, Um, Why Does the New Google Phone Have a Barometer in It?, Popular Science, http://www.popsci.com/gadgets/article/2011-10/so-um-why-does-new-google-phone-have-barometer-it (Oct. 19, 2011).

[34] *See Notice*, ¶ 57.

[35] *See Presentation of Specification to TSG or WG: TS 25.171, Version 1.0*.0, 3GPP RAN (Sep. 7, 2004) (available at http://www.3gpp.org/ftp/tsg_ran/tsg_ran/TSGR_25/Docs/PDF/RP-040341.pdf)(presenting the A-GPS specification to 3GPP for formal standardization years after it had been in general use).

[36] *See Uplink Time Difference of Arrival (U-TDOA) Location Method Is Added in GSM Standards*, PR Newswire (May 5, 2003) (available at http://www.prnewswire.com/news-releases/uplink-time-difference-of-arrival-u-tdoa-location-method-is-added-in-gsm-standards-55517352.html) (noting that U-TDOA had been formally standardized by the 3GPP only after national GSM operators decided to use it for E-911 service).

adoption throughout the ecosystem.[37] Currently, NextNav's technology is being integrated into various chipsets and core network providers are beginning to build support for the technology in advance of standardization.

To further facilitate widespread adoption, NextNav is working to have its underlying MBS technical approach (the use of a terrestrial beacon system, generically referenced as TBS) standardized by the Open Mobile Alliance ("OMA"), the Alliance for Telecommunications Industry Solutions ("ATIS"), and the Third Generation Partnership Project ("3GPP"), including addressing standards for TBS air interface, and for control plane and user plane messaging between the handset and the network (effectively making TBS a completely open platform).[38] NextNav's work is co-authored by AT&T and has been broadly supported by many others in the industry, including Broadcom, Blackberry, US Department of Commerce (FirstNet), TCS, Qualcomm, and others.[39] As a result, the standardization process will not inhibit the commercial availability of new handsets incorporated with MBS location technology by the Commission's second year benchmark.

Although new handsets with indoor location capabilities can be made available to consumers within two years, such capabilities will not realistically appear in all available handset models by the second year benchmark. Further, sufficient time will be needed for consumers to purchase indoor location-capable handsets as a part of their customary transition to new and better devices. Studies indicate that consumers replace their wireless handset on average every 18-22 months, and that handset changes may require 5-6 years to reach very high penetration

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[37] *See CSRIC Test Bed Report* at 9.

[38] *See, e.g., 3GPP Paper on TBS Standardization*.

[39] *See id.* at unnumbered page 6.

levels across the embedded base of subscriber handsets.[40] Therefore, NextNav believes that the handset requirements within the *Notice* should focus on a rapid rollout of new handsets with compliant indoor location capabilities. At the same time, if a location technology requires a handset-based component, the 67 percent and 80 percent thresholds should be calculated using only those handsets that are equipped with suitable hardware and are thus indoor location capable, to reflect the necessary turnover period required for upgraded consumer handsets to sufficiently penetrate the marketplace.[41]

Leading up to the five-year benchmark, the Commission may wish to employ a phased approach, initially requiring at the second year benchmark that each carrier have some complement of indoor location capable handsets available for purchase, and that those handsets demonstrate horizontal accuracy of 50 meter for 67 percent of test calls in compliance test beds. Subsequent year milestones could specify an increasing percentage (by volume) of new handsets available for purchase that are indoor location capable. Each subsequent handset model should be subject to bench level testing (rather than verification in a test bed) to ensure performance at least as good as the handsets that were tested in a compliance test bed. By the fifth year milestone, it is expected that all new handsets available for purchase should be indoor location capable and be demonstrated to achieve the required horizontal and vertical accuracy for 80 percent of test calls.

This phased implementation would provide timely availability of critical indoor location capability to the public without undue burden on carriers regarding handset models, features, cost or availability. The wireless carriers have previously noted their rapid and successful

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[40] *See, e.g.,* Comments of Rosum Corporation, Docket No. 07-114, 94-102, 05-196 at 5 (Sep. 20, 2007); Remarks of Ryan Jensen, T-Mobile, at 4:18:07 ("*Jensen Remarks*").

[41] *Notice*, ¶ 58.

implementation of GPS chips into wireless devices in furtherance of the Phase II rules, and they should be no less successful in implementing indoor location handset capabilities with similar efficiency.[42]

### B. Vertical Accuracy of Within Three Meters is Needed and Achievable in a Reasonable Timeframe Using Currently Available Technologies

For indoor locations, particularly in urban areas, public safety has confirmed that vertical information is "imperative."[43] As NENA has explained, the delivery of vertical-axis position information should be "required for future-generation networks and devices, under uniform standards."[44] In the Commission's 1994 Notice of Proposed Rulemaking on wireless location requirements, the Commission tentatively concluded that its proposed locations rules should be applicable to both the horizontal and vertical dimensions.[45] The Commission did not include the vertical requirement in the rules that it adopted in 1996, however, based on arguments from commenters that reasonably accurate vertical information might not have been technically

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[42] Comments of CTIA, PS Docket No. 07-114, at 2 n.4 (2009) (noting that "Sprint, Verizon Wireless and ALLTEL, provide approximately 95% or more of all their customers with location capable functionality, with all new handsets sold and initialized having location capability…a capability that has been implemented in just a few short years") ("*CTIA November 20, 2009 Wireless E911 Location Accuracy Comments*").

[43] Remarks of Lisa Hoffmann, San Francisco Division of Emergency Communications, at 2:27;49 ("*Hoffmann Remarks*"); Remarks of Terry Hall, York County PSAP/APCO, at 53:50 ("*Hall Remarks*").

[44] Comments of NENA, Docket Nos. 05-196 & 07-114, at 11 (filed Jan. 19, 2011).

[45] *Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket 94-102, RM-8143, Notice of Proposed Rulemaking, 9 FCC Rcd 6170, 6178-79 (1994).

achievable within the immediate five years and would only benefit public safety primarily in downtown areas of major cities.[46]

Today, location services incorporating vertical location capabilities are either currently in commercial deployment or will be ready in the near term.[47] These systems have been designed to work within the established specifications of PSAP consoles, meaning that, unlike Next Generation 9-1-1, PSAPs will be able to begin using location information immediately without the need for significant hardware or software upgrades or changes to the normal E911 call flow. Such an expansion of PSAP capabilities can greatly benefit emergency response in any multi-story environment or circumstances where height is a factor, and not solely in dense urban downtown areas. Accordingly, the Commission should respond to the long-standing needs of public safety by promptly adopting the proposed vertical accuracy requirements.

#### 1. Independently Conducted Tests Demonstrate that Vertical Accuracy of Within Three Meters is Achievable Using Competitive Technologies

As the CSRIC Test Bed Report documented and the *Notice* acknowledges, the technological approach demonstrated by at least one participant can achieve very precise vertical accuracy across all locations, with a median accuracy of 2 meters (essentially "floor level"), even in large multistory buildings.[48] As with its Rev-2 improvements in its horizontal performance, NextNav's August 14, 2013 *ex parte* letter in this docket detailed the extent of enhancements to

[46] *E911 First Report & Order* at IV.B.1(b)(3).

[47] *See, e.g.*, Remarks of Timothy Lorello, Telecommunication Systems, at 3:30:50.

[48] *Notice*, ¶¶ 71, 79.

NextNav's capabilities since the test bed, demonstrating that its MBS system now achieves reliability of about 1 to 2 meter vertical accuracy for at least 67 percent of test calls.[49]

In addition to MBS, the Workshop presentations and previous CSRIC reports establish that multiple other technologies are capable of providing vertical location information, including floor-level accuracy in the near future.[50] The CSRIC LBS Report discussed several vertical location technologies including OTDOA technologies,[51] Distributed Access System proximity-based location technologies,[52] CSR's Fusion Platform,[53] and hybrid A-GPS technologies.[54] Further, the underlying approach to the vertical location capabilities provided by MBS (the use of continuously calibrated Micro-Electro-Mechanical Systems ("MEMs") pressure sensors in handsets) is a technique numerous other vendors have noted can readily be supported by their systems as well.[55] Thus, the Commission should expect multiple indoor vertical location technologies to achieve similar accuracy consistent with its initial requirements, and should adopt rules accordingly.

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[49] *See* NextNav, LLC, Ex Parte Letter, WT Docket No. 07-114 (Aug. 14, 2013) ("*NextNav Aug. 14, 2013 Ex Parte*").

[50] *See, e.g., Pattabiraman Remarks* at 3:03:47, *De Lorenzo Remarks* at 3:44:00; *CSRIC LBS Report* at 37, 40, 49, 54.

[51] *CSRIC LBS Report* at 37 and 40.

[52] *See id.* at 49.

[53] *See id.* at 53.

[54] *See id.* at 54.

[55] *Id.* at 53 (noting CSR's use of Micro-Electro-Mechanical Systems ("MEMs") pressure sensors for vertical location information); *TruePosition Aug. 6, 2013 Comments* at 24 n.46 (asserting that pressure sensors "can be used with any location technology solution" to provider vertical location information).

### 2. Vertical Accuracy Requirements Can be Achieved Within Three Years for 67 Percent of Calls and Within Five Years for 80 Percent of Calls

Given the substantial development of vertical location technology in recent years, the Commission's proposed initial requirement of three meter vertical accuracy within three years for 67 percent of calls and within five years for 80 percent of calls is reasonable and well supported by the record.[56] This time period provides adequate opportunity for CMRS providers to choose among competitive vendors and to incorporate, test, and deploy their chosen technology. Equally important, the proposed timeline is sufficient to ensure appropriate upgrades to wireless carrier software systems and any support that might be required to ensure uniform delivery to all PSAPs.[57]

In a question with significant bearing on the appropriate timeline for the vertical requirement, the *Notice* asks whether the vertical requirement should be applied to "only a subset" of the environments with horizontal location requirements, such as only urban areas.[58] As a factual matter, PSAPs in urban areas have expressed the most pressing need for vertical location information. The Public Safety Foreword of the CSRIC Test Bed Report explained that "floor level vertical accuracy is valuable in large multi-story structures common in urban and dense urban morphologies, but is of lesser importance in rural morphologies and single family structures."[59] Thus, it would not be unreasonable if vertical location accuracy requirements were focused on areas with significant concentrations of multi-story buildings, which are also

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[56] *Notice*, ¶ 74.

[57] *Id*.

[58] *Id.*, ¶ 108.

[59] *CSRIC Test Bed Report* at 9.

expected to be areas which require terrestrial augmentation for compliant horizontal accuracy performance. In any event, NextNav's MBS deployment provides horizontal and vertical reference information from the same network, so vertical information will become available at the same times and in the same places that MBS horizontal location capability is deployed.

The Commission seeks comment on "the path to implementation of a z-axis requirement …including specific steps and corresponding timeframe estimates."[60] E911 vertical location capability relies on several sub-elements: the handset's ability to compute elevation, passing this information to the carrier network, the carrier network forwarding it to the PSAP, and the PSAP's ability to display the information on the Computer Aided Dispatch ("CAD") terminal. The timeline for implementing a vertical location accuracy requirement must take each of these sub-elements into account.

With regard to computing elevation, as the Commission has previously noted, nearly all handsets are now equipped with an array of sensors, some including barometric sensors, enabling handsets to calculate various position and location information, including elevation.[61] Handset makers such as Samsung already include barometric pressure sensors in some of their most popular smartphones,[62] and they are also common in tablets, sports and exercise watches and other consumer devices currently on the market. MBS technology uses these readily-available barometers combined with real-time reference data provided by NextNav's beacon network to enable the accurate computation of altitude.

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[60] *Notice*, ¶¶ 77-78.

[61] *Id.*, ¶ 79.

[62] *See supra n.33.*

As discussed in a subsequent section of these comments, messaging protocols between the handset and the carrier network are also largely in place already. Thus, in response to the *Notice*'s question of whether "development timetables and cost considerations warrant a longer implementation timeframe,"[63] the record strongly indicates that both the need and the capability for accurate vertical location information are well established, and the proposed three year/three meter timeline is more than sufficient.

### 3. PSAPs Can Begin to Utilize Vertical Location Information Rapidly and With Little Expense

The basic ability to use and benefit from vertical location information is available or can be made available in the very near term and can be implemented or accessed at little expense by the PSAPs. This is in part because location service vendors such as NextNav have designed their vertical location technologies to fit within the existing protocols for providing E911 call location information to PSAPs. [64]

The vertical location systems of NextNav and other vendors can easily be integrated into PSAP operations because messaging protocols for vertical information between the handset, the carrier network, and the PSAPs are largely in place already. The interface between the user handset and the carrier's Enhanced Serving Mobile Location Center ("E-SMLC") is governed by the positioning protocols for various air interfaces such as LTE/UMTS, which already support

[63] *Notice*, ¶ 62.

[64] *Id.*, ¶¶ 76, 80 (asking what steps must be taken and what timeframe can be expected to permit implementation of z-axis data into the PSAP response process).

altitude information.[65] The Gateway Mobile Location Center ("GMLC") in J-STD-036 Rev C adds support to altitude as an optional field.[66] The Wireless Emergency Service Protocol E2 interface between the GMLC and the Emergency Services Message Entity ("ESME")/Automatic Location Identification ("ALI") systems also already includes support for vertical.[67] In addition, the PSAP Display Format 4 has reserved fields (positions 377-382) that can be revealed by setting the appropriate masks.[68] Further, it is our understanding that most new PSAP CAD systems can support the appropriate 'Format 4' messages.

The established protocol support for a vertical-location data stream between the handset, the carrier network, and the PSAPs, and within the PSAP itself contrast sharply with the lack of support facing other E911 projects such as Next Generation 911, which may require extensive hardware, software, and personnel training upgrades to accept and process new streams of text,

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[65] *See LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)*, 3GPP TS 36.355 version 11.5.0 Release 11, at 32 and 38 (Jan. 7, 2014) (available at www.etsi.org/deliver/etsi_ts/136300_136399/136355/11.05.00_60/ts_136355v110500p.pdf) (describing how vertical accuracy and confidence is represented in the 3GPP specification).

[66] Alliance for Telecommunications Industry Solutions and Telecommunications Industry Association, ANSI/J-STD-036-C at 2.3.2.11 (September 2009) (adding altitude as an optional element of the GeographicPosition parameter).

[67] NENA Standard Data Formats For 9-1-1 Data Exchange & GIS Mapping at 68 (Dec. 2,2003) (available at http://c.ymcdn.com/sites/nena.site-ym.com/resource/collection/C74A8084-E3BD-405D-93C2-48AFCFA5B490/NENA_02-010-v9_Data_Formats_for_ALI_MSAG_GIS.pdf) (including elevation/altitude among the data elements to be included in updates to the ALI database for wireless calls).

[68] *See* E911 PSAP Display Format #04, California Office of Emergency Services (available at http://www.calema.ca.gov/PSC/Documents/911/pdf/Format04_w_positions.pdf) (last viewed May 6, 2014).

image, and video data.[69] There is no such transition period or retrofitting required for PSAPs to receive and use vertical location capabilities. Instead, the appropriate standards already exist and the allowance of one additional year (between the effective date of the initial horizontal requirement and the initial vertical requirement) should be sufficient to ensure that carriers' infrastructure software elements reflect current standards, and any harmonization between the different subsystems can be addressed.

Although it is not difficult to make vertical location information available to PSAPs for their use, some parties have expressed concern that there are no databases currently implemented to convert measured height to floor level for individual buildings. This fact is undeniably true. Building and altitude information, however, is already available today from providers such as Google (Google Earth in 3D building mode), Pictometry Inc., and others. Further, internal building mapping is an area of active industry development with companies such as Google,[70] Micello,[71] and others, rapidly developing comprehensive data on individual structures. Through

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[69] *Facilitating the Deployment of Text-to-911 and Other Next Generation 911 Applications, Framework for Next Generation 911 Deployment, PS Docket No 11-153, PS Docket No. 10-255*, Further Notice of Proposed Rulemaking, FCC 12-1490, ¶ 127 (2012) ("*2012 Further Notice*") (noting that "many…PSAPs will not be NG911-capable for an extended period of time" and thus the transition to Next Generation 9-1-1 "must take the disparate capabilities of PSAPs into account").

[70] *See A New Frontier for Google Maps: mapping the indoors*, Google Inc,, http://googleblog.blogspot.com/2011/11/new-frontier-for-google-maps-mapping.html (last visited May 6, 2014); *see also Indoor Maps availability*, Google Inc., https://support.google.com/gmm/answer/1685827 (noting that "[o]ver 10,000 floor plans" are available in countries, including over 200 major facilities in the United States such as airports, convention centers, sports venues, hotels, casinos, museums, and malls, as well as major retail locations).

[71] *Micello Announces 15,000 Indoor Venue Maps Available Worldwide*, Micello, Inc., http://micello.com/15k (last visited May 6, 2014) (explaining that Micello now provides over 14, 000 venue maps in the United States, including 114 airports, thousands of malls, universities, and other places of interest).

such efforts, tens of thousands of buildings are already mapped in detail and this database of information is likely to expand significantly over the coming years. PSAPs therefore have access to building and altitude level information today that could be further refined with indoor floor maps as these industries mature. Further, public safety representatives, particularly Fire Safety Inspectors who visit urban building structures on a periodic basis, have indicated a willingness and desire to include translating altitude to floor level data as part of their normal "fire pre-plan" activities for buildings within their jurisdiction.[72]

Although such highly detailed floor level identification would undeniably be useful—as well as dramatically demonstrating the improved capabilities of indoor location systems—the fact is that the availability of even raw altitude data nonetheless represents a dramatic improvement over the basic X and Y data previously available to PSAPs. Coarse estimates of floor height can be created simply by comparing the reported altitude with the known elevation of the surrounding terrain. In addition, first responders are expected to have their own devices, even potentially incorporated into their worn equipment, that can allow the responder to match his or her elevation to the conveyed elevation of the emergency, removing the need for integrating databases or guesswork by dispatchers and responders on scene.

As a result, as NextNav shared with the Workshop, "[t]he question of how Z-axis information is ultimately implemented into PSAPs…need not delay the adoption of vertical accuracy rules because such information can be useful to first responders with or without accompanying mapping systems."[73] Public safety representatives have reiterated numerous times in this proceeding that, given the urgency of the need and the substantial benefits to be

[72] Comments of the International Association of Fire Fighters, Docket No 07-114, at 6-7 (May 9, 2014).

[73] *Parsons Remarks* at 4:41:11.

gained, the Commission should support and require implementation of "[a]ny significant improvement over the current regime…whether or not it can reach our ultimate ideal right away."[74] The common position of first responders with regard to improved location information is that the "the perfect cannot be the enemy of the good."[75] In essence, 50 meter horizontal accuracy is not a perfect substitute for a dispatch-able building address, and 3 meter vertical location is not a perfect substitute for a precise floor, but they are clearly of great value to first responders and a notable improvement over the location information that is available today. The Commission should therefore promptly adopt the proposed three-meter vertical accuracy requirement.

### C. The Proposed Accuracy Rules Can be Implemented at Reasonable Cost to Wireless Carriers and Consumers

The *Notice* seeks comment on the "[p]otential costs of providing indoor location services and the factors that may impact the extent of those costs" as well as any "[p]otential for cost reduction due to market forces implementing location technologies already."[76] As a threshold issue, the Commission has long since appropriately concluded that wireless carriers must provide accurate location information to public safety for wireless E911 callers and that the costs of

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[74] Comments of NENA, WT Docket No. 11-49, at 2 (March 22, 2013) ("*NENA March 22, 2013 Comments*").

[75] *See, e.g.*, Reply Comments of the Texas 9-1-1 Alliance, The Texas Commission on State Emergency Communications, and the Municipal Emergency Communications Districts Association, CC Docket No. 94-102, WC Docket No. 05-196, PS Docket No. 07-114, PS Docket No. 10-255 at 7 (Aug. 6, 2012); Reply Comments of NENA, CC Docket No. 94-102, WC Docket No. 05-196, PS Docket No. 07-114, PS Docket No. 10-255 at 6 (Aug. 6, 2012).

[76] *Notice*, ¶¶ 35-37.

enabling such capabilities is warranted given the substantial benefits that would result.[77] The shift to wireless E911 calls, and the increasing majority of wireless E911 calls from indoor locations, means that the Commission's conclusion as to the importance of accurate location information logically extends to indoor locations as well. Only by ensuring high accuracy and consistency across devices and locations can the E911 system ensure that emergency first response capabilities are maintained at the levels that consumers justifiably expect.

Fortunately, available evidence indicates that indoor location technologies can be deployed and maintained at a very reasonable cost. The total cost of providing indoor location services is a factor of the handset costs and the network costs. Although costs to initially implement GPS for outdoor location accuracy were relatively expensive at the time (approximately $10 for each chip in 2002),[78] handset support for GNSS today is effectively ubiquitous already, and newer handsets, especially those supporting Voice-over-LTE ("VoLTE"), typically will support OTDOA as well.

With respect to NextNav's MBS location capability, the most significant modification to new handsets, as noted previously, is establishing an RF signal path for the NextNav's 900 MHz beacon signals to the GPS chip. In an era of multi-frequency (700, 850, 1,900 MHz, *etc.*) LTE and multi-constellation (GPS, GLONASS, and Beidou) handsets, support for a new terrestrial constellation does not impose a significant cost for chip manufacturers. Based on input from chipset providers, a fully integrated solution is expected to impose no additional 'Bill of

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[77] *See, e.g.*, *id.*, ¶¶ 27-37 (reiterating at length the urgent need for and expected benefits of improved indoor location accuracy); *Wireless E911 Location Accuracy Requirements, PS Docket No. 07-114*, Second Report and Order, FCC 10-176, ¶ 25 (2010) (noting that the "important public safety issues at stake outweigh the potential cost impact of imposing these regulations") ("*E911 Second Report & Order*").

[78] John G. Spooner, Motorola: New chip will bring GPS to all, CNET (Sep. 30, 2002) (available at http://news.cnet.com/2100-1040-959085.html).

Material' cost to wireless handsets when manufactured in significant commercial volumes. The cost impact to the core network elements is also negligible since it is primarily a software upgrade and similar to adding support for a GNSS constellation in the E-SMLC.

From the perspective of including vertical location capabilities within the handset, as noted previously, MBS technology uses readily-available barometric pressure sensors combined with real-time reference data provided by NextNav's beacon network to enable the accurate computation of altitude. Analysts estimate that the inclusion of atmospheric pressure sensors in smartphones is expected to increase to 681 million new units per year in 2016, up more than eightfold from 82 million new units per year in 2012.[79] Such sensors are relatively inexpensive already and should be expected to continue to fall in price at a rate of approximately 15 percent per year as adoption grows.[80] It is further projected that the average sales price of these devices will fall to between $0.25 and $0.35 by 2017 as a direct result of the commercial demand that already exists for such components and any further stimulus to the adoption of such devices (such as the adoption of the Commission's proposed rules) would likely accelerate the decline in price as sales volume increases.[81]

Infrastructure is likely to be similarly cost effective, for related reasons. First, just as multiple services can make use of existing capabilities on a handset to minimize the cost of the handset, many location infrastructure solutions can be shared by multiple wireless carriers. The CSRIC Test Bed Report explained that the use of a "shared infrastructure approach, like GPS,

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[79] Julien Happich, Samsung Leads the Adoption of Pressure Sensors in Smartphones, for Floor-Accurate Indoor Geolocation, EE Times Europe, http://www.electronics-eetimes.com/en/samsung-leads-the-adoption-of-pressure-sensors-in-smartphones-for-floor-accurate-indoor-geolocation.html?cmp_id=7&news_id=222916211 (Mar. 21, 2013).

[80] Comments of Bosch Sensortec, PS Docket No. 07-114, at 6 (May 12, 2014).

[81] *Id.*

helps ensure the cost of the service is competitive."[82] The CSRIC Report also noted the operational and maintenance savings associated with solutions that remain separate from the carriers' call and data-carrying RAN infrastructure, which would not be impacted by ongoing RAN network modifications and enhancements, and which could be cost shared among multiple parties.[83] It is also recognized that having a single frequency on the handset for a reference indoor location network (such as MBS) that is shared across multiple wireless carriers has a lower overall cost on the handset since the handset costs can be amortized across a larger volume.

Terrestrial beacon-based solutions such as NextNav's and others[84] employ a one-way multilateration approach to location identification that greatly reduces the number of transmitters required to establish an indoor position fix for tracked handsets. Through the use of high site locations surrounding urban centers, augmented by select roof-top locations, a relatively small number of terrestrial beacons can enable indoor location in an entire metropolitan area. The construction and operating costs for such a network are vastly less than for two-way cellular networks, which require more densely placed transmitters to meet capacity and coverage requirements. Unlike two-way cellular systems, a broadcast-only location network requires no additional transmitters or spectrum as the number of users on the network increases. Further, the low-cost network equipment does not require expensive backhaul facilities or elaborate antenna

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[82] *See CSRIC Test Bed Report* at 45.

[83] *See Id.* at 53-54 (explaining that "Location technologies that allow costs to be shared across carriers are preferred" and location technologies should be independent from (1) the wireless network, (2) cell site locations and density, (3) changes in frequencies, bands, and deployment configurations, and (4) Radio Access Network technology changes).

[84] *See TruePosition Aug. 6, 2013 Comments* at 15 (stating that TruePosition is developing a terrestrial beacon system utilizing digital TV signals).

arrays. As a result, both the infrastructure and handset components of location services can be deployed cost effectively to support a high degree of indoor location accuracy.

The *Notice* also asks whether more precise horizontal accuracy requirements would increase the cost of indoor location accuracy systems.[85] The current proposed initial requirement of 50 meter horizontal accuracy represents an appropriate balance between public safety's desires for a dispatch-able address and the ability of the wireless industry to leverage to the maximum extent possible the capabilities of currently deployed technologies (AGNSS and OTDOA) and augment them with new technologies (such as MBS) to deliver the best accuracy possible with the greatest level of reliability and consistency.

Public safety has made it clear, however, that accuracy of at most 50 meters (and preferably better) is critical to achieve the "actionable location" required for effective emergency response.[86] In contrast, "horizontal positional fixes that substantially exceed 50 meter accuracy, provide[] only general location information."[87] With MBS technology, a somewhat denser beacon network can generally achieve correspondingly better performance than has been previously demonstrated, and approaches that may not require additional infrastructure are also available to improve performance and accuracy over time. Search rings of larger than 50 meters, however, will not serve the needs of public safety and would not justify marginal cost savings. Thus, less precise requirements would compromise the goal of the rules and should not be considered.

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[85] *Notice*, ¶ 52.

[86] *CSRIC Test Bed Report* at 9.

[87] *Id*.

### D. It is Not Necessary to Delay Implementation of Indoor Location Rules Until Further Testing has been Completed

The *Notice* asks whether the Commission should delay initiating the compliance timeline until after a test bed administrator has certified that existing commercial technologies meet the proposed accuracy standards.[88] Such a delay or tentative implementation would be unnecessary and detrimental to the Commission's goals of promoting regulatory certainty and public safety.

The last time the Commission formally examined the need for indoor location in 2011,[89] CTIA used almost identical language in asserting that the issue was premature for Commission action and urging the Commission to instead turn to an industry-based stakeholder group to form a full record of the available location technologies before promulgating rules.[90] The Commission heeded CTIA's urging at the time and specifically charged CSRIC, the industry-based stakeholder group, with assessing the capabilities of indoor location technology available for E911 such that the Commission could promulgate rules based upon a fully informed record.

The resulting CSRIC III represented a broad industry group that balanced the inputs of public safety, carriers and vendors to achieve that objective and provide the FCC actionable

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[88] *Notice*, ¶ 60.

[89] *See* Amending the Definition of Interconnected VoIP Service in Section 9.3 of the Commission's Rules, GN Docket No. 11-117, Wireless E911 Location Accuracy Requirements, PS Docket No. 07-114; E911 Requirements for IP-Enabled Service Providers, WC Docket No. 05-196, *Notice of Proposed Rulemaking, Third Report and Order, and Second Further Notice of Proposed Rulemaking*, FCC 11-107, FNPRM ¶ 84 (July 13, 2011)("*E911 Third Report and Order*").

[90] Comments of CTIA, PS Docket No. 07-114, at 2-4 (Oct. 3, 2011)( explaining that "[r]ather than embarking on new proposed regulations, CTIA urges the Commission to revisit location accuracy standards through an industry-based stakeholder group,.."); *see also* Comments of CTIA, PS Docket No. 07-114, at 4 (Nov. 20, 2009)(citing the need to "develop[] a substantial record" and recommending creation a working group for E911); Comments of CTIA, PS Docket No. 07-114, CC Docket No. 94-102, WC Docket No. 05-196, at 2 (2007) (expressing concern that "that the FCC may prematurely adopt technical standards before a full and adequate record is established").

information. Technologies that were deemed ready for vetting for E911 were blind tested by a neutral third party. The comprehensive results of the CSRIC Working Group 3 Test Bed sufficiently demonstrated that both horizontal and vertical technologies are able to achieve substantial and useful improvements as compared to the unacceptable status quo. Additional test results undertaken separately from the CSRIC process were submitted to the Commission by NextNav and an additional location technology vendor.[91] The performance capabilities of still other location technologies were studied by CSRIC and were addressed in the LBS Report that CSRIC filed with the Commission last year,[92] and additional technology vendors have been working outside the CSRIC process to validate the indoor capabilities of their location technologies.[93] Presentations by some of these location technology vendors at the E911 Location Accuracy Workshop indicate that location technologies are continuing to evolve at a rapid pace, improving upon the 2012 Test Bed performance and already approaching or exceeding the Commission's proposed requirements. Taken together, this voluminous data on the technical capabilities of numerous indoor location technologies indicates a "strong ecosystem" with multiple vendors offering location technology solutions that are now or soon will be able to meet the Commission's requirement.[94] Thus, there is no reason for the Commission to again delay implementation to further verify technologies that have already been tested at the CSRIC Test Bed that was convened explicitly for that purpose.

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[91] *See NextNav Aug. 14, 2013 Ex Parte*; *TruePosition Aug. 6, 2013 Comments* (including reports for tests it had conducted on its technology in Delaware, New York and Texas as attachments).

[92] *CSRIC LBS Report.*

[93] *See, e.g.*, Letter from Mary L. Brown, Director, Cisco Government Affairs, to Marlene H. Dortch, Secretary, Federal Communications Commission (July 24, 2013) (providing a presentation on the capabilities of Cisco's Wi-Fi location technology as an attachment).

[94] *Burroughs Remarks* at 3:13:27; *Anderson Remarks* at 3:24:05.

Further, entertaining proposals for delay creates the risk of producing uncertainty and sapping the momentum that the Commission has struggled to build to address this crucial issue.[95] Workshop presenters noted that Commission leadership is critical to provide the expectations toward which public safety and the industry will work.[96] As NENA explained, a lack of definitive Commission action through an NPRM creates uncertainty for carriers that may impede or delay efforts to improve location accuracy capabilities.[97] Therefore, the Commission should not forestall adoption or implementation of indoor location rules until repetitive rounds of testing have been completed.

### E. The Implementation of Indoor Location Accuracy Rules Is Likely to Have a Corresponding Impact on Outdoor Location Capabilities

As the *Notice* acknowledges, improvements in A-GPS combined with the build out of technologies to provide improved indoor location accuracy are likely to have significant benefits for outdoor location accuracy capabilities as well.[98] The proposed indoor location accuracy requirement of 50 meters for at least 80 percent of calls in 5 years is substantially similar to the existing E911 Phase II requirement of outdoor accuracy for handset-based systems of 50 meters for 67 percent of calls and 150 meters for 90 percent of calls by 2019.[99] In the case of the

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[95] *E911 Third Report and Order*, ¶ 86 (characterizing indoor location accuracy as "a significant public safety concern that requires development of indoor technical solutions and testing methodologies to verify the effectiveness of such solutions").

[96] *Anderson Remarks* at 3:24:05.

[97] Remarks of Brian Fontes, NENA, at 2:28:45.

[98] *Notice*, ¶ 166.

[99] *E911 Second Report and Order* at Appendix C at 39-40; 47 CFR 20.18(h)(2)(ii) (requiring handset-based technologies to achieve outdoor location accuracy of 50 meters for 67 percent of calls, and 150 meters for 90 percent of calls, on a per-county or per-PSAP basis within eight years from January 18, 2011).

NextNav system, outdoor accuracy is often improved in areas where NextNav provides indoor service, particularly in dense urban morphologies, providing an alternative or improvement to existing outdoor location methods. NextNav expects that the deployment of other indoor location services will provide similar benefits to outdoor accuracy in urban areas where they are deployed.

As a result, NextNav concurs with the Commission's proposal that it would not be unreasonable to unify the indoor and outdoor requirements and require a single standard of 50-meter accuracy for 80 percent of all calls, indoors and out, in five years. This would assist in creating a single accuracy expectation for the public and public safety, as well as simplifying the Commission's E911 rules. From a practical standpoint, however, whether there are changes to the existing outdoor standards or not, the expected outcome of meeting the proposed indoor standards would result in an associated improvement in outdoor performance, at least in urban markets.

### F. Implementation of the Commission's Proposed Rules Will Hasten the Eventual Development of Optimal Long Term Solutions

As the *Notice* explains, the Commission's ultimate long term goal is to ensure "location information [that is] sufficiently granular to provide a specific residential or business address, including floor and suite or apartment information."[100] The *Notice* further recognizes, however, that "based on existing technological considerations and the needs of the public safety community…the public safety and interest would be better served by adopting [the proposed 50 meter] requirement in the near term rather than allowing a regulatory gap to grow."[101] NextNav

[100] *Notice*, ¶¶ 45-46.

[101] *Id*.

strongly concurs with this observation. Firm and quantifiable, but feasible, near-term requirements will drive development, deployment, and economies of scale that will directly benefit the Commission's ultimate goal of highly accurate and ubiquitous address-specific location capabilities.

The *Notice* inquires whether adoption of near-term indoor location accuracy requirements could raise the risk that early technological investment could become "stranded" as the Commission's requirements evolve toward more precise location requirements and a true "dispatchable address."[102] NextNav does not believe this is a significant concern for most of the technologies discussed in the record, nor is it likely to be for those in development. In the past, a major cause of stranded investments was the linking of the carrier's location technology to the radio access network ("RAN") used to carry calls. Frequent modifications to, or even replacement of, RAN equipment created an obsolescence risk to such integrated systems. This is a central rationale behind the carriers' expressed interest in location solutions that are separate from their individual call and data-carrying networks and which could be cost-shared among multiple carriers irrespective of the underlying RAN network technology and roaming agreements.[103] Separate systems are much more robust to technological change. GPS, for example, has proven exceedingly reliable across multiple generations of technology and has always remained backwards compatible even as new GPS satellites and GNSS constellations have been added to improve accuracy, availability and yield. Like GPS, terrestrial beacon technologies such as NextNav's are independent of the calling function and the carrier network,

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[102] *Id.*

[103] *CSRIC Test Bed Report* at 54 (noting that a location technology should be "[i]ndependent (or largely independent) from the Wireless network").

and are easily scalable and shared by multiple carriers. It should therefore not result in stranded investment for NextNav, client carriers, or end user consumers.

Eventually, specific address information may also be achievable through a combination of location technology, mapping technology and accurate building databases predictive technology, *i.e.*, if a caller appears to be a few feet outside a building, but is at an altitude of 50 meters above terrain, they are probably standing in the building near a window or on an exterior appendage such as a balcony. The development of such capabilities is best undertaken as incremental improvements to the indoor location capabilities that are now available or under development, rather than as green field proposals with no verifiable technology currently available that meets those requirements and that would require complete replacement of the indoor location technologies that are now being made available to carriers and public safety. In this way, investments in improved accuracy are directly applicable to more stringent future accuracy requirements, minimizing the risk of stranded investment as the expectations of consumers and public safety evolve and the Commission's rules change accordingly.

## II. A DEMONSTRATED NEED EXISTS FOR THE ADOPTION OF INDOOR LOCATION RULES TO SUPPORT EMERGENCY SERVICES

When an emergency arises, victims and good Samaritans reach for their wireless devices to summon help rapidly and reliably. A regulatory gap exists today, however, because the Commission's current rules do not require the provision of indoor location accuracy information that is critical to the chain of E911 emergency response and consequently do not meet the expectations of public safety or the public. To correct this, the Commission should adopt the proposed indoor location accuracy rules to ensure that emergency services are equipped to respond to calls for help regardless of the caller's phone or location.

### A. The Predominance of Wireless Devices and Lack of Corresponding Indoor Location Capabilities Constitutes a Serious Technology Gap for Public Safety

As the Commission is well aware, wireless phones are now used for more than 70 percent of 911 calls.[104] Indeed, nearly two in five American homes are now wireless only, and for some demographics these numbers are even higher.[105] At the same time, most wireless calls are placed from indoor locations.[106] As a result, it is clear that today, emergency calls are wireless calls and wireless calls are indoor calls.[107]

Unfortunately, as first responders and the Commission have acknowledged, "[c]ell phone calls from indoors and in urban canyons are often unable to report accurate information in a timely manner, if at all."[108] The steadily increasing rate of wireless indoor calls to 911 has significantly affected the availability of E911 information and, in turn, has compromised the ability of public safety officials to respond to calls for help.[109] Despite the improvements in E911, "current generation location technology is often unable to locate accurately callers indoors, especially in multi-story buildings. This shortcoming increases when the size of

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[104] *Id.*, ¶ 22.

[105] *Id.*, ¶ 28 (citing CTIA, Wireless Quick Facts, available at http://www.ctia.org/advocacy/research/index.cfm/aid/10323 (last visited Jan. 28, 2014)).

[106] *See* Wireless Network Data Problems Increase as More Subscribers Use Web Applications, JD Power, available at http://www.jdpower.com/content/press-release/p5rCap4/2012-u-s-wireless-network-quality-performance-study-volume-1.htm (last visited on Aug. 13, 2013).

[107] Letter from Bart R. Johnson, Executive Director, International Association of Chiefs of Police, to Julius Genachowski, Chairman, Federal Communications Commission, WT Docket No. 11-49, at 1 (March 29, 2013).

[108] *Id.*

[109] *Notice*, ¶ 31.

buildings grow."[110] As a result, "accuracy provided by current E911 location technologies is often dramatically insufficient, providing search rings which can contain multiple city blocks and include thousands of apartments in multistory buildings."[111]

As the Commission has acknowledged, the failure of the E911 system to meet consumer expectations and public safety needs comes with concrete human and economic costs.[112] Emergency medical care delayed by even minutes correlates with measurably poorer prognoses for patients.[113] The same holds true for police and fire calls where rapid and accurate dispatch can assist first responders in reaching a scene promptly before a situation escalates, exponentially reducing the risk to victims, property, the homeland, and responders. Reliable vertical location information is an integral part of dispatch in urban environments, and is equally critical in fire and police incidents as it is in medical emergencies.

The unreliability and unavailability of indoor location information affects not just potential victims, but also first responders. The International Association of Fire Fighters ("IAFF") explains that the same indoor location accuracy technology that can improve safety for

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[110] Comments of Telecommunications for the Deaf & Hard of Hearing, Inc. et al., WT Docket No. 11-49, at 2 (April 12, 2013) ("*TDI Comments*"); *see also* Comments of the International Association of Fire Fighters, WT Docket No. 11-49, at 1 (March 25, 2013) ("*IAFF Comments*") (explaining that "signal reception challenges presented by large institutional structures and tall buildings can also delay the arrival of assistance when emergency responders cannot locate victims quickly").

[111] Comments of the Minnesota Metropolitan Emergency Services Board and the Minnesota Department of Public Safety, WT Docket No. 11-49, at 1 (April 18, 2013); *see also* Comments of the National Sheriffs' Association, WT Docket No. 11-49, at 1 (April 3, 2013) (noting that "[i]mproving the ability of dispatchers and first responders to locate [indoor] callers has become an important public safety issue")("*Minnesota Comments*").

[112] *Notice*, ¶ 33.

[113] Comments of the American Heart Association, Docket No. 07-114, at 1-2 (May 9, 2014) (noting that "for every minute without life-saving CPR and defibrillation, chances of survival decrease 7%-10%").

911 callers "would be equally valuable to incident commanders seeking to maintain situational awareness and personnel management."[114] The IAFF notes that "a fundamental step toward protecting the public is the protection of the firefighters and paramedics with a duty to respond."[115] Therefore, technology that can "provide the capability to both rapidly locate victims and fallen rescuers, with precise horizontal and vertical accuracy, indoors and out, can only improve first responder performance, safety and outcomes."[116]

### B. Public Safety Has Demonstrated an Actual Need for Indoor Location Accuracy That, at a Minimum, Achieves the Proposed 50 Meter and 3 Meter Requirements

The CSRIC Test Bed Report summarizes the ultimate desires of public safety to consistently generate "actionable location" data, which effectively means "a specific dispatchable building and floor," or lacking that, more generally "the smallest possible search ring."[117] By contrast, the "accuracy provided by current E911 location technologies is often dramatically insufficient, providing search rings which can contain multiple city blocks and include thousands of apartments in multistory buildings."[118] In response to this mismatch between the needs of first responders and the limited capabilities of the current E911 system, NENA explained that "[a]ny significant improvement over the current regime of impossibly-large outdoor search rings and indeterminate indoor search rings must be encouraged, whether or not it can reach our ultimate

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[114] *IAFF Comments* at 2.

[115] *Id*.

[116] Letter from Dominick Marino, President, Professional Firefighters Association of New Jersey, at 1-2 (Apr. 3, 2013).

[117] *CSRIC Test Bed Report* at 9.

[118] *Minnesota Comments* at 1.

ideal right away."[119] Public safety representatives have made it clear that they require a high yield of very reliable indoor location information that does not substantially exceed 50 meters in horizontal error and includes floor level vertical accuracy in multi-story urban environments. The Commission is therefore well justified in promptly adopting the proposed indoor location accuracy rules as proposed in the *Notice*.

### C. Alternatives Such as Applying the Existing Outdoor Rules to Indoor Location Would be Inadequate to Address the Needs of Public Safety

The Commission should not default to overly simplistic approaches such as arbitrarily extending its outdoor location rules to indoor locations.[120] The outdoor rules do not require the same combination of accuracy and yield as the proposed indoor rules, and thus create the possibility of much wider search areas.[121] As the *Notice* acknowledges, "[s]uch an approach could be inconsistent with the Commission's intent to progress towards more granular location data for all wireless calls to 911."[122] Further, a key finding of CSRIC III Working Group 3 was that indoor location accuracy and outdoor location accuracy do not require the same standards, and, most specifically, from the standpoint of the needs of the public safety community, the desired accuracy for indoor location is greater than that required for outdoor location accuracy due to the inherently greater difficulty in locating calling parties indoors in a metropolitan

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[119] *NENA March 22, 2013 Comments* at 2.

[120] *Notice*, ¶ 53 (seeking comment on the alternative of extending "the existing E911 Phase II location accuracy requirements" to indoor locations).

[121] 47 CFR 20.18(h)(2)(ii) (providing the outdoor handset-based outdoor location standard requiring location accuracy of 50 meters for 67 percent of calls, and 150 meters for 90 percent of calls.)

[122] *Id*.

environment.[123] The existing rules for outdoor location would therefore be inadequate to address the demonstrated needs of public safety for more accurate indoor location capabilities.

In taking this position, NextNav acknowledges that it has previously advocated that "at a minimum," the outdoor rules should be extended to indoor locations.[124] NextNav, however, concurrently argued that the Commission should require that the percentage of calls that achieve accuracy of within 50 meters should increase above 67 percent over time "in order to fulfill the stated needs of the public safety community for consistent sub-50 meter location accuracy in urban and suburban markets."[125] NextNav also argued that the percentage of calls that achieve 50 meter accuracy should be "tightened over time to further increase the percentage of fixes within 50 meters, potentially reaching 80 percent or more at some subsequent milestone."[126] This is exactly what the Commission has appropriately proposed.

Some might argue in response that only a modest difference exists between the current outdoor requirement of at least 50 meters for 67 percent of calls (using handset-based technologies) and the proposal of requiring 50 meter accuracy for at least 80 percent of calls by the five year benchmark. In reality, the added requirement of reaching 50 meter accuracy for at least 80 percent of calls has substantial benefits to the entire population of indoor calls and not just for the 13 percent of calls that would be directly affected by the shift from 67 to 80 percent. This is because the types of technological improvements to a location technology that are

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[123] *See CSRIC Test Bed Report* at 30-31 and 52.

[124] NextNav, LLC Ex Parte Letter, WT Docket No. 07-114, at 2-3 (Dec. 23, 2013) ("*NextNav December 23 Ex Parte*"); Comments of NextNav, LLC, WT Docket No. 07-114, at 8-10 (Sep. 25, 2013) ("*NextNav September 25 Comments*").

[125] *See NextNav December 23 Ex Parte* (citing *CSRIC Test Bed Report* at 9).

[126] *NextNav September Comments* at 7.

necessary in order to move the 50 meter threshold from 67 to 80 percent invariably shifts the entire distribution curve of location fixes and thereby increases the accuracy of both the 67 percent of calls that were already within the 50 meter threshold and the 20 percent of calls that remain outside the 50 meter threshold.

A second shortcoming with applying the Commission's existing outdoor location rules to indoor environment is the resulting imposition of two search rings – a 50 meter ring for 67 percent of calls (using handset-based technologies) and a 150 meter ring for 90 percent of calls.[127] As the public safety community explained in its foreword to the CSRIC Working Group 3 Test Bed Report, there is little practical benefit to a 150 meter location ring because "[h]orizontal positional fixes that substantially exceed 50 meter accuracy, provides only general location information."[128]

## III. THE KEY PERFORMANCE ATTRIBUTES THAT MUST BE INCORPORATED INTO THE COMMISSION'S RULES ARE LOCATION ACCURACY, LATENCY, AND YIELD

The proposed rules accurately capture the performance attributes required to ensure that indoor wireless location information is comparable to the information available for wireline and outdoor E911 calls.[129] Dispatch-able accuracy, low time to first fix ("TTFF"), and high reliability and yield regardless of a caller's location are necessary and appropriate to ensure that the E911 system can once again meet the expectations of consumers and the needs of public safety.

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[127] 47 C.F.R. § 20.18(h)(2)(i), (ii) (applying to handset-based technologies); *see also* 47 C.F.R. § 20.18(h)(1)(i), (ii) (applying to network-based technologies).

[128] CSRIC Test Bed Report, Public Safety Foreword at 9.

[129] *Notice*, ¶ 89-91.

### A. A Maximum Latency of 30 Seconds is Reasonable and Appropriate

The effectiveness of emergency dispatch is directly dictated by the speed and accuracy with which an initial E911 location determination fix is achieved. Thus, the TTFF requirement is always a compromise between the need to deliver location information quickly and the need to ensure that the information provided is accurate enough to fulfill the needs of the PSAP.

At the most basic level, calls cannot be routed to the correct PSAP until at least coarse location information is provided, and responders cannot be dispatched until a sufficiently precise location is identified. The goal of rapidly processing and resolving a 911 call is largely dependent on the combined speed and accuracy of the location fix. During the Commission's Workshop, public safety representatives indicated that a TTFF of 30 seconds is often too long to assist 911 operators because many calls last less than 30 seconds.[130] PSAP representatives explained during the Workshop that, rather than wait 30 seconds for Phase II location information, 911 operators often spend the critical initial portion of an emergency call orally eliciting location information from the caller, substantially negating the benefit of Phase II location capabilities that require a full 30 seconds to become available to the public safety dispatcher.[131]

Thus, the proposed TTFF of 30 seconds, which has historically been used in testing for Phase II outdoor location compliance, represents a compromise between the technological limitations of current generation systems and the preference of public safety personnel for

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[130] *Anderson Remarks* at 3:19:19; *Hall Remarks* at 2:08:52, *Hoffmann Remarks* at 37:50 (noting that nearly 90 percent of 911 calls are answered in 10 seconds or less, which is not enough time for automatic location information to be provided with the initial call delivery).

[131] *Hoffmann Remarks* at 1:48:29; (noting that operators can often elicit location information manually in less time than it takes to rebid); Remarks of Jennifer Green, District of Columbia Office of Unified Communications, at 2:02:10.

accurate data as quickly as possible.[132] As a practical matter, next generation location systems such as those based on MBS technology will be able to provide location fixes much earlier during an emergency call, but timeframes up to 30 seconds may still be needed by systems that rely heavily on GPS fixes, which may continue to be the predominant technology in non-urban areas for the immediate future.

In addition to the 30-second maximum latency requirement, the Commission should also consider encouraging carriers to provide their "best available" Phase II location information at the earliest possible time after the initiation of an emergency call, followed by more accurate Phase II location information in a subsequent data transmission with the PSAP within 30 seconds of the call's initiation. Early "best available" information combined with 50-meter accuracy information within 30 seconds will help to ensure that PSAP operators have the most accurate information possible at all stages of the 911 call. This is particularly achievable and desirable in urban environments where terrestrial-based location technologies such as MBS, AFLT, UTDOA and OTDOA all can establish a very rapid first fix that can be relayed to the PSAP on a "best available" basis.

### B. A Yield Requirement That Excludes Calls Disconnected Within 10 Seconds Might be Reasonable in Urban Areas, but Would Have no Practical Impact on Compliance Testing

Yield is a critical metric of any location technology and accurately measuring the yield of a particular technology is key to evaluating how reliable it will be in actual practice, as well as for drawing valid comparisons between the accuracy performance of different location

[132] *Notice*, ¶ 145.

technologies.[133] The expectation for consumers and public safety is that, if a wireless device is able to place an E911 call from an indoor location, the location technology should be able to achieve a location fix for that device for virtually all of those same calls. The Commission's indoor location accuracy rules should reflect this expectation.

At the same time, however, the Commission's compliance requirements should be carefully controlled to ensure fair and consistent testing between location technologies that achieve different yields. Specifically, it is important to ensure during the Commission's proposed test bed compliance process that all test calls are included in the accuracy calculation. The CSRIC III Test Bed revealed yield percentages between technologies that varied between 85 and 99 percent depending on morphology. The CSRIC report specifically noted, however, that the accuracy calculations were only based on calls that generated a Phase II fix. Including all test calls in the accuracy calculations would not have materially impacted the results in those cases where very high (*i.e.*, 95-99 percent) yield was achieved, but would have significantly impacted results where poor yield (*i.e.*, 85-90 percent) was exhibited. Such significant discrepancies would invariably be revealed in compliance tests that, as the Commission clearly intends, would require that all test calls, each of which would last for 30 seconds, be included in the accuracy calculations for assessing compliance with the 67th and 80th percentile accuracy metrics.

In daily operation outside of a compliance test bed, however, the *Notice*'s dual proposals to exclude calls of less than ten seconds and also require location information be delivered no later than 30 seconds raises the question of how calls will be treated when they are interrupted after 10 seconds but before 30 seconds has elapsed (when Phase II information is required to

[133] *See* Final Report – Outdoor Location Accuracy, CSRIC III, Working Group 3, at 29 (March 14, 2012) ("*CSRIC III Outdoor Location Report*").

have been delivered). Commissioner Ajit Pai identifies this mismatch in his statement accompanying the *Notice*, noting that the rules would appear to imply that "[i]f a call lasts for twenty seconds, then a carrier will be penalized for failing to transmit accurate location information within those twenty seconds even though the rule ostensibly provides the carrier with thirty seconds to do so."[134] As noted earlier, this situation does not arise during compliance testing because the test procedures are closely controlled to ensure that all test calls have a solid connection and last for the entire 30 seconds. This procedure is consistent with the approach employed during the CSRIC III Test Bed. Although in actual usage emergency calls will be of various durations, including very short calls, the test bed will present a standardized circumstance that is representative of practical usage while ensuring a predictable and uniform test criteria.

### C. PSAPs Must be Provided Confidence and Uncertainty Data, But in a Manner that makes it Useful for Their Purposes

NextNav concurs that confidence and uncertainty ("C/U") data is important to enable dispatchers and first responders to evaluate the quality of the location data they are provided.[135] Unfortunately, this data is not always used by PSAPs in large measure because the lack of a uniform standard for reporting C/U information means that, "disparate service providers and technologies report confidence and uncertainty values differently."[136] Because uncertainty "has no meaning unless you associate it with a confidence level,"[137] the value of C/U data is

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[134] *Wireless E911 Location Accuracy Requirements, PS Docket No. 07-114*, Statement of Commissioner Ajit Pai, FCC 14-13 (Feb. 21, 2014).

[135] *Notice*, ¶ 155.

[136] *Id.*, ¶ 153 (*citing CSRIC Outdoor Location Accuracy Report* at 28).

[137] *Green Remarks* at 1:09:40.

diminished when these criteria are unclear, and some PSAPs opt to suppress potentially valuable data rather than attempt to make sense of highly variable data during emergency situations.[138] Other PSAPs have indicated that they use and rely on C/U data to guide dispatching strategy, and seek Commission action to ensure that this data is provided in a uniform manner to assist first responders in quickly and intuitively understanding the value of the information provided.[139]

In order to be a useful indicator of location information accuracy that can inform the actions of first responders, C/U data must be standardized across providers and location technologies.[140] Specifically, NextNav has previously advocated for setting the standard required confidence level at the 90 percent level proposed by the ATIS Emergency Services Interconnection Forum ("ESIF"), and supported by T-Mobile and Sprint, among others.[141] A 90 percent confidence threshold ensures that—regardless of the size of the search ring that first responders must contend with—first responders can be confident that the location information provided likely captures the actual location of the caller.[142] Clearly, a higher confidence level may require larger reported uncertainty, but in a process that involves life and death, first responders must have clear knowledge and understanding of the practical limits of the location information that has been provided to them. By standardizing the C/U values at the 90 percent

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[138] *Notice*, ¶ *153*.

[139] *Hoffmann Remarks* at 2:27:09; *Hall Remarks* at 1:34:03.

[140] *Notice*, ¶¶ 155-156.

[141] *See Id.*,¶ 154; *see also ESIF Technical Report – ATIS 0500001 (Annex A and B ); Jensen Remarks* at 1:13:27; *see also* Slide deck: *E911 Phase II Location Accuracy Workshop*, T-Mobile, at 3 (Nov. 18, 2013) (available at http://transition.fcc.gov/bureaus/pshs/911/Phase%202/Workshop_11_2013/T_Mobile_Nov2013_FINAL.pdf); *Snapp Remarks* at 0:24:30 (noting that Sprint's network is already hardcoded to use a 90 percent confidence level).

[142] Letter from Bruce A. Olcott, Counsel for NextNav, to Marlene H. Dortch, Secretary, Federal Communications Commission, Docket No. 07-114, at 7 (Nov. 26, 2013).

confidence level, the Commission can ensure that PSAPs can more effectively process information delivered from disparate carriers and technologies, and adopt response strategies best matched to the quality of the information available.

Standardization of C/U data would also obviate the need to report to PSAPs the identity of the providing carrier or location technology type for each emergency call, or any other information that a PSAP might currently use to assess the potential reliability of the location information that is provided.[143] Instead, PSAPs could be certain that the quality of the information provided is reliable and consistent between calls, streamlining the process and increasing confidence in the E911 location system.

## IV. THE USE OF INDEPENDENT TEST BEDS TO DEMONSTRATE COMPLIANCE WOULD ENSURE LOCATION ACCURACY AT A REASONABLE COST

The 2012 CSRIC Test Bed demonstrated that public safety representatives, location service vendors, carriers, and independent test houses can effectively collaborate to develop a rigorous test methodology at a reasonable cost. The 2012 CSRIC Test Bed established the essential elements of a rigorous test bed, which the pending CSRIC IV report expects to reiterate and which the *Notice* confirms:

- testing in representative environments and building types;
- measurement of key performance attributes of latency, accuracy and yield; and
- emulation of actual deployment.[144]

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[143] Remarks of Renee Hardwick, Deputy Director, E911 Center for Horry County, South Carolina, 1:38:20; Remarks of David Turetsky, Bureau Chief, Public Safety and Homeland Security Bureau, Federal Communications Commission, at 1:43:33.

[144] *Notice*,¶ 83 (noting that "the capability and credibility of this test house were key factors in the success of the test bed"); *Id.*, ¶ 88-93.

The *Notice* also recognizes that these essential elements can be satisfied by CMRS carriers through joint or individual testing following the model of the 2012 Test Bed, potentially offering significantly improved flexibility and cost effectiveness while maintaining a rigorous testing methodology.[145] NextNav strongly supports the *Notice*'s proposal for such a representative compliance testing approach, either through joint testing consistent with CSRIC III/IV and ATIS/ESIF recommendations, or individual testing with comparably representative test points and testing criteria. Indeed, given the now clearly identified testing criteria and the significant benefits of independent testing, NextNav questions whether there is a need for an ongoing test administrator.[146] Instead, carefully constructed test procedures, potentially an opportunity for public notice and comment on a carrier's test procedures, along with disclosure of the test results, should be sufficient to ensure the Commission's requirements and goals are met.

The role of a true test bed manager (as defined by CSRIC) is critical when evaluating new technologies since it would be responsible for ensuring that the threshold criteria for the testing of a new technology have been achieved, such as the hiring of a truly independent party to conduct the tests. From a compliance perspective, the administrator's role could include facilitating access to various locations and managing the funds for conducting such a compliance program across multiple carriers. This is especially important in indoor environments where building access is a challenge and compliance may require an ongoing ability to secure access to such facilities. Thus, the role of a 'compliance" test bed manager is different from that of the

[145] *Id.*, ¶ 98.

[146] *Id.*, ¶ 95.

independent third party that would actually administer the tests that would be used to evaluate one or more new location technologies.

Finally, once a carrier has demonstrated compliance through the established testing framework, retesting should not be required for dedicated location networks (i.e., AGNSS, OTDOA, UTDOA, or MBS) unless there is a significant network or database changes or modifications that would impact location accuracy, or significant deterioration in noted key performance indicators. Particularly with handset-based technologies, once the efficacy of a technology has been proven through a compliance test bed, subsequent handsets should be able to demonstrate compliance in bench level testing that exhibits favorable results compared to previously validated handsets. For location systems that rely on unmanaged infrastructure, such as those based on Wi-Fi or Bluetooth, the consistency and reliability may be less consistent and predictable and may require a more regular testing regime.

### A. The CSRIC Working Group 3 Test Bed Established the Key Elements of Indoor Location Accuracy Testing

As the *Notice* notes, the 2012 CSRIC Test Bed adopted an approach of testing representative environments, that allowed the test bed to achieve an accurate picture of the capabilities of the tested technologies at a reasonable cost.[147] Continuing representative testing in future test beds would keep the cost of testing at manageable levels and minimize the challenge of securing building access, which proved to be "one of the biggest challenges" that the working group faced in its indoor location accuracy test process.[148]

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[147] *Id.*, ¶ 102.

[148] *CSRIC Test Bed Report* at 50.

Therefore, NextNav concurs with the proposal of physical testing inside a representative sampling of building construction types and locations in a representative set of markets or RF morphologies. This limited physical testing, combined with a process of characterization of local building types and conditions, could be used to extrapolate and demonstrate that the representative test results can be reliably applied to the characterized homogeneous community. Public safety participants in the CSRIC Working Group 3 process have expressed support for this approach of representative empirical testing and monitoring of key performance indicators to identify areas where further testing is required, if any, to address specific questions.[149]

### 1. Compliance Test Beds Should Demonstrate Compliance Across Representative Environments

CSRIC Working Group 3 investigated the issue of appropriate test morphologies and concurred with the ATIS recommendation of segregating wireless use environments into four defined categories – Dense Urban, Urban, Suburban, and Rural cellular morphologies.[150] NextNav participated in these efforts and concurs that the four identified environments provide a reasonable framework for identifying and implementing wireless indoor location test beds.[151]

As CSRIC further noted, however, identifying the underlying environmental morphologies is only the first step in the process. A second requisite step is the "[i]dentification of representative building types (including size, construction method and materials) within the morphologies."[152] In identifying these representative building types, the *Notice* acknowledges

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[149] *See id.* at 9.

[150] *Id.* at 11 (referencing ATIS-0500011).

[151] *Notice*, ¶ 88.

[152] *CSRIC Test Bed Report* at 8.

that the characteristics of a particular environment in one part of the country may not be the same as that same environment in another part of the country.[153] For example, the characteristically dense brick and stone structures of many urban areas of the northeast may not be representative of the less densely spaced glass and steel structures of newer urban communities. This does not mean that additional wireless user environments or morphologies need to be identified beyond the four employed by CSRIC. It does mean that individual test points within a test bed that may be representative of an urban environment in one part of the country may not be sufficiently representative of an urban environment in other regions unless specific building selection efforts are undertaken to achieve that result.

Wireless carriers, however, probably will not need to employ a large number of test beds in multiple geographic locations to address this issue. It may be possible to identify a minimal number of metropolitan areas that include a sufficient mix of representative building types for each of the four ATIS morphologies to enable indoor location testing in those communities that is representative of the preponderance of the United States. The San Francisco Bay Area, used for the CSRIC Test Bed, came close to achieving this objective and was specifically chosen because it included certain building types that were more representative of different geographic areas, as well as a mix of "newer urban" represented by San Jose and "older urban" represented by the older, densely developed areas of San Francisco.

NextNav therefore recommends that, rather than dictating the use of a particular number of geographic locations for test beds, the Commission should permit individual carriers (and the independent test houses that they work with) to select the geographic locations of their test beds and to identify the representative building types and test points that will be used within those

[153] *Notice*, ¶ 82.

geographic locations. Carriers, of course, would need to justify their selection of test bed locations and representative test points in order to adequately demonstrate that their test bed results form a sufficient basis to establish compliance with the Commission's indoor location requirements.

Carriers would have clear guidance in the development of valid test beds through the prior work of the CSRIC Test Bed and the development of a compliance framework that is currently underway by the ATIS-ESIF working group (Issue 84). This group has carefully selected a subset of cities where compliance tests could be conducted, and is investigating how to maintain test parameters consistent between cities and how results can be extrapolated to ensure that test bed results are valid for other cities.[154] Given the significant efforts that are already underway by the ATIS-ESIF working group, the Commission should take into consideration the recommendations of this working group in proposing any final guidelines on compliance testing.

#### 2. Compliance Test Beds Should Reflect the Actual County-Level Environments Where the Test Results will be Applied

The *Notice* asks whether each test bed should be constrained to a small geographic area, similar to the CSRIC III example, or whether the selection of test points should change periodically or cover a larger geographic area.[155] As noted above, the availability of cooperative or individual testing by carriers will likely mean that a variety of locations may be used for

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[154] Email from Thomas Goode, ATIS General Counsel, to David De Lorenzo, CSRIC IV, Working Group 1, Task Group 3 Chair (Feb. 7, 2014) (available at https://www.atis.org/legal/Docs/ESIF%20DOCS/ESIF_Letter_DeLorenzo_Feb2014.pdf) (identifying "a practical set of regional test beds that are representative of common indoor use environments and use-cases for wireless 911 calls, such that testing conducted across this set of test beds could be expected to reflect performance in other indoor locations where 911 calls are made across the nation).

[155] *Notice*, ¶ 93.

testing. The most important factor is that any test bed area be carefully chosen to contain a representative sample of the four morphologies.[156] Carefully chosen representative test bed locations will reduce the need for changes or duplicative testing, which will reduce the costs and administrative burdens of compliance testing.

Representative testing is particularly important to support the Commission's requirement that compliance be demonstrated on a county-level basis. This should mean that, for each county, the number and type of test points chosen should be representative of the mix of each of the four morphologies in that county (assuming all four are represented in a county) and the areas to which the results are to be extrapolated. If a carrier is using and testing only one indoor location technology across a county, then the capabilities of that technology (as demonstrated in a test bed) should be demonstrated across all morphologies consistent with and representative of the mix of morphologies that are represented in the county. This methodology means that certain location technologies, particularly A-GNSS, will likely prove adequate in many less developed counties (as the Commission presumes in the *Notice*),[157] but likely will not alone be adequate in urban counties.

To address this, most carriers will likely use multiple indoor location technologies to support their E911 location solution, whether hybridized or operating independently, with different technologies potentially serving different morphologies within each county. In this more common scenario, it will still be important to ensure that a representative county mix of test points and morphologies are included in evaluating the combined capabilities of the

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[156] *CSRIC Test Bed Report* at 11-12 (explaining that "the San Francisco Bay Area was chosen by WG3 because it has these four morphologies and thus enabled efficient testing using one test team, with a reasonable amount of travel within the area").

[157] *Notice*, ¶ 47.

technologies employed and tested. This approach would ensure that compliance testing reflects the actual makeup up in each county and would ensure the performance fulfills the expectations of the callers in each area. This approach will also facilitate comparison of county or PSAP level compliance testing with the actual daily operational results experienced in each county or PSAP service area.

### 3. Compliance Test Beds Should be Required to Test the Location Technologies as They will Actually be Deployed

As the *Notice* notes, all participants in the CSRIC Test Bed were not at that time prepared to test their technologies exactly as they would be deployed to serve a CMRS network.[158] To ensure validity of the results of the compliance test beds, NextNav concurs with the Commission's proposal that testing conducted for purposes of compliance be carried out with each indoor location technology as it will actually be deployed with the CMRS provider's network, including the handset component and network delivery methodology through to the delivery and display of the location information at the PSAP.[159]

For example, for carrier-deployed AFLT/OTDOA and for NextNav's MBS network, the tower density, placement of the towers, antenna placement and cable lengths, and the presence of DAS, micro-cells, macro-cells and in-building deployments are important parameters that need to remain comparable between test bed locations and the actual network configuration adopted by the carrier in each of the "safe harbor" cities for which the test bed performance should be representative. Relatively small changes in network infrastructure deployments can cause

[158] *Id.*, ¶ 93.

[159] *Id.*

significant variance in system performance, particularly with positioning systems based on communications networks and using heterogeneous networks.[160]

For systems based predominantly on technologies deployed in-building, particularly ad-hoc technologies such as Wi-Fi beacons, important considerations include the density of access points, the stability and freshness of the database, and the type of access points employed (*i.e.*, 802.11a/b/g/n, 802.11v, and Bluetooth Low Energy, etc.). Appropriate testing of these systems is critical for two reasons. First, the type of beacon or access point is important because certain systems, such as those relying on 802.11a/b/g/n protocols, are typically better suited for positioning based on signal strength or proximity positioning techniques, whereas other systems, such as the emerging 802.11v standard, allow for ranging between the access point and handset, which leads to more precise positioning.

Second, the availability of in-building systems varies not just by market, but within markets and even within buildings. CSRIC III was unable to test a DAS-based system because, based on the blind nature of the trial, it could not be determined in advance whether the system under consideration would be installed and available at the test locations. Wi-Fi and BlueTooth systems might be present on a floor within a building, but not every floor, and might be available with varying density. Thus, a database used in downtown Manhattan with a higher density of 802.11v access points may provide extremely promising results, but if the same database is used on a residential structure on the Upper West Side or a still smaller market, where the type of access points may be 802.11a/b/g/n, the results may be very different. It is therefore imperative that any testing match the potential variability in the availability and performance of the system,

[160] *See*, *e.g.*, 47 CFR 20.18(h)(vi) (permitting carriers to exclude from compliance particular counties where infrastructure is insufficiently deployed or visible to support location services).

particularly when the system relies on environmental properties (*e.g.*, the presence of privately owned Wi-Fi access points that are not controlled by the location service provider).

### B. Carriers That Have Demonstrated Compliance Should Not Be Required to Retest Absent Substantial Changes in System Deployment or Technology

Given the clear testing methodology and the above mechanisms to provide assurance before, during, and after the independent test process, the compliance test beds will provide the Commission a high level of confidence that a carrier's indoor location accuracy tests were rigorously conducted and its chosen indoor location technologies should perform consistent with the Commission's requirements. This is certainly true for systems based on dedicated location networks such as AGNSS and MBS, and may also be true for location systems based on managed communications networks, such as OTDOA, AFLT, and UTDOA. In such systems, the configuration of networks, density of sites, or the number of visible satellites all remain relatively stable. With respect to dedicated location networks, it is reasonable to expect that any upgrades to these systems will only improve performance. With respect to location systems that include some parameters that are more dynamic and lacking centralized control, more periodic testing may be required to ensure that the indoor location capabilities of such services remain compliant.

Accordingly, depending on the type of underlying location technology in use, the Commission may or may not require carriers to re-test their indoor location accuracy systems absent a significant change in key performance indicators.[161] Going forward, carriers can be expected to consider location accuracy compliance as part of any ongoing network maintenance

[161] *Id.*, ¶ 100.

or augmentation and, as discussed below, PSAPs will likely also monitor the quality of indoor location information delivered, further reducing the need for mandatory periodic re-tests.[162]

### C. Individual PSAPs and the Commission Should be Able to Challenge a Presumption of Compliance Based on Documented Evidence of Inadequate Indoor Location Capabilities

Although carriers employing centrally controlled location technologies should not generally be required to retest after demonstrating compliance, NextNav concurs that this presumption should not preclude review, retesting, or modification of a carrier's deployment upon substantiated evidence from a PSAP that the system was not performing as demonstrated.[163] Granted, PSAPs should be encouraged to configure their technical systems and operating procedures to ensure that they take full advantage of the data provided by the carriers' location systems. An ongoing reporting obligation regarding E911 call performance, including TTFF, yield, and type of technology used to obtain the fix, should provide sufficient information for PSAPs to assess whether the carrier's ongoing performance is consistent with the expected results based on representative compliance testing in a test bed.[164] PSAPs may identify areas of concern based on the ongoing carrier reports as well as their own experience (whether anecdotal or otherwise), which may warrant additional empirical testing to validate that actual performance is matching expected results. As a practical matter, ongoing reporting by the carrier of key performance indicators is likely to represent the most immediate indication of substandard performance.

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[162] *Id.*

[163] *Id.*, ¶¶ 85, 111.

[164] *Id.*, ¶ 100.

The *Notice*, however, seeks comment on whether there should exist any specific "preconditions" on the ability of PSAPs to present evidence that carrier systems are not performing as demonstrated.[165] Many issues related to the full utilization of available location information are likely to be resolved as a result of this proceeding. For example, the Workshop revealed that wide agreement now exists among public safety representatives and carriers that automatic rebidding is now a best practice and should be "standard and ubiquitous."[166] This approach is likely to be communicated to PSAPs through their representative public safety organizations and does not require regulatory intervention or assistance. Other factors that may need to be considered include whether a PSAP that is raising a concern used appropriately compatible handsets in any tests that it conducted given the fact that an appreciable number of legacy devices may still be in use in the marketplace and whether the test data was collected following industry accepted guidelines.

In the event that a PSAP does provide evidence overcoming the presumption of compliance with respect to a specific carrier, NextNav concurs that carriers should be given an appropriate opportunity to resolve any identified issues prior to enforcement action.[167] Given the public safety objective of the Commission's rules, as well as the many technical, environmental, and operational factors relevant to location system operation, such a safe harbor is appropriate and will encourage the efficient resolution of potential issues without onerous enforcement actions. Such an approach would also give carriers an incentive to correct any identified problems promptly rather than challenge their existence to avoid potential enforcement action.

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[165] *Id.*, ¶ 171.

[166] *Hoffmann Remarks* at; *Hall Remarks*, at 0:49:35.

[167] *Notice*, ¶ 85.

## V. MARKET FORCES AND COMMERCIAL LOCATION SERVICES MAY SUPPLEMENT BUT CANNOT BE THE PRIMARY LOCATION TECHNOLOGIES DEDICATED TO E911

Several commenters have implied that the urgency of the Commission's proposed rules is offset by the growth of commercial location based services. Although such services may have a role in supplementing E911 location technologies, commercial location services are not designed with the same requirements and cannot take the place of a dedicated, requirements-based emergency location system.

### A. Inadequate Market Incentives Exist to Address the Indoor Location Requirements of Emergency First Responders

Despite the steady improvements in network coverage and speed, indoor location accuracy continues to fall far short of the needs of public safety and the expectations of consumers. Carriers have made an admirable effort to deploy A-GPS technology in response to the need for outdoor location accuracy, but these efforts have been increasingly overtaken by the shift in consumer usage patterns toward the use of wireless devices indoors and in urban environments. Market forces are likely to drive incremental improvements in indoor location accuracy for the foreseeable future, but do not provide the impetus or the specificity necessary to guarantee the near term development and deployment of satisfactory indoor location accuracy technologies. Indeed, given the broadly-held—and often incorrect—expectation of consumers that PSAPs can currently locate them reliably regardless of their device or call location, market incentives are not acting strongly on this issue. Because most consumers rarely call 911 and

many have an inaccurate understanding of the limits of current indoor location accuracy capabilities, consumer demand has not and cannot be expected to pressure the market to provide reliable E911 location information indoors.[168]

In circumstances involving core government responsibility, such as effective emergency response, market forces cannot be relied upon to ensure industry action of sufficient promptness, uniformity, and capabilities to safeguard the public. The Commission's 1996 wireless E911 requirements were adopted based on the Commission's conclusion that the action of market forces did not satisfy the Commission's mandate to ensure that wire and radio communications "promot[e] safety of life and property"[169] and that the delay created "increasing concern regarding the inability of wireless customers to benefit from the advanced emergency capabilities of E911 systems that are available to most wireline customers."[170] The Commission's rules and the market have once again fallen behind the needs of public safety and consumers, and the importance of the need for improved indoor location accuracy means that the Commission should adopt requirements to ensure near term improvement and drive further development and deployment of location services.

### B. Commercial Location Services May be Useful, but Cannot be Relied Upon to Provide Emergency-Grade Reliability and Nationwide Coverage

As the *Notice* explained, "commercial location-based services ("LBS") are applications that CMRS providers load, or consumers download, onto their phones, and are independent of any solutions that CMRS providers might be required to adopt to comply with [the

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[168] *Id.*, ¶ 54.

[169] 47 U.S.C. § 151.

[170] *First Report & Order*, § II.A.3, ¶ 1.

Commission's] location accuracy requirements."[171] Although such underlying technologies might prove a useful supplement for E911 location services, the commercial services themselves cannot be relied upon as a sole or primary source for critical emergency functions given the differing system and service design criteria for such services. E911 systems need to be ubiquitous, have extremely high yield and have safety-of-life reliability; commercial LBS services, particularly those that rely on proximity to unmanaged radiators such as Wi-Fi access points, are generally best-efforts services that may or may not function based on a variety of unknowable factors.

The CSRIC report on LBS captures many of the reasons why reliance on commercial LBS for emergency service would be "problematic."[172] One threshold issue that the *Notice* acknowledged is that LBS technologies are generally only available if the customer or provider has previously enabled the service.[173] Not only does enabling Wi-Fi and other services consume battery and system resources, it also may represent a privacy concern for users, making them more likely to keep these services off unless and until they are needed.[174] CSRIC noted that if LBS were to be adopted for E911, "Wi-Fi must be activated regardless of the user's Wi-Fi settings" which relies on integration at a lower level out of the user's control.[175]

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[171] *Notice*, ¶ 127.

[172] *CSRIC LBS Report* at 17.

[173] *Notice*, ¶ 127.

[174] *CSRIC LBS Report* at 17; *CSRIC III Outdoor Location Report* at 14 (citing ATIS Technical Report 0500001 – High Level Requirements for Accuracy Testing Methodologies).

[175] *CSRIC LBS Report* at 18.

More generally, commercial LBS is not optimized for the capabilities necessary in an emergency system. The accuracy, yield, and TTFF criteria for emergency situations are far more stringent than for convenience functions such as providing retail recommendations. As CSRIC explains, LBS services are not "subjected to mandated accuracy levels and rigorous compliance testing" and "wireless broadband service providers have no visibility or control in the accuracy, integrity, and reliability of the location provided by these…applications."[176] Spoofing of Wi-Fi access points could be an issue that would have to be dealt with in order to ensure that the problem of accurate location in response to a 911 call is not exacerbated. Further, because the Wi-Fi access points themselves are generally not owned or deployed by the system manager, it would be difficult to extrapolate compliance test results for Wi-Fi based systems from one building to the next, let alone one city to the next, without detailed characterization of the Wi-Fi deployment in each structure. Commercial Wi-Fi based systems need only be optimized to serve major—that is, commercially profitable—markets and locations, and should not be expected to provide the robust yield or ubiquitous coverage expected of a system supporting emergency response. Thus, such technologies, when available, may indeed provide a useful augmentation if integrated with an E911 location system, but such an end-to-end system can only be defined pursuant to robust and uniform Commission rules for E911.

## VI. CONCLUSION

The Commission's E911 rules were created in recognition that 911 is the most important call a consumer can make. Effective emergency response relies on rapid, accurate, and reliable location information, and consumers have come to expect that when they dial 911, help is on the way. When this information is not available, public safety response is compromised and lives

[176] *Id.* at 17.

and property are put at risk. The wireless revolution has forever changed the way consumers reach 911, and, as the Commission wisely acknowledges, the nation's E911 rules must change accordingly.

The proposed indoor location accuracy rules represent a reasonable balance between the public safety need for the best possible location information, and the technical and economic realities of upgrading the nation's E911 location system. Fortunately, as CSRIC studies and submissions in the record of this proceeding indicate, the proposed rules can be met in the near term at a reasonable cost with technology that exists today, and is in many cases already widely deployed. NextNav's MBS technology can already meet or exceed the Commission's initial indoor location requirements, and technologies developed by other vendors are approaching similar results. By leveraging existing technologies like A-GPS alongside wholly new systems, wireless carriers and location vendors can rapidly extend advanced location capabilities across the nation, with a particular focus on the dense urban cores where existing services are least reliable and new vertical capabilities will provide the most value.

The new location capabilities can be economically and reliably tested through the use of independent testing houses applying the key elements developed through the CSRIC Test Bed. Representative locations, reflective of various morphologies at the county level, and emulation of actual deployments will provide the Commission, public safety, and the public with confidence that each carrier's location system works across its entire service area.

After nearly two decades since wireless E911 was first established, the pieces are in place for rapid, accurate and ubiquitous location capabilities that can help ensure first responders locate victims wherever they are calling from. NextNav applauds the Commission for its

leadership in developing the proposed rules and urges the Commission to adopt them without delay.

Respectfully submitted,

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