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47 CFR Part 20
Wireless E911 Location Accuracy Requirements; Final Rule

FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 20

[PS Docket No. 07–114; FCC 15–9]

Wireless E911 Location Accuracy Requirements

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: In this *Fourth Report and Order,* the Federal Communications Commission (Commission) adopts measures that will significantly enhance the ability of Public Safety Answering Points (PSAPs) to accurately identify the location of wireless 911 callers when the caller is indoors. It also strengthens its existing E911 location accuracy rules to improve location determination for outdoor as well as indoor calls.

DATES: This final rule is effective April 3, 2015 except for 47 CFR 20.18(i)(2)(ii)(A) and (B); 20.18(i)(2)(iii); 20.18(i)(3)(i) and (ii); 20.18(i)(4)(i), (ii), (iii) and (iv); and 20.18(j)(2) and (3), which contains information collection requirements that have not been approved by the Office of Management and Budget. The Commission will publish a document in the **Federal Register** announcing OMB approval and the effective date.

FOR FURTHER INFORMATION CONTACT: Dana Zelman of the Policy and Licensing Division of the Public Safety and Homeland Security Bureau, (202) 418–0546 or *dana.zelman@fcc.gov.* For additional information concerning the Paperwork Reduction Act information collection requirements contained in this document, contact Benish Shah, (202) 418–7866, or send an email to *PRA@fcc.gov.*

SUPPLEMENTARY INFORMATION: This is a summary of the Commission's *Fourth Report and Order* in PS Docket No. 07–114, released on February 3, 2015. The full text of this document is available for public inspection during regular business hours in the FCC Reference Center, Room CY–A257, 445 12th Street SW., Washington, DC 20554, or online at *https://apps.fcc.gov/edocs_public/Query.do?numberFld=15-9&numberFld2=&docket=07-114&dateFld=&docTitleDesc=.*

Synopsis of the Fourth Report and Order

I. Introduction and Executive Summary

1. In this *Fourth Report and Order,* we adopt measures that will significantly enhance the ability of Public Safety Answering Points (PSAPs) to accurately identify the location of wireless 911 callers when the caller is indoors. We also strengthen our existing E911 location accuracy rules to improve location determination for outdoor as well as indoor calls.

2. Our actions in this order respond to major changes in the wireless landscape since the Commission first adopted its wireless Enhanced 911 (E911) location accuracy rules in 1996 and since the last significant revision of these rules in 2010. Consumers are increasingly replacing traditional landline telephony with wireless phones; the majority of wireless calls are now made indoors; and the majority of calls to 911 are from wireless phones. This increases the likelihood that wireless 911 calls will come from indoor environments where traditional location accuracy technologies optimized for outdoor calling often do not work effectively or at all. This gap in the performance of 911 location service needs to be closed: The public rightfully expects 911 location technologies to work effectively regardless of whether a 911 call originates indoors or outdoors.

3. The record in this proceeding also indicates that a range of potential solutions to this gap already exist and have the potential to be implemented over the next few years through concerted effort by Commercial Mobile Radio Service (CMRS) providers and PSAPs. These solutions will both lead to more accurate horizontal location of indoor calls, and add the capacity to provide vertical location information for calls originating in multi-story buildings. In addition, the record makes clear that the potential exists to move beyond coordinate-based location and to provide PSAPs with ''dispatchable location'' information for many indoor 911 calls, *i.e.,* a street address plus sufficient information, such as floor and room number, to identify the location of the caller in the building.

4. To be sure, no single technological approach will solve the challenge of indoor location, and no solution can be implemented overnight. The requirements we adopt are technically feasible and technologically neutral, so that providers can choose the most effective solutions from a range of options. In addition, our requirements allow sufficient time for development of applicable standards, establishment of testing mechanisms, and deployment of new location technology in both handsets and networks. Our timeframes also take into account the ability of PSAPs to process enhancements in the location data they receive. Clear and measurable timelines and benchmarks for all stakeholders are essential to drive the improvements that the public reasonably expects to see in 911 location performance.

5. In determining the appropriate balance to strike in our requirements and timeframes, we give significant weight to the ''Roadmap for Improving E911 Location Accuracy'' (Roadmap) that was agreed to in November 2014 by the Association of Public Safety Communications Officials (APCO), the National Emergency Number Association (NENA), and the four national wireless CMRS providers, and supplemental commitments related thereto as discussed below. We give similar weight to the ''Parallel Path for Competitive Carriers' Improvement of E911 Location Accuracy Standards'' (''Parallel Path'') that was submitted by the Competitive Carriers Association (CCA). We believe the Roadmap and the Parallel Path establish an essential foundation for driving improvements to indoor location accuracy, and we therefore incorporate their overall timelines and many of their provisions into the rules adopted in this order. In addition, to provide greater certainty and accountability in areas that the Roadmap and the Parallel Path do not fully address, the rules we adopt today include additional elements with ''backstop'' requirements derived from our proposals in the *Third Further Notice,* 79 FR 17820 (Mar. 28, 2014), and recent *ex parte* submissions by the parties to the Roadmap.

6. Incorporating all of these elements, we adopt the following E911 location rules:

Horizontal Location

- All CMRS providers must provide (1) dispatchable location, or (2) x/y location within 50 meters, for the following percentages of wireless 911 calls within the following timeframes, measured from the effective date of rules adopted in this Order (''Effective Date''):
  - *Within 2 years:* 40 percent of all wireless 911 calls.
  - *Within 3 years:* 50 percent of all wireless 911 calls.
  - *Within 5 years:* 70 percent of all wireless 911 calls.
  - *Within 6 years:* 80 percent of all wireless 911 calls.
- Non-nationwide CMRS providers (regional, small, and rural carriers) can extend the five- and six-year deadlines based on the timing of Voice over Long Term Evolution (VoLTE) deployment in the networks.

Vertical Location

• All CMRS providers must also meet the following requirements for provision of vertical location information with wireless 911 calls, within the following timeframes measured from the Effective Date:

○ *Within 3 years:* All CMRS providers must make uncompensated barometric data available to PSAPs from any handset that has the capability to deliver barometric sensor data.

○ *Within 3 years:* Nationwide CMRS providers must use an independently administered and transparent test bed process to develop a proposed z-axis accuracy metric, and must submit the proposed metric to the Commission for approval.

○ *Within 6 years:* Nationwide CMRS provides must deploy either (1) dispatchable location, or (2) z-axis technology that achieves the Commission-approved z-axis metric, in each of the top 25 Cellular Market Areas (CMAs):

▪ Where dispatchable location is used: The National Emergency Address Database (NEAD) must be populated with a total number of dispatchable location reference points in the CMA equal to 25 percent of the CMA population.

▪ Where z-axis technology is used: CMRS providers must deploy z-axis technology to cover 80 percent of the CMA population.

○ *Within 8 years:* Nationwide CMRS providers must deploy dispatchable location or z-axis technology in accordance with the above benchmarks in each of the top 50 CMAs.

○ Non-nationwide carriers that serve any of the top 25 or 50 CMAs will have an additional year to meet these benchmarks.

Reporting and Compliance Measures

• Compliance with the above metrics will be determined by reference to quarterly live 911 call data reported by CMRS providers in six cities (San Francisco, Chicago, Atlanta, Denver/Front Range, Philadelphia, and Manhattan Borough, New York City) and their surrounding areas that have been determined to be representative of dense urban, urban, suburban, and rural areas nationally. Quarterly reporting of this data will begin no later than 18 months from the Effective Date.

• Beginning no later than 18 months from the Effective Date, CMRS providers in the six cities will also provide quarterly live call data on a more granular basis that allows evaluation of the performance of individual location technologies within different morphologies (*e.g.,* dense urban, urban, suburban, rural). This more granular data will be used for evaluation and not for compliance purposes.

• PSAPs will be entitled to obtain live call data from CMRS providers and seek Commission enforcement of these requirements within their jurisdictions, but they may seek enforcement only so long as they have implemented policies that are designed to obtain all 911 location information made available by CMRS providers pursuant to our rules.

• In order to gauge progress on the development of improved indoor location accuracy solutions and the implementation of these rules, nationwide CMRS providers must submit reports on their initial plans for implementing improved indoor location accuracy and must submit subsequent reports on their progress.

The foregoing rules leverage many aspects of the Roadmap and the Parallel Path to improve indoor location accuracy in a commercially reasonable manner. They do not change, or seek to change, the voluntary commitment that both nationwide and non-nationwide CMRS providers voluntarily have entered into and have already made progress towards. The rules are intended to build confidence in the technical solutions outlined in the Roadmap and Parallel Path, and to establish clear milestones that gauge progress and ensure that there is clear accountability for all CMRS providers.

7. In addition, we revise our regulatory framework for all 911 calls, both indoor and outdoor, as follows:

• We adopt a 30-second limit on the time period allowed for a CMRS provider to generate a location fix in order for the 911 call to be counted towards compliance with existing Phase II location accuracy requirements that rely on outdoor testing, but we do not extend this provision to the new indoor-focused requirements adopted in this order.

• We require that confidence and uncertainty data for all wireless 911 calls—whether placed from indoors or outdoors—be delivered at the request of a PSAP, on a per-call basis, with a uniform confidence level of 90 percent.

• We require CMRS providers to provide 911 call data, including (1) the percentage of wireless 911 calls to the PSAP that include Phase II location information, and (2) per-call identification of the positioning source method or methods used to derive location coordinates and/or dispatchable location, to any requesting PSAP. Compliance with the 30-second time limit will also be measured from this data.

8. In establishing these requirements, our ultimate objective is that all Americans using mobile phones—whether they are calling from urban or rural areas, from indoors or outdoors—have technology that is functionally capable of providing accurate location information so that they receive the support they need in times of emergency. We also view these requirements as a floor, not a ceiling. We encourage CMRS providers to take advantage of the potential of rapidly-developing location technology to exceed the thresholds and timelines established by this order. In addition, we encourage CMRS providers to work with public safety organizations and consumer organizations, including disability organizations, to develop new and innovative solutions that will make all Americans safer.

II. Background

9. In February 2014, we released the *Third Further Notice* in which we proposed to revise our existing E911 framework to require delivery of accurate location information to PSAPs for wireless 911 calls placed from indoors. In the near term, we proposed to establish interim indoor accuracy metrics that would provide approximate location information sufficient to identify the building for most indoor calls, as well as vertical location (z-axis or elevation) information that would enable first responders to identify floor level for most calls from multi-story buildings. In the long term, we sought comment on how to develop more granular indoor location accuracy requirements that would provide for delivery to PSAPs of in-building location information at the room or office suite level. In addition, we sought comment on other steps the Commission should take to strengthen our existing E911 location accuracy rules to ensure delivery of more timely, accurate, and actionable location information for all 911 calls. We also asked whether we should revisit the timeframe established by the Commission in 2010 for replacing the current handset- and network-based outdoor location accuracy requirements with a unitary requirement, in light of the rapid proliferation of Assisted Global Navigation Satellite Systems (A–GNSS) technology in wireless networks and the prospect of improved location technologies that will soon support 911 communication over LTE networks. A detailed examination of these proposals and the subsequent comment record is discussed below.

10. In setting forth these proposals, we emphasized that our ultimate

objective was that all Americans using mobile phones—whether calling from urban or rural areas, from indoors or outdoors—have technology that is capable of providing accurate location information in times of an emergency. We sought comment on whether our proposals were the best way to achieve this objective, and we also ''encourage[d] industry, public safety entities, and other stakeholders to work collaboratively to develop alternative proposals for our consideration.''

11. On November 18, 2014, APCO, NENA, AT&T Mobility, Sprint Corporation, T-Mobile USA, Inc., and Verizon Wireless (collectively, ''Roadmap Parties'') submitted the Roadmap. According to the Roadmap Parties, the Roadmap ''marks a new course using indoor technologies to deliver a 'dispatchable location' for indoor 9–1–1 calls'' and ''contrasts with current and proposed outdoor technologies that provide estimates of location and face challenges with indoor location accuracy,'' adding that ''the Roadmap commits to meaningful improvements and FCC-enforceable timeframes to deliver effective location solutions.'' On November 20, 2014, we sought expedited comment on the Roadmap. We received extensive comment in response, both supportive and critical of the Roadmap.

12. Following the submission of comments on the Roadmap, CCA submitted its Parallel Path proposal on behalf of its members, which include most of the nation's non-nationwide CMRS providers, including small, regional, and rural carriers. The Parallel Path for the most part tracks the Roadmap, and commits the non-nationwide CMRS providers to the same approach and requirements for improving indoor location that the nationwide CMRS providers committed to in the Roadmap. However, the Parallel Path proposes to modify certain Roadmap benchmarks and timeframes to afford non-nationwide CMRS providers more time and flexibility to meet their commitments.

13. Most recently, in response to criticism of the Roadmap by some commenters and to concerns raised by Commission staff, the Roadmap Parties have amended the Roadmap to strengthen certain provisions and incorporate additional commitments by the nationwide CMRS providers, particularly with respect to deployment of dispatchable location and z-axis technologies.

III. Indoor Location Accuracy Requirements

14. The record in this proceeding demonstrates that circumstances affecting wireless location accuracy have changed dramatically since the Commission first adopted its Phase II location accuracy rules. As discussed in the *Third Further Notice,* the great majority of calls to 911 now originate on wireless phones, and the majority of wireless calls now originate indoors. These changes increase the importance of ensuring that indoor 911 calls can be accurately located. The record also indicates that, while PSAPs and CMRS providers may be able to address some of the challenges through technological and operational improvements, the outdoor-oriented focus of the Commission's Phase II rules to date has created a regulatory gap: By focusing on outdoor requirements for verifying compliance, our rules currently provide no remedy to address poor performance of location technologies indoors.

15. The record in this proceeding—including the CSRIC test bed results, the Amended Roadmap and Parallel Path, and other evidence indicating further improvements to indoor location technologies—also demonstrates that there has also been progress in the development of technologies that can support improved indoor location accuracy. Accordingly, we find that it is now appropriate to implement measures designed to address public safety's critical need for obtaining indoor location information, and to ensure that wireless callers receive the same protection whether they place a 911 call indoors or outdoors.

A. Ubiquity and Challenges of Indoor Wireless Calling

16. *Background.* In the *Third Further Notice,* we noted that the large increase in indoor wireless usage over the last decade has made indoor location accuracy increasingly important. Accordingly, we sought more granular information regarding the percentage of wireless calls placed from indoors and, to the extent available, the percentage of wireless calls to 911 from indoors. We also sought further data on the types of indoor environments from which 911 calls are placed, *e.g.,* in the caller's own home, his or her work location or in public accommodations such as airports, schools and movie theaters; and whether it is possible to identify the type of building morphology where current location technologies routinely fail to provide accurate location information. In response to this inquiry, commenters indicate an ''ongoing, dramatic increase'' in the number of wireless calls placed from indoors.

17. In the *Third Further Notice,* we also noted that indoor locations pose particular challenges for first responders attempting to find the caller. We sought comment on whether and how the increase in wireless calls to 911 from indoors has affected the delivery of E911 information and the ability of public safety officials to respond to calls for help. APCO indicates that location accuracy for wireless calls placed from indoors is currently inferior to both wireline calls placed from indoors and wireless calls placed from outdoors. The Department of Emergency Management for San Francisco (DEMSF) states that problems with wireless indoor location accuracy are particularly acute ''in dense urban environments with multiple, adjacent high-rise buildings.'' Commenters indicate that the increase in wireless 911 calls from indoors has affected the delivery of E911 information and eroded the ability of public safety officials to respond to calls for help, and to keep first responders safe.

18. *Discussion.* The record confirms that more wireless 911 calls are coming from indoors, and indoor 911 calls pose challenges for location that will lead to further degradation of 911 services if not addressed. In 1996 there were approximately 33 million cellular subscribers in the United States. By the end of 2013, there were nearly 336 million wireless subscriber connections. At the end of 2007, only 15.8 percent of American households were wireless-only. During the first half of 2014, that number increased to 44 percent (more than two of every five American homes), an increase of more than 3.0 percentage points since the second half of 2013. Furthermore, adults living in or near poverty and younger Americans are more likely to live in wireless-only homes than are higher-income adults. Several major CMRS providers reflect this trend by marketing wireless service as a replacement in the home for traditional landline service.

19. The record also indicates that the increase in wireless calls to 911 from indoors has reduced the quality of location information available to first responders in the absence of compensatory technologies to enhance location. Specifically, satellite-based location technologies do not provide accurate location data for many wireless calls placed from indoor locations, particularly in urban areas where a growing number of Americans reside. This highlights the critical importance of the enhanced indoor wireless indoor location accuracy rules that we adopt

today, which will enhance public safety and address the need to develop alternative technological approaches to address indoor location.

B. E911 Location Accuracy Requirements

20. In this *Fourth Report and Order,* we adopt E911 location accuracy requirements that codify major elements of the Roadmap, the Parallel Path, and the additional commitments that CMRS providers have made in recent *ex parte* filings. These requirements afford CMRS providers flexibility to develop dispatchable location solutions, but also include requirements and timeframes for provision of x/y and z-axis information in the event that dispatchable location is not available.

21. CMRS providers must certify at 36 months and again at 72 months that they have deployed compliant technology throughout their networks to improve indoor location accuracy, consistent with the compliant technology's performance in an independent test bed. To demonstrate further compliance with these metrics, CMRS providers must submit aggregated live 911 call data from the six cities recommended for indoor testing by the Alliance for Telecommunications Industry Solutions Emergency Services Interconnection Forum (ATIS ESIF). CMRS providers that provide dispatchable location must also provide x/y coordinates to the PSAP (as well as z coordinates where feasible and appropriate). This will enable PSAPs to corroborate the validity of dispatchable location information, but the coordinates will not be considered for FCC compliance purposes.

1. Incorporation of Roadmap and Parallel Path Commitments

22. *Background.* In the *Third Further Notice,* we proposed that within two years of the Effective Date CMRS providers must locate 67 percent of indoor 911 calls within 50 meters, and that within five years, they must achieve 50-meter accuracy for 80 percent of indoor 911 calls. We further proposed that within three years of the Effective Date, CMRS providers must deliver vertical (z-axis) data within 3 meters accuracy for 67 percent of indoor calls, and 3-meter accuracy for 80 percent of calls within five years. We proposed establishment of an indoor location accuracy test bed for demonstrating compliance with these requirements, and asked about other approaches to validating compliance.

23. We also invited comment on alternative approaches that would best weigh the costs and benefits of implementing an indoor location requirement with technical feasibility, timing, and other implementation concerns. In particular, we invited industry and public safety stakeholders to propose consensus-based, voluntary commitments that would address the public safety goals set forth in this proceeding and facilitate closing the regulatory gap between indoor and outdoor location accuracy without the need to adopt regulatory requirements.

24. Subsequent to the close of the comment period, NENA, APCO, and the four national CMRS providers submitted the Roadmap agreement. The Roadmap provides that, within one year, the signatory CMRS providers will establish a test bed for 911 location technologies and, within three years, they will establish a national location database for provision of dispatchable location information from in-building beacons and hotspots (*e.g.,* Wi-Fi and Bluetooth). The Roadmap also specifies that, beginning at Year 2 of Roadmap implementation and extending through Year 8, the CMRS providers will introduce VoLTE-capable handsets that (1) support satellite-based location using multiple positioning systems (*e.g.,* GLONASS in addition to GPS), (2) can deliver Wi-Fi and Bluetooth beacon information, and (3) can deliver z-axis information.

25. As originally proposed, the Roadmap contained the following horizontal location accuracy performance benchmarks:

- Within two years of the Roadmap's execution, CMRS providers will use ''heightened location accuracy technologies'' to locate 40 percent of all 911 calls (indoor and outdoor). ''Heightened location accuracy technologies'' consist of: (1) Satellite-based (A–GNSS) location, (2) dispatchable location, or (3) ''any other technology or hybrid of technologies capable of location accuracy performance of 50 m[enters].''
- Within three years, CMRS providers will use the above ''heightened location accuracy technologies'' to provide location for 50 percent of all 911 calls (indoor and outdoor).
- Within five years, CMRS providers will use the above ''heightened location accuracy technologies'' to provide location for 75 percent of all VoLTE 911 calls (indoor and outdoor).
- Within six years, CMRS providers will use the above ''heightened location accuracy technologies'' to provide location for 80 percent of all VoLTE 911 calls (indoor and outdoor).

26. In recent *ex parte* filings, the nationwide CMRS providers have modified the five-year and six-year Roadmap benchmarks so that they will apply to all wireless 911 calls, not just VoLTE calls. To adjust for the inclusion of non-VoLTE calls, the nationwide CMRS providers propose to lower the five-year benchmark from 75 percent to 60 percent. No adjustment is proposed to the six-year deadline or the 80 percent benchmark for all calls, however.

27. The Roadmap commits CMRS providers to use live 911 call data to demonstrate compliance with these metrics. The data will be collected monthly in the six cities that ATIS ESIF has recommended for indoor location technology testing (San Francisco, Chicago, Atlanta, Denver/Front Range, Philadelphia, and Manhattan). Providers will provide reports to APCO and NENA on a quarterly basis, subject to appropriate confidentiality protections, with the first report due 18 months after the Effective Date. All CMRS providers, along with APCO and NENA, will use the data from these reports to assess the trend in positioning performance over time.

28. Rather than propose a specific z-axis metric, the Roadmap focuses on dispatchable location solutions to identify floor level. After 36 months, the parties will determine if these efforts are ''on track,'' and only if they are ''off track'' are the CMRS providers obligated to pursue development of a standards-based z-axis solution (*e.g.,* use of barometric sensors in handsets). In recent *ex parte* filings, however, the nationwide CMRS providers have committed to begin delivering uncompensated barometric data from barometer-equipped handsets within three years, and have offered additional commitments with respect to deployment of both dispatchable location and z-axis solutions.

29. The Parallel Path incorporates the same two- and three-year horizontal accuracy benchmarks as the Roadmap, and proposes slightly different five- and six-year benchmarks. Under the Parallel Path, non-nationwide CMRS providers would use heightened accuracy technologies in 70 percent of all wireless 911 calls (VoLTE and non-VoLTE) within five years or within six months of having a commercially operating VoLTE platform in their network, whichever is later. Similarly, non-nationwide CMRS providers would achieve heightened accuracy for 80 percent of all wireless 911 calls within six years or within one year of having a commercially operating VoLTE platform in their network, whichever is later.

30. Regarding data reporting, the Parallel Path commits non-nationwide CMRS providers to collect data for live wireless 911 calls that would show the percentage of time that each ''positioning source method'' (*e.g.,* dispatchable location, A–GPS, A–GNSS, OTDOA, AFLT, RTT, Cell ID, which are discussed in greater detail in Section III.B.3.b(i) below) is used to deliver a wireless 911 call. Small CMRS providers that operate in one of the six ATIS ESIF regions will collect and report data for that region.

31. For z-axis location information, the Parallel Path provides that for small CMRS providers whose service footprints include any county or county equivalent with a population density of 20.0 people per square mile or more (per most recent U.S. Census data), those providers agree to deliver uncompensated barometric pressure data to PSAPs from any voice-capable handset that supports such a capability within four (4) years of that agreement, while such providers whose serve designated areas with population densities of 19.9 or less will be exempt from providing any uncompensated barometric pressure data to PSAPs.

32. Some vendors praise the Roadmap as a meaningful step toward improved indoor location. For example, TCS states that the proposals in the Roadmap are more realistic than the proposals in the *Third Further Notice* because it acknowledges CMRS providers' inability to distinguish between indoor and outdoor wireless calls.

33. However, some public safety entities, consumer advocacy groups, and other vendors express strong concern about the Roadmap proposals. Multiple commenters argue that the Roadmap dilutes the Commission's efforts to adopt indoor location accuracy rules and does not present a viable alternative to the proposals in the *Third Further Notice.* Though it regards the Roadmap as a step in the right direction, TDI submits that the Roadmap should serve only as a complement, not a replacement, to the Commission's rules. The Associated Firefighters of Illinois believe that the Roadmap pushes out the timeline for improved location accuracy too far. IACP and Fairfax County support the concept of dispatchable location, but question the feasibility of the Roadmap's dispatchable location provisions. Multiple commenters express concern at the Roadmap's blended metric for indoor and outdoor calls. TruePosition cautions that the use of GLONASS for 911 may raise political and security issues, though APCO, CTIA and TCS dispute that use of GLONASS poses a security threat. Numerous parties highlight concerns with the Roadmap's proposal for the National Emergency Address Database (NEAD). Some Roadmap Parties submit rebuttals to these concerns raised in the record.

34. *Discussion.* As discussed in detail below, the Roadmap and Parallel Path contain numerous positive elements that will help drive improvements in indoor location. In particular, they lay the foundation for development of a location technology test bed, a national location database, and introduction of improved location technology into VoLTE handsets and networks. The Roadmap and Parallel Path also for the first time commit CMRS providers to using live 911 call data, not just test data, to measure progress and compliance with location accuracy metrics. They also commit CMRS providers to a timetable for achieving improved horizontal and vertical location accuracy in the absence of a dispatchable location solution.

35. Critics of the Roadmap and the Parallel Path have raised legitimate concerns regarding the sufficiency of the commitments made by CMRS providers therein. However, we believe that the recent amendments to both the Roadmap and the Parallel Path have substantially strengthened these commitments and provide the basis for ensuring measurable improvements in indoor location while holding CMRS providers accountable for results. Of particular significance, the horizontal accuracy benchmarks in both the Amended Roadmap and the Parallel Path now apply uniformly to all wireless 911 calls rather than some benchmarks applying to VoLTE calls only. Similarly, the nationwide CMRS providers' commitment to begin delivering uncompensated barometric data within three years will provide an important near-term opportunity for PSAPs that have the strongest interest in obtaining vertical location information, while development of enhanced vertical location technologies proceeds in parallel. Finally, the new provisions in the Amended Roadmap for development of a z-axis standard and the inclusion of timeframes for deployment of dispatchable location and z-axis technology will drive investment in solutions to the challenge of identifying the floor level—or preferably, the dispatchable location—of 911 calls originated from multi-story buildings.

36. We applaud the process that resulted in these commitments and the benefits that will flow to the American people as a result. To ensure that all parties make progress as promised, and to ensure that all stakeholders and the Commission have adequate assurances that parties are held accountable, we are codifying these commitments through the rules we adopt today. We are also including reporting, recordkeeping, and retention obligations associated both with the technology test bed and live 911 call information that will illuminate the implementation of the dispatchable location standard, and the real world performance of the horizontal and vertical location technologies that have been put forward in the record.

37. In this respect, to ensure transparency and accountability, we require that nationwide CMRS providers report to the Commission on their plans and progress towards implementing improved indoor location accuracy no later than 18 months from the Effective Date, and that non-nationwide CMRS providers submit their plans no later than 24 months from the Effective Date. These reports should include details as to each provider's implementation plan to meet our requirements. For the nationwide CMRS providers, this report must also include detail as to steps taken and future plans to implement the NEAD, which is discussed in further detail below. These reports will provide a baseline for measuring the subsequent progress made by each provider toward improving indoor location accuracy. In addition we require each CMRS provider to file a progress report at 36 months indicating what progress the provider has made consistent with its implementation plan. Nationwide CMRS providers shall include in their 36-month reports an assessment of their deployment of dispatchable location solutions. For any CMRS provider participating in the development of the NEAD database, this progress report must also include detail as to implementation of the database. Furthermore, we encourage CMRS providers to share these reports and discuss their implementation plans with public safety, consumer, and disability groups. We incorporate these requirements into our rules.

38. In the Roadmap, the CMRS providers state that within six to twelve months they intend to test ''improved'' A–GNSS technologies that can augment GPS-only geolocation by obtaining positioning information from other international satellite positioning systems, including the Russian GLONASS system. TruePosition contends that the potential use of GLONASS to support E911 location ''raises a wide range of national security, reliability, liability, and economic trade issues,'' and should be rejected by the Commission. CTIA, however, explains that ''the Roadmap never states that GLONASS will be the

exclusive source of user location data, and instead makes clear that both GPS and GLONASS will be tested as positioning sources . . . this bogeyman is nothing more than a desperate attempt to distract the stakeholders and the Commission and undermine the actual merits of the Roadmap.'' CTIA asserts that ''the use of GLONASS chips in handsets does not give Russia power over U.S. wireless communications,'' and that ''[t]here simply is no national security risk whatsoever with the Roadmap.''

39. To date, none of the CMRS provider parties to the Roadmap have submitted, nor has the Commission approved, any waiver petition or application that would seek authorized use of any non-U.S. Radionavigation Satellite Service (RNSS) system to support E911 location or general location-based services. Indeed, the Roadmap only states that the signatory CMRS providers intend to test the potential use of non-U.S. systems (such as GLONASS or Galileo) to support E911 location. It does not call for the Commission to approve operations with any non-U.S. satellite systems, either explicitly or implicitly, in this proceeding, and we decline to do so. Thus, the parties to the Roadmap and other CMRS providers must comply with the location accuracy requirements established by this order regardless of the disposition of any future request they may make under FCC rules to operate with any non-U.S. satellite systems in support of E911 location. Moreover, any such request will be subject to a full review and federal inter-agency coordination of all relevant issues, including technical, economic, national security, and foreign policy implications.

40. We do not decide the issue of operating with non-U.S. satellite signals in this proceeding, which would require consideration of a variety of issues, including its potential impact on the use of adjacent bands. Therefore, nothing in today's decision authorizes the use of any non-U.S. satellite system in conjunction with the 911 system, including the 911 location accuracy rules we adopt today. Moreover, A–GNSS technologies used to augment GPS may increase the potential exposure of devices to interference by increasing the number of unwanted signals and the number of signals that can introduce data integrity problems. We believe that CMRS providers seeking to use non-U.S. satellites should also conduct testing to ensure that operation with these signals does not inadvertently introduce vulnerabilities to the devices that could impair E911 performance or compromise data integrity. For example, devices that are augmented to receive signals from multiple satellite constellations may be more susceptible to radio frequency interference than devices that receive signals from GPS alone. Devices should also be evaluated to determine their capabilities to detect and mitigate the effects of inaccurate or corrupted data from any RNSS system that could result in incorrect location information, or no information at all, being relayed to a PSAP. We expect CMRS providers, at the time they certify their compliance with the Commission's location accuracy requirements, to also certify that any devices on their network operating with foreign A–GNSS signals for 911 location accuracy have proper authorizations in place to permit such use. Before incorporating foreign A–GNSS into E911, CMRS providers must coordinate plans for foreign A–GNSS signal integration with the Public Safety and Homeland Security Bureau to confirm that signals are interoperable with GPS and that measures to prevent interference are appropriate. Furthermore, CMRS providers are expected to certify that the devices have been tested to determine their ability to detect and mitigate the effects of harmful interference.

2. Dispatchable Location

41. In the *Third Further Notice,* we identified the delivery by CMRS providers to PSAPs of ''dispatchable address'' information as a long-term objective to improve indoor location. While we proposed indoor accuracy requirements based on x/y/z coordinate information, we noted that public safety needs would be better served if PSAPs could receive the caller's building address, floor level, and suite/room number. Therefore, we sought comment on whether to adopt an alternative indoor location requirement that CMRS providers could satisfy by delivering a caller's building address and floor level.

42. Although we viewed development of dispatchable location capability as a long-term goal in the *Third Further Notice,* the subsequent comment record and the Roadmap indicate the proliferation of in-building technology such as small cells and Wi-Fi and Bluetooth beacons, which can be used together, has made dispatchable location solutions technically feasible in a much shorter timeframe than we initially anticipated. Therefore, as described below, we conclude that CMRS providers should be allowed to use dispatchable location to comply with our indoor location accuracy requirements.

a. Definition of Dispatchable Location

43. The Roadmap uses the term ''dispatchable location'' rather than ''dispatchable address'' to describe the same objective identified in the *Third Further Notice.* The Roadmap defines ''dispatchable location'' as ''the civic address of the calling party plus additional information such as floor, suite, apartment or similar information that may be needed to adequately identify the location of the calling party.''

44. For the purposes of this rulemaking, we define ''dispatchable location'' as the verified or corroborated street address of the calling party plus additional information such as floor, suite, apartment or similar information that may be needed to adequately identify the location of the calling party. We note that while all dispatchable addresses are necessarily civic addresses, not all civic addresses are ''dispatchable,'' *e.g.,* P.O. Boxes, diplomatic or armed forces pouch addresses, *etc.* PSAPs currently use street address in dispatch systems, the very essence of any ''dispatchable'' location solution. Public safety organizations have described dispatchable location as the ''gold standard'' in terms of location accuracy and utility for allocating emergency resources in the field. Accordingly, we adopt a definition similar to the one offered in the Roadmap, but substitute the term ''street address'' to provide clarity and ensure that dispatchers are not sent to addresses which may not be street addresses, and therefore, may not be ''dispatchable.'' Although IMSA contends that the Roadmap's definition of dispatchable location lacks specificity, we find that this definition strikes the appropriate balance between specificity and flexibility.

b. Technological Feasibility and Implementation Issues

45. In the *Third Further Notice,* we recognized that provision of a dispatchable location would most likely be through the use of in-building location systems and network access devices, which could be programmed to provide granular information on the 911 caller's location, including building address and floor level. We noted that CMRS providers are already deploying in-building technologies to improve and expand their network coverage and speed, and asked how these technologies could be leveraged to support indoor 911 location, as well as any challenges to implementation. For the reasons stated below, we believe the Roadmap commitments, including those

made in the Addendum, and the comments in the record demonstrate that a dispatchable location solution is feasible and achievable on the timetable we establish, and that in light of our predictive judgment about the future course of development of various wireless location technologies, this approach provides appropriate incentives for CMRS providers to achieve our foregoing goals as effectively and promptly as practicable. In the absence of an approved z-axis metric alternative, CMRS providers will be obligated to rely on dispatchable location.

(i) In-Building Infrastructure

46. Commenters confirm that the feasibility of dispatchable location is linked to the proliferation of indoor, infrastructure-based technologies, including small cell technology, distributed antenna systems (DAS), Wi-Fi access points, beacons, commercial location-based services (cLBS), institutional and enterprise location systems, and smart building technology. These technologies can be used in a location system information ''stack'' that would allow a CMRS provider's location server to compile and compare location fixes from multiple sources, to identify and disregard inaccurate fixes, and otherwise synthesize available location data.

47. The record also confirms that many of these technologies can contribute to the development of dispatchable location solutions in the near term. Nearly all wireless phones are now equipped with Bluetooth and Wi-Fi capabilities, though some standardization work remains. Small cells are increasingly deployed in urban areas, and all four nationwide CMRS providers currently sell or plan to sell in-home consumer products designed to provide improved wireless coverage indoors, but which could also be leveraged to provide dispatchable location information. Indeed, the Roadmap commits to making all CMRS provider-provided small cell equipment compatible with any dispatchable location solution. Additionally, Bluetooth beacons and Wi-Fi hotspots are increasingly deployed in public spaces. For example, TCS estimates that there are more than 126 million Wi-Fi access points nationwide, with approximately 40 million in commercial settings and 86 million in residential settings. Cisco and TCS assert that, using Cisco's wireless local area network and TCS's gateway client technology for commercial location solutions, they can already provide a '' 'dispatchable' location—indicating street address, building identifier, floor number, and suite number—along with a floor plan . . . showing the location of the phone,'' with accuracy between five and ten meters. Though much of the deployment of indoor location-capable infrastructure thus far has been commercial, there are a growing number of residential products that easily be used as a source of location in a comprehensive dispatchable location solution. Nevertheless, some commenters still argue that beacon and Wi-Fi technologies have not been thoroughly enough tested to justify reliance on them in any dispatchable location solution. Others submit that the Commission should open a separate proceeding dedicated to dispatchable location.

48. CMRS commenters note that much of the in-building infrastructure that will be needed to support dispatchable location lies outside their control and will require building owners and other third-party stakeholders to be involved in the deployment process. T-Mobile submits that ''[t]o attain truly actionable indoor locations requires buy-in and development from all stakeholders—not just wireless carriers, but also public safety, . . . state and local governments who regulate building codes, and, perhaps most critically, premises owners.'' T-Mobile suggests that state and local governments should modify building and fire codes to require deployment of such devices throughout a building.

(ii) Handset Hardware and Software Changes

49. Despite the widespread availability of Wi-Fi- and Bluetooth-equipped phones, commenters observe that implementation of dispatchable location solutions may require hardware, firmware, and/or software modifications to handsets to enable them to communicate with in-building infrastructure such as Wi-Fi or Bluetooth beacons. Several commenters also note that in order for handsets to use Wi-Fi or Bluetooth to search for nearby location beacons when a caller places a 911 call, handset operating systems will need to be configured to activate Wi-Fi and Bluetooth automatically, in the same manner that current GPS-capable handsets activate GPS automatically when the user calls 911. The Roadmap Parties commit to work with device manufacturers and operating system developers in order to implement these changes.

50. The Roadmap also anticipates the need for deployment of new handsets to accommodate dispatchable location technologies, and commits the signatory CMRS providers to equip all carrier-provided VoLTE handset models with the ''capability to support delivery of beacon information, *e.g.,* Bluetooth LE and WiFi, to the network'' no later than 36 months after completion of relevant standards, including interim benchmarks at the 24 and 30 month timeframes. The parties also agree to enable their VoLTE networks to deliver beacon-based location information from handsets within 24 months after the completion of relevant standards.

51. The Parallel Path offers similar commitments on a longer timeframe, including a suggestion that all VoLTE handset models for non-nationwide CMRS providers would support the same delivery of beacon information no later than 48 months after the completion of relevant standards. The Parallel Path commits to the delivery of beacon information by their VoLTE networks within 36 months after completion of standards, or 12 months of their VoLTE networks becoming operational, with full end to end functionality for dispatchable location for their VoLTE networks within 60 months (or 12 months of becoming operational).

52. Some commenters stress the need for further development of standards to ensure that location applications originally developed for cLBS have the level of quality, reliability and redundancy needed to support emergency location. We note that efforts are already under way to develop such standards. The 3rd Generation Partnership Project (3GPP) and Open Mobile Alliance (OMA) have been in cooperative efforts to enhance LTE to meet public safety application requirements, and 3GPP has been prioritizing indoor positioning in developing its most recent release for LTE. In addition, CSRIC IV Working Group 1 was charged to examine whether CMRS providers transitioning to VoLTE platforms should still heed recommendations from an earlier CSRIC report on testing methodology and parameters as they began ''blending'' GPS handset-based location data with network-based data, per Section 20.18(h) of the Commission's rules. Among other findings, CSRIC notes that ''[i]n addition to the committed LTE location methods discussed . . ., other location methods such as Wi-Fi for VoLTE have been standardized. Wi-Fi for position calculation has been standardized in Secure User Plane (''SUPL'') 2.0 and is available for deployment on GSM, UMTS, CDMA and LTE.''

53. The Roadmap commits the four nationwide CMRS providers to promote

development and approval of standards within 18 months of the date of the Agreement, as well as to formally sponsor standards efforts regarding the use and delivery of Bluetooth LE and Wi-Fi information to the network. Additionally, the Roadmap Parties committed to participate actively in standards setting work, as well as to engage with technology companies and others in the private sector to promote the prioritization and completion of standards setting work. The parties also agree to sponsor standards activities to operationalize the display of dispatchable location in pre-NG911 PSAPs.

(iii) Location Database Development and Management

54. We sought comment in the *Third Further Notice* on the use of location databases by CMRS providers to verify location information, as well as the privacy and security implications raised by these databases. Commenters note that some of the database infrastructure that would be needed to support dispatchable location already exists. TCS states that it has database access to the location of more than 38 million Wi-Fi nodes to assist in locating users of cLBS applications. However, existing databases that map in-building infrastructure may not provide the level of reliability and security needed to support 911 location. Commenters assert that any database used to support dispatchable location will require mechanisms to enable PSAPs to access the location data, verify the trustworthiness and accuracy of the data, and keep the data up-to-date. CMRS providers also contend that developing and managing secure location databases will require the cooperation of building owners and state and local governments.

55. The Roadmap addresses the database issue by proposing a plan for the implementation of a National Emergency Address Database (NEAD). As envisioned in the Roadmap, the NEAD will contain media access control (MAC) address information of fixed indoor access points, which a device would ''see'' upon initiating a wireless 911 call. When the device ''sees'' the MAC address of this particular device, the CMRS network would cross-reference this MAC address with a dispatchable address, which would be made available to the PSAP. The Roadmap Parties have committed to work together to develop the design, operations, and maintenance requirements for the NEAD within 12 months of the Agreement. The Parallel Path makes a similar commitment within the 12-month timeframe. The parties also agree to ''work together to establish a database owner, funding mechanisms, provisions for defining security/privacy, performance, and management aspects, and to launch the initial database within 12–24 months after the development of the design requirements.'' Finally, the parties agree to work together to integrate dispatchable location information from third-party sources into the NEAD, and to enlist the support of other organizations to achieve this goal.

56. In response to the Roadmap's NEAD proposal, numerous commenters express concern that the proposal lacks critical details and leaves too many issues unresolved, some of which could hamper development. For example, NASNA states that ''the carriers promised to 'take steps to make non-NEAD dispatchable location information available for delivery of PSAPs,' but did not describe when or how those steps would be taken. It may be surmised from the discussion in the Roadmap at 2.b.i, ii and iii that this would occur within 30 days of the anniversary of the agreement, but that is not clear.'' NASNA also notes that Roadmap does not specify how it will incorporate existing legacy location databases and new or soon-to-be operational NG911 location databases. To address this concern, Sprint submits that the Commission could play an important role in the development and implementation of the NEAD: ''the Commission could, for example, include in its equipment authorization rules, procedures or training materials for telecommunications certification bodies a labeling requirement instructing the consumer or installer of the equipment to register it in the NEAD.''

57. Additionally, a number of commenters express concern with regard to the preservation of individual privacy throughout the implementation and subsequent use of the NEAD. Specifically, Public Knowledge cautions that the NEAD would contain sensitive personal information, and that the proposal as written in the Roadmap lacks safeguards to ensure ''that the database will be secure, used only for E911 purposes, and never sold to or otherwise shared with third parties, including government entities.'' Public Knowledge suggests that the Commission should require communications providers, cable operators, and satellite providers offering wireless consumer home products to allow consumers to ''opt out'' of including their products in such a database. Public Knowledge asks the Commission to clarify that location information collected from a consumer's device and stored in the NEAD would be considered customer proprietary network information (CPNI), and determine what safeguards would apply to information that may not constitute CPNI. Public Knowledge urges that the Commission address these privacy issues now and encourages the Commission to adopt a ''privacy by design'' approach. Public Knowledge also recommends that the Commission adopt regulations that ''require CMRS carriers and others to treat mobile 911 location information and NEAD as protected information and prohibit its sharing with third parties.''

58. On the other hand, TCS states that ''the technologies suggested by the Roadmap raise no new privacy concerns that do not already exist with today's 9–1–1 solutions; and the security concerns raised are no greater than those already facing public safety with regards to [NG911] technologies.'' TCS adds that ''our current public safety infrastructure contains much more sensitive information than what the Roadmap envisions.'' AT&T submits that the Roadmap's proposal is ''basically analogous to how 911 location has always been performed on the PSTN,'' and stresses that the NEAD database would be limited ''to access for 911 purposes and only during the processing of 911 calls.'' Sprint states that privacy related concerns ''will be addressed in the context of working groups.''

59. In response to these concerns, the Roadmap Parties filed an Addendum that sets forth measures they will take to address privacy and security concerns related to the implementation of the NEAD. In particular, the Roadmap Parties commit to (1) ''engage with various industry experts on privacy and security to ensure that best practices are followed in the development and operation of the database''; and (2) ''require the vendor(s) selected for the NEAD administration to develop a Privacy and Security Plan in advance of going live and transmit it to the FCC.'' New America, Public Knowledge, and other privacy advocates suggest that these measures remain insufficient, however, and urge the Commission to take additional actions to promote privacy and security.

(iv) PSAPs' Ability To Use Dispatchable Location Information

60. Finally, we sought comment in the *Third Further Notice* on whether and how PSAPs would be able to use dispatchable location information. NASNA submits that ''E911 location databases and call-handling software

products have a field that is used in wireline calls to identify apartment numbers. This field could be used to display this information.'' In addition, NASNA states that ''[i]f the LBS data are converted to lat/long or a civic address, NASNA does not know why it would cause any issues.'' Cisco states that ''a 911 Service Provider, would query enterprise networks located in and around the cell site where a 911 call originates, using a new gateway device to access the location data for that particular end user device,'' a process which it describes as ''relatively simple straightforward.'' Nevertheless, Intrado and TCS caution that changes at the PSAP level would be necessary.

61. The commitments in the Roadmap regarding dispatchable location are not contingent on a PSAP's ability to accept such information, but the Roadmap does include a caveat that ''implementation and execution of the elements within this document may be subject to a number of variables, including but not limited to . . . third party resources, which may require the signatories to reassess the progress'' of the Roadmap. However, the Roadmap also states that the parties ''will work with public safety to study and consider further steps to providing wireline-equivalent routing for wireless consumer home products that provide a dispatchable location.''

c. Discussion

62. Although we originally proposed dispatchable location as a long-term goal, the record shows that technology exists today that could be used to implement various dispatchable location solutions in the near term, as evidenced by the Amended Roadmap's provisions for immediate commencement of development of dispatchable location solutions and the Parallel Path's provisions committing to the implementation of dispatchable location technologies into wireless consumer home products and wireless handsets. Moreover, CMRS providers are already incentivized to deploy many of these technologies to expand coverage and to manage network capacity more efficiently. For example, Cisco notes that in 2013, ''approximately 45 percent of all mobile data traffic was offloaded on the fixed network via Wi-Fi or femtocell'' and further estimates that ''by 2018, more traffic will be offloaded on to Wi-Fi networks than will be carried over cellular networks.'' Given the commercial benefits of deploying the technologies that would support improved indoor location accuracy, we anticipate that commercial location systems will continue to proliferate, providing additional resources that could be leveraged for E911 use.

63. The record also confirms the clear public safety benefits of implementing dispatchable location as a core component of our approach to improving wireless indoor location. As APCO and NENA point out, dispatchable location represents the ''gold standard'' for first responders, because it provides the functional equivalent of address-based location information provided with wireline 911 calls. We note that wireline-equivalent location accuracy is of particular importance to individuals who are deaf, hard of hearing, deaf-blind, and/or have speech disabilities, and we believe the approach adopted here serves as a significant step in the right direction towards achieving such location accuracy.

64. We recognize, nonetheless, that dispatchable location cannot be achieved overnight, that the implementation concerns raised by commenters must be addressed, and that we must adopt timeframes that afford sufficient time to address these concerns. We agree with Verizon that any indoor location solution that can be scaled nationwide ''will depend on third parties or require cooperation with vendors in order to comply with any standards the Commission may adopt,'' but also that ''[t]he need for engagement with other stakeholders merely reflects the diversity of the wireless communications ecosystem consisting of service providers, solution vendors, manufacturers, and others and already exists today.''

65. We believe the Amended Roadmap provides the appropriate foundation for our approach. With regard to standards, as described above, the standards development process for many dispatchable location technologies is already under way, and the Amended Roadmap contains commitments to advance the development and approval of standards for many relevant technologies. The Amended Roadmap also offers a reasonable path forward with respect to deployment of in-building infrastructure and introducing necessary hardware and software modifications into new handsets. The Parallel Path makes similar commitments for non-nationwide CMRS providers. In light of the Amended Roadmap and Parallel Path, we find that the implementation timeframes adopted today sufficiently consider these issues and provide adequate time for all CMRS providers to plan for and implement a compliant dispatchable location solution if they so choose.

66. In evaluating dispatchable location, the Addendum also proposes that compliance with vertical accuracy requirements would be satisfied in a CMA where the total number of ''dispatchable location reference points'' in that CMA meets or exceeds the population of the CMA divided by a concentration factor of 4 within six years, based on 2010 census data. The Addendum commits parties to populate the NEAD with MAC address or Bluetooth reference points for dispatchable location reference points under their direct control for all CMAs. We agree with this approach, and find that a location solution that provides dispatchable location information to PSAPs in accordance with the prescribed benchmarks and meets the density calculation recommended by the Addendum will be considered in compliance with the vertical location accuracy requirements adopted herein. We concur that given the average population per household in the top 50 CMAs and typical Wi-Fi usage scenarios, the density calculation recommended in the Addendum should provide adequate coverage, particularly in light of the horizontal accuracy benchmarks described below that CMRS providers using dispatchable location must ensure that they meet.

67. The Parallel Path suggests that non-nationwide providers would be able to take certain steps in advance of the NEAD's implementation to develop dispatchable location ability, and that such CMRS providers commit to development, design and implementation of the NEAD, population of its data, and support of the database in concert with NENA, APCO and other stakeholders. They also commit to certain timeframes associated with handset and network design and development to support delivery of beacon information.

68. With respect to the proposal to develop and implement the NEAD to support dispatchable location, we recognize that while the NEAD has significant public safety value, there are significant privacy and security concerns associated with the aggregation of critical infrastructure and private intellectual property data. Although some commenters contend that the NEAD does not present a greater threat to data privacy than already exists today, the Roadmap and Parallel Path Parties agree that there is a need for privacy and security measures to be implemented with the NEAD. We emphasize that privacy and security concerns must be addressed during the design and development of the NEAD from its earliest stages. We will hold the

NEAD administrator, as well as individual CMRS providers that utilize the NEAD, accountable for protecting the privacy and security of consumers' location information.

69. *Development of the NEAD Privacy and Security Plan.* We require each of the nationwide CMRS providers to develop and submit for Commission approval a detailed Privacy and Security Plan for the NEAD, to be submitted with the interim progress reports discussed above, due 18 months from the Effective Date. We note that the Roadmap Parties specifically commit ''to require the vendor(s) selected for the NEAD administration to develop a Privacy and Security Plan in advance of going live and transmit it to the FCC.'' While we require the nationwide CMRS providers (rather than the vendor) to submit the Privacy and Security Plan, our approach is otherwise consistent with this commitment. The Roadmap Parties also pledge to collaborate with ''industry experts on privacy and security to ensure that best practices are followed in the development and operation of the database.'' In this regard, we expect the providers to develop the plan in close collaboration with a broad range of relevant stakeholders, including network security and reliability experts, equipment manufacturers (including device, software and network manufacturers), public interest advocacy groups (including privacy advocates, and consumer and disabilities rights groups), and other, non-nationwide communications service providers. The plan should appoint an administrator for the NEAD, prior to the database's activation, who will serve as a single point of contact for the Commission on the security, privacy, and resiliency measures that will be implemented in the NEAD.

70. We will make the NEAD Privacy and Security Plan available for public notice and comment to promote openness and transparency, and to ensure that the plan addresses the full range of security and privacy concerns that must be resolved prior to use of the database. Upon review of the plan and the record generated in response, we will evaluate the need to take any additional measures to protect the privacy, security, and resiliency of the NEAD and any associated data. In this respect, while commenters have raised important issues, we need not address their specific concerns regarding the treatment of data within the NEAD at this time, as such concerns can be raised and fully addressed in connection with our evaluation of any specific plan that may be filed.

71. *Privacy and Security Measures Applicable to Individual CMRS Providers.* In addition to the NEAD Privacy and Security Plan, we believe that certain explicit requirements on individual CMRS providers are necessary to ensure the privacy and security of NEAD data and any other information involved in the determination and delivery of dispatchable location. We require that, as a condition of using the NEAD or any information contained therein to meet our 911 location requirements, and prior to use of the NEAD, CMRS providers must certify that they will not use the NEAD or associated data for any purpose other than for the purpose of responding to 911 calls, except as required by law. Additionally, should aspects of a CMRS provider's dispatchable location operations not be covered by the NEAD privacy and security plan, the provider should file an addendum to ensure that the protections outlined in the NEAD plan will cover the provider's dispatchable location transactions end-to-end. We note that there is support for this requirement in the record, including by the Roadmap Parties. For example, AT&T pledges that the information contained in the NEAD will not be used for any non-emergency purposes. Likewise, Verizon affirms that ''the Roadmap signatories committed to addressing the security and privacy of customers' information as part of the NEAD's development, *which will be used exclusively for 911 purposes.*'' To the extent location information (by itself or in conjunction with other data concerning the customer) constitutes proprietary information protected under Section 222 of the Communications Act, we note that Section 222 expressly allows for the provision of a user's call location information to certain emergency response providers, in order to respond to the user's call for emergency services. In light of the Section 222 exception for 911 calls and the required certification by CMRS that NEAD data will only be used for 911 location purposes, nothing in this *Fourth Report and Order* should be construed to permit any use of customer or location information stored in the NEAD in any other context.

72. *PSAP Ability To Use Dispatchable Location Information.* We disagree with commenters who argue that PSAPs will not be able to accept dispatchable location information. First, PSAPs already receive location data in street address format (as opposed to geodetic coordinates) for wireline 911 calls. This capacity to receive non-geodetic data can be readily leveraged to accept delivery of dispatchable location information from wireless calls as well. Second, under the approach we adopt today, PSAPs retain the choice of whether to accept dispatchable location information (where available) or to request that the CMRS provider provide only geodetic coordinates to that PSAP. Even where PSAPs choose to accept dispatchable location information with 911 calls, CMRS providers should also make coordinate information for such calls available to the PSAP whenever feasible. Although PSAPs may need to make adjustments in procedure and additional personnel training may be necessary, we do not believe these factors justify a delay in adopting indoor location accuracy requirements that encourage dispatchable location solutions.

73. We applaud the commitments for dispatchable location set forth in the Amended Roadmap and Parallel Path, as they represent a meaningful and actionable plan for achieving dispatchable location for wireless 911 calls, particularly indoor calls. The Roadmap and Parallel Path also state that the signatory CMRS providers will work with public safety to study and consider further steps to providing wireline-equivalent routing for wireless consumer home products that provide a dispatchable location. However, as many commenters point out, the Roadmap contains no guarantee that dispatchable location will be successfully deployed or will function as intended. Therefore, to ensure sufficient location accuracy for all wireless indoor 911 calls, we find it necessary to adopt coordinate-based requirements for both the x- and y-axes and the z-axis as alternatives to dispatchable location. We discuss these requirements below.

3. Horizontal Location Information

74. In the *Third Further Notice,* we proposed a horizontal accuracy standard of 50 meters for indoor wireless calls, to be achieved by 67 percent of indoor 911 calls within two years and 80 percent of indoor 911 calls within five years. As discussed in Section III.B.2, *supra,* we are incorporating the Roadmap's provisions for implementation of dispatchable location as an alternative means to provide accurate indoor location information with a 911 call. However, the Roadmap also provides that CMRS providers will meet their commitments by providing coordinate information based on a 50-meter standard, in the event a dispatchable location solution is unavailable. Therefore, the rules we adopt include a

standard for coordinate-based location as an alternative to dispatchable location. In addition, we modify our originally proposed horizontal location benchmarks and timelines to incorporate elements from the Roadmap (including the slightly more generous timeframes and percentage benchmarks from the Addendum and the Parallel Path), but we also include backstop elements adapted from our original proposals:

- Nationwide CMRS providers must provide (1) dispatchable location, or (2) x/y location within 50 meters, for the following percentages of wireless 911 calls within the following timeframes, measured from the effective date of rules adopted in this Order (''Effective Date''):
  - Within 2 years: 40 percent of all wireless 911 calls.
  - Within 3 years: 50 percent of all wireless 911 calls.
  - Within 5 years: 70 percent of all wireless 911 calls.
  - Within 6 years: 80 percent of all wireless 911 calls.
- Non-nationwide CMRS providers are subject to the same two- and three-year benchmarks as nationwide CMRS providers *(i.e.,* 40 percent at 2 years, and 50 percent at 3 years). At years 5 and 6, non-nationwide CMRS providers are subject to the rules as follows:
  - Within the later of five years from the Effective Date or six months of having an operational VoLTE platform in their network, 70 percent of all wireless 9–1–1 calls (including VoLTE calls); and
  - within the later of six years from the Effective Date or six months of having an operational VoLTE platform in their network, 80 percent of all wireless 9–1–1 calls (including VoLTE calls).

We discuss the elements of these requirements below.

a. 50-Meter Search Ring

75. *Background.* In the *Third Further Notice,* we proposed to require CMRS providers to identify an indoor 911 caller's horizontal location within 50 meters. We reasoned that a search radius of 50 meters had a reasonable likelihood of identifying the building from which the call originated, while a search radius larger than 50 meters was unlikely to assist first responders in building identification. We also proposed to implement the 50-meter accuracy requirement in two stages with different reliability thresholds (67 percent in two years and 80 percent in five years). We noted that our current outdoor-based location accuracy rules use a ''dual search ring'' approach, with separate metrics for 50-meter and 150-meter accuracy. However, given the limited utility of a search radius larger than 50 meters for indoor location, we proposed a single-ring rather than a dual-ring approach.

76. Public safety commenters overwhelmingly support the proposed 50-meter standard, although some express a preference for a smaller search radius than 50 meters. Some CMRS providers argue against setting a 50-meter standard. AT&T, for example, argues that such a requirement is of ''dubious value to public safety'' for indoor location dense-urban and urban morphologies.'' CMRS providers also argue that it is more efficient to concentrate their resources on achieving dispatchable location rather than meeting a 50-meter standard that provides only approximate location. The Roadmap, however, provides that technologies capable of achieving 50-meter indoor horizontal accuracy qualify as ''heightened location accuracy technologies'' that may be used to meet the accuracy benchmarks in the agreement.

77. *Discussion.* We find it in the public interest to require CMRS providers to provide location information based on a horizontal 50-meter search radius where a dispatchable location is not available. Public safety commenters overwhelmingly confirm that a 50-meter x/y capability would be of significant benefit in helping to locate indoor 911 callers. Moreover, the Roadmap effectively adopts a 50-meter standard for indoor horizontal location. The record further indicates that provision of tighter geodetic data can contribute to better provision of a dispatchable location by, for example, helping to incorporate and distinguish accurate WLAN-based signals of opportunity as well as by providing more accurate geodetic location information for reverse geo-coding.

b. 50-Meter Compliance Thresholds and Timeframes

(i) Background

78. In the *Third Further Notice,* we proposed a two-stage implementation timeframe for the 50-meter horizontal requirement, with a reliability threshold of 67 percent to be achieved in two years and an 80 percent threshold to be achieved in five years. We stated our belief that even if currently available location technology could not satisfy the proposed 50-meter standard in the most challenging indoor environments, the proposed timeframe would be sufficient for the development of improved technology and deployment of such technology by CMRS providers as needed to comply with the proposed requirements. We sought comment on our proposed timeframe and various alternatives, and received substantial comment on these issues.

79. CMRS providers generally object to the *Third Further Notice* proposal, contending that the proposed two- and five-year benchmarks cannot be met with existing technology and do not provide enough time for technological improvements. Many other commenters, however, argue that the *Third Further Notice's* benchmarks and timeframes are both achievable and reasonable.

80. The Roadmap proposes horizontal location benchmarks and timeframes that, like those in the *Third Further Notice,* require CMRS providers to achieve a defined level of accuracy for a specified percentage of 911 calls over a series of interim and longer-term deadlines. The details of the Roadmap proposal, however, differ from the *Third Further Notice* proposal in several respects. First, the Roadmap proposes to use live call data that would combine indoor and outdoor calls for purposes of measuring location accuracy performance, where the *Third Further Notice* proposed an indoor-specific standard with test-bed data used to measure compliance. Second, the Roadmap sets forth different compliance percentages and timeframes than the *Third Further Notice:* As an interim threshold, the *Third Further Notice* proposes 50-meter accuracy for 67 percent of indoor calls after two years, while the Roadmap would require heightened accuracy for 40 percent of combined indoor and outdoor calls after two years and for 50 percent of combined calls after three years. For the longer term, the *Third Further Notice* proposes 50-meter accuracy for 80 percent of indoor calls after five years, while the Roadmap sets benchmarks of 75 and 80 percent of combined indoor and outdoor calls for the fifth and sixth years, respectively, and would have limited the calculation to VoLTE calls.

81. The parties to the Roadmap contend that the Roadmap benchmarks and timelines offer significant advantages over the corresponding proposals in the *Third Further Notice.* The Roadmap parties also argue that the proposals included in the Roadmap are technically achievable, whereas the proposals of the *Third Further Notice* were not. Many other commenters cite similar reasons for supporting the proposed Roadmap horizontal location metrics. For example, CCA believes the Roadmap ''is a well-balanced proposal aimed at improving enhanced location

accuracy standards for both outdoor and indoor calls to 911, while also establishing benchmarks for providing 'dispatchable location' to first responders.''

82. However, many other commenters criticize the proposed Roadmap benchmarks and timeframes as inadequate to improve indoor location accuracy. These commenters contend that because the Roadmap accuracy benchmarks blend indoor and outdoor measurements, CMRS providers can meet the benchmarks primarily through improvements to satellite-based location that enhance outdoor location accuracy without achieving any significant improvement to indoor location accuracy. They also criticize the fact that the Roadmap sets lower percentage thresholds than the *Third Further Notice,* particularly in the early stages (*e.g.,* 40 percent of calls compared to 67 percent of calls at the two year mark), and extends the overall implementation period from five to six years. Many commenters also object strongly to the five- and six-year Roadmap benchmarks because they only consider VoLTE 911 calls in measuring compliance. These commenters generally argue that the Commission should reject the Roadmap and simply adopt the original benchmarks and timeframes proposed in the *Third Further Notice.*

83. In debating the relative merits of the proposed benchmarks and timeframes for horizontal location in the *Third Further Notice* and the Roadmap, commenters present contrasting views of the viability of certain location technologies to improve horizontal location accuracy, particularly indoors. In particular, commenters focus on the following technologies: (1) Observed Time Distance of Arrival (OTDOA), (2) terrestrial beacon systems, (3) Uplink Time Distance to Arrival (UTDOA), (4) Radio Frequency (RF) fingerprinting, and (5) in-building infrastructure, including Wi-Fi and Bluetooth.

84. *OTDOA.* OTDOA is a location technology that uses the time difference observed by user equipment between the reception of downlink signals from two different cells. CMRS providers plan to implement OTDOA in conjunction with the rollout of VoLTE. While Qualcomm states that initial field trials have shown that OTDOA ''is able to provide accuracy to within a few tens of meters both indoors and outdoors when carriers deploy and configure their networks appropriately,'' it adds that OTDOA has not been sufficiently tested yet and that its deployment ''will require extensive infrastructure improvements and capital expenditures by each carrier.''

85. *Terrestrial Beacons.* The principal proponent of terrestrial beacons is NextNav, which tested a first-generation version of its Metropolitan Beacon System (MBS) in the 2013 CSRIC test bed. NextNav asserts that its second-generation system has achieved significantly improved horizontal accuracy in urban, dense urban, and suburban areas, and could meet a five-year performance metric of 50 meters for 80 percent of indoor calls. NextNav also believes its technology will be standardized in 2015 and that comprehensive network construction would require fifteen to eighteen months in most urban markets. Commenters challenge NextNav's ability to meet the indoor horizontal requirement in the timeframe proposed in the *Third Further Notice,* arguing, for example, that NextNav's claimed indoor location accuracy results may be overstated because it has only tested a technology prototype.

86. *UTDOA.* This is a network-based system developed by TruePosition that determines location based on the time it takes the 911 caller's cell phone signal to travel to nearby receivers called Location Measurement Units (LMUs). TruePosition claims that 2014 test results demonstrate that UTDOA technology could meet the Commission's proposed two-year accuracy standard today, and could meet the proposed five-year standard assuming sufficient density of LMU deployments; it also asserts that UTDOA is commercially available, that LMUs could be deployed rapidly, and that implementation does not require replacement or upgrading of handsets. CMRS providers dispute these assertions, arguing that UTDOA is not compatible with the evolving design of 3G and 4G networks and that it requires handsets to operate at increased power that will cause disruptive interference.

87. *RF Fingerprinting.* This technology locates wireless calls by analyzing radio frequency measurements from all available sources (including A–GNSS, OTDOA, and small cells or Wi-Fi hotspots), and matching them against a geo-referenced database of the radio environment. Its principal proponent, Polaris, states that it has been able to ''demonstrate [ ] indoor location accuracies of approximately 30–40m across a variety of indoor morphologies'' and that it can meet the Commission's proposed horizontal accuracy requirements within the proposed timeframe. Some commenters, however, question the viability of Polaris' technology, arguing that it has received only limited testing and that its accuracy in measuring horizontal location degrades with the height of the test point.

88. *In-Building Infrastructure.* Several commenters note that indoor, infrastructure-based technologies that can support dispatchable location, as discussed in Section III.B.2.b *infra,* may also be able to provide geodetic coordinates that could improve indoor location. For example, Rx Networks submits that ''proliferation of Wi-Fi enabled devices such as door locks, thermostats, security systems, and light bulbs will increase the density of indoor Wi-Fi devices thereby providing a greater number of points that can be located (either through self-location or crowd sourcing the location) which will result in improved multilateration fixes,'' while TIA asserts that application of this standard to Wi-Fi based location ''will be capable of producing 10 feet of accuracy on a horizontal X/Y axis 90% of the time.''

(ii) Discussion

89. As noted, both the *Third Further Notice* and the Amended Roadmap propose horizontal location benchmarks and timeframes that require CMRS providers to achieve a defined level of accuracy for a specified percentage of 911 calls over a series of deadlines, but the proposals diverge in some details. In comparing the two, we conclude that some elements of the Amended Roadmap proposal offer advantages over our original proposal. In particular, the Amended Roadmap offers more clarity by identifying the categories of technologies that would be deemed to provide ''heightened location accuracy'' sufficient to meet its benchmarks. At the same time, it provides flexibility for CMRS providers to choose from a wide array of different technological approaches to achieve heightened location accuracy, and provides a mechanism for development and test-based validation of new location technologies. These elements are consistent with our strong preference for flexible and technologically neutral rules, as we stated in the *Third Further Notice.*

90. Another key strength of the Amended Roadmap is its use of live 911 call data as opposed to relying solely on test data to measure compliance with location accuracy requirements. While test data also plays an important role in validating location accuracy performance, both in the Amended Roadmap and in the rules we adopt in this *Report and Order,* the Amended Roadmap commitment to use live call data establishes for the first time an empirical basis for measuring the use and performance of different

technologies in delivering location data to PSAPs, and holds CMRS providers accountable based on actual 911 calls rather than solely on test calls. Therefore, we believe it is appropriate to incorporate this element of the Amended Roadmap into our rules.

91. We also modify our original proposal to establish horizontal location benchmarks at two and five years, instead adopting benchmarks at two, three, five, and six years that are more reflective of the Amended Roadmap timetable. While many commenters would prefer us to adopt our original timetable, we also received extensive comment indicating that adhering to overly aggressive deadlines could end up being counterproductive. In this respect, we believe the general timeframes and benchmarks offered in the Amended Roadmap, which were the product of intense negotiation among the Roadmap parties, are more realistic and therefore more likely to result in concrete improvements in location accuracy. We also note that Roadmap's six-year timeframe is not significantly longer than the five-year timeframe proposed in the *Third Further Notice.*

92. Regarding horizontal location information, the Parallel Path commits the non-nationwide CMRS providers to providing dispatchable location or x/y location within 50 meters for the following percentages of calls:

- 40 percent of all wireless 911 calls within two (2) years;
- 50 percent of all wireless 911 calls within three (3) years;
- 70 percent of all wireless 911 calls (including VoLTE calls) within the later of five (5) years, from the date of this Agreement or six months of having an operational VoLTE platform in their network; and
- 80 percent of all wireless 911 calls (including VoLTE calls) within the later of six (6) years from the date of this Agreement or one year of having an operational VoLTE platform in their network.

93. We conclude that it is in the public interest to codify the horizontal location benchmarks in the Amended Roadmap (as modified for small CMRS providers in the Parallel Path) in this *Report and Order.* We recognize that this approach differs from that of the *Third Further Notice,* which proposed indoor-specific benchmarks for which compliance would be measured by testing in a variety of indoor environments. However, the approach adopted here, based on the Amended Roadmap, will enable measurement of location accuracy performance based on live calls, an approach that has substantial benefits. When using live call data, it is difficult to distinguish individual 911 calls based on whether they were originated indoors or outdoors, as numerous commenters point out. Thus, establishing an indoor-specific benchmark that relies solely on live call data may not be practical.

94. As noted above, some commenters have criticized allowing CMRS providers to blend location accuracy data from outdoor as well as indoor calls. However, we do not believe it is practical or appropriate to establish compliance benchmarks that are limited to indoor calls or indoor-oriented solutions, or that the foregoing concerns outweigh the substantial benefits of live call data. For example, the record indicates that satellite-based A–GNSS location is not only capable of providing a location fix of 50 meters or less outdoors, but will also be able to locate callers in indoor environments where satellite signal reception is not compromised (*e.g.,* in single-story wood frame buildings or in larger structures where the caller is located near a window). NextNav has cited data from the 2013 CSRIC III test bed report indicating that the percentage of successful indoor GPS fixes was 23 percent in urban environments and 11 percent even in dense urban environments. We see no reason to discount reliance by CMRS providers on such successful indoor fixes in promoting our goals for indoor location accuracy. Conversely, particularly in light of the rapidly accelerating trend toward indoor wireless calls, we do not believe these figures provide any significant disincentive for CMRS providers to pursue alternative solutions for indoor calls in more challenging indoor locations. Indeed, CMRS providers have significant incentive in many indoor situations to pair A–GNSS with other location technologies. As CSRIC notes, ''[m]ultiple combinations of different technologies can be combined together to produce a more reliable and accurate position estimate than any one system alone.'' In regard to LTE specifically, CSRIC notes that ''[location a]ccuracy may be improved because LTE supports more flexible hybrid positioning methods than 2G/3G. The [Serving Mobile Location Center] can initiate multiple location methods at once.''

95. CMRS providers will be able to choose from a variety of technology solutions that are either already commercially available or close to commercial availability, because they have already recognized the potential need to rely on these technologies to meet their commitments if there is no timely dispatchable location solution, and because CMRS providers will have substantial time and flexibility to implement the best solution or combination of solutions. To the extent that CMRS providers choose to move forward with dispatchable location, as discussed in Section III.B.2.b, *infra,* any dispatchable location solution will count towards the horizontal benchmark at the appropriate thresholds. In addition, CMRS providers have the option of leveraging indoor infrastructure such as small cells and Wi-Fi hotspots to provide x/y location within 50 meters as opposed to dispatchable location. Similarly, providers may use OTDOA to comply with the horizontal benchmark to the extent that OTDOA is determined through testing to meet the 50-meter standard. This is consistent with the CMRS providers' commitment in the Roadmap to deploy OTDOA in their roll-out of VoLTE and to use it in conjunction with A–GNSS as a primary location solution.

96. In addition to dispatchable location and OTDOA, CMRS providers have several other technologies to choose from. While NextNav's first-generation beacon technology fell short of 50-meter accuracy in some environments in the CSRIC test bed, subsequent testing indicates that its second-generation MBS technology can achieve 50-meter accuracy in suburban, urban, and dense urban environments. Moreover, the additional year CMRS providers will have to meet our benchmarks should provide sufficient time for deployment of MBS-capable handsets.

97. UTDOA technology is also sufficiently developed to present a viable option for CMRS providers. Although TruePosition has not tested UTDOA with LTE networks, CSRIC notes that ''[l]ocation accuracy of UTDOA deployed on LTE networks should be comparable to, or better than, the accuracy achieved by UTDOA deployed on 3G or 2G networks . . .'' UTDOA is already commercially available from two different vendors and does not require any handset replacement, only updates to the CMRS providers' networks. While some commenters question UTDOA's viability because it relies on ''powering up'' by the handset, this is not an insurmountable problem. Powering up already occurs for emergency voice calls on GSM networks, adjustment of handset power is incorporated into industry standards, and any power-up requirements for emergency calls would be fairly brief and limited exclusively to 911 calls. We also find that should CMRS providers decide to pursue

UTDOA as a solution, the additional year afforded them to meet the benchmarks should provide sufficient time to address any issues regarding the impact of LMU deployment on network performance.

98. Polaris Wireless' RF fingerprinting technology will also likely be able to meet our requirements in many indoor environments when used in conjunction with other location technologies. Radio Frequency (RF) fingerprinting can be used in conjunction with OTDOA and other location technologies, with no handset replacement necessary because the RF mapping capability is implemented from the network side. Thus, if CMRS providers wish to use RF mapping, the technology is also likely to be sufficiently developed that it can be used in a hybrid solution to help meet both our horizontal location accuracy requirements.

c. Geographic Scope of Horizontal Location Requirements for Non-Nationwide CMRS Providers

99. In the *Third Further Notice,* we proposed to apply the horizontal indoor location accuracy requirements on a nationwide-basis, across all geographic areas, under the belief that only a limited number of environments would require CMRS providers to deploy additional infrastructure to satisfy our proposed indoor accuracy requirements, so that applying the requirements nationwide would be both technologically feasible and economically reasonable. Nevertheless, we sought comment on an alternative proposal to apply the proposed indoor location accuracy requirement in a more targeted fashion based on population and multi-story building density. We also sought comment on whether exclusions based on population density or dense forestation should apply, as well as how compliance based on one or more test beds would affect the definition of areas to exclude.

100. In response to the *Third Further Notice,* several commenters express support for a targeted application of indoor location requirements based on population density. Taking it a step further, several small and regional CMRS providers argue that it would also be appropriate to *exclude* rural areas from indoor-focused location accuracy requirements. Absent any such exclusion, RWA expresses concerns about the ability of small and rural CMRS providers to achieve compliance with the indoor horizontal location accuracy requirements in the proposed timeframe. SouthernLINC submits that ''a significant proportion of the nation's regional and rural carriers are . . . transitioning their networks and systems to LTE'' and adds that if the nationwide carriers are able to achieve'' the proposed milestones of the Roadmap, ''regional and rural carriers should be able to achieve them . . ., but would need additional time because the necessary technology, equipment, and vendor support will generally not become available to them until after the nationwide carriers have completed . . . implementation.'' Similarly, CCA remarks that non-nationwide providers are not on the same LTE and VoLTE deployment timelines as the nationwide CMRS providers. In the Parallel Path, CCA urges the Commission to consider providing non-nationwide providers additional time to meet the five and six-year horizontal location accuracy benchmarks of the Roadmap, so that those providers can ''gain access'' to VoLTE handsets.

101. *Discussion.* To ensure compliance with our indoor-focused location accuracy standards, we provide an approach that addresses the concerns of non-nationwide CMRS providers and provides them flexibility as they migrate to VoLTE networks. For purposes of the instant *Report and Order,* we refer to providers with networks that are limited to regional and local areas—as ''non-nationwide providers.'' We recognize that, compared to the four nationwide CMRS providers that are parties to the Roadmap, our indoor-focused location accuracy requirements will substantially affect non-nationwide CMRS providers, particularly in years five and six under horizontal location accuracy requirements we adopt today. In this regard, we decline to phase in our horizontal location requirements based on population density. Satellite-based location technology has already proven able to meet our horizontal location requirements in rural areas and should provide the same capability soon in urban clusters. Accordingly, small and rural, as well as some regional, CMRS providers will likely need to make little additional expenditure to comply with our two and three-year horizontal location accuracy requirements. Similarly, we do not expect other providers to need to expend substantial additional resources to meet our requirements in the less densely populated areas that they serve. Rather, the non-nationwide providers can focus their resources on investing for and meeting our indoor-focused horizontal location requirements in years five and six as set forth below.

102. Moreover, our existing E911 exclusions apply only to outdoor areas in which naturally-formed physical characteristics of the area prevent the CMRS provider from obtaining accurate location information on the 911 caller. Because the rules we adopt today are focused on indoor 911 calls—which are not hindered by naturally-formed physical characteristics—there is no need to adopt similar exclusions here. Moreover, applying these requirements uniformly nationwide is consistent with the principle that improving 911 location is just as important in the least populous markets as in the most populous.

103. First, for compliance with the horizontal indoor location metrics, we require that the non-nationwide CMRS providers provide either dispatchable location or x/y location within 50 meters for the same percentages of all wireless 911 calls, applicable to the nationwide providers, 40 and 50 percent at the two-year and three-year timeframes, respectively, that are measured from the Effective Date. As noted above, the record shows that non-nationwide CMRS providers that use handset-based location technologies already rely extensively on satellite-based location technologies. Further, our requirement allows them to comply with the indoor-based location accuracy requirements by using any location technologies or combinations thereof. Similarly, current network-based non-nationwide CMRS providers can either continue to use their non-satellite technologies that provide x/y coordinates or combine them with implementing hybrid location technologies within the initial timeframes we require. These providers also have the option and incentive to commence working on dispatchable location technologies and resources to satisfy both our horizontal and vertical requirements.

104. Second, compared to the horizontal location metrics for years five and six under the Roadmap, we require that non-nationwide CMRS providers that have deployed a commercially operating VoLTE platform in their network shall provide dispatchable location or x/y location within 50 meters for the same percentages of all wireless 911 calls applicable to the nationwide providers as follows: (i) 70 percent within the later of five years or six months of deploying a commercially operating VoLTE platform, and (ii) 80 percent of all wireless 911 calls within the later of six years or one year of deploying a commercially operating VoLTE platform. We agree with CCA that the disadvantages non-nationwide CMRS providers face in deploying LTE networks warrant flexibility as they migrate to VoLTE networks over the next few years. Non-nationwide

providers are not on the same LTE and VoLTE deployment timelines as the nationwide providers. As CCA notes, non-nationwide providers face ''resource constraints, spectrum constraints, and lack of equipment availability'' that mean they ''are often not able to deploy LTE (much less VoLTE) on the same or even similar timeline as the nationwide carriers.'' More specifically, due to the limited scale and scope of their networks, non-nationwide CMRS providers often have limited access to handsets that incorporate the latest technologies driven by the handset product cycles of the nationwide CMRS providers. In light of these challenges, some non-nationwide provides may face unavoidable delays in obtaining VoLTE-capable handsets and testing and deploying them in their networks. Therefore, we conclude it is reasonable to provide non-nationwide CMRS providers with greater flexibility than the nationwide providers to extend the five and six-year benchmarks until they have had a reasonable opportunity to deploy and begin offering VoLTE on their networks. This additional flexibility will enable non-nationwide small CMRS providers to integrate the measures needed to meet our location accuracy standards into their plans to acquire, test, and deploy VoLTE handsets and networks.

4. Vertical Location Information

a. Background

105. In the *Third Further Notice,* we proposed that CMRS providers identify an indoor caller's vertical location within 3 meters for 67 percent of calls within three years, and for 80 percent of calls within five years. We noted that at least one vendor had developed and tested vertical location technology that could locate callers to within 2.9 meters at the 90th percentile and demonstrated improvements in subsequent testing, and other vendors estimated having similar granular capabilities within three to five years. Moreover, by the time the *Third Further Notice* was released, nearly all smartphones had been equipped with sensors that can determine speed, compass direction, and movement, and in some cases, height above sea level. These developments indicated that vertical location technology had sufficiently matured to propose the inclusion of vertical location information for indoor wireless 911 calls. We sought comment on whether an initial benchmark of three years would be achievable.

106. Public safety and consumer commenters urge the Commission to adopt indoor location accuracy requirements as quickly as possible, but the record is divided with regard to the technical feasibility of the proposed vertical location accuracy requirements and timeframe for implementation. Some commenters argue that the proposed requirements are technically feasible, particularly if multifaceted approaches are used. Other commenters, however, argue that current vertical location technologies are not sufficiently precise to support the proposed level of vertical accuracy, and that it will take significantly more time than estimated in the *Third Further Notice* to achieve such accuracy levels.

107. The comments suggest two potential paths for providing floor-level information with indoor 911 calls: (1) Programming physical fixed infrastructure such as beacons or Wi-Fi access points with accurate floor-level information, and (2) using barometric pressure sensors in handsets to determine the caller's altitude, which is then used to identify the caller's floor level. With respect to the second option, commenters note that barometric sensors are increasingly common in handsets, and some analysts project that the number of smartphones equipped with such sensors will increase to 681 million new units per year in 2016. Bosch, a leading international supplier of sensors, notes that the large volume of sensors being produced has resulted in significant economies of scale, which it estimates will drive the per-unit cost downward to between $0.24 and $0.35 by 2017.

108. Despite the widespread commercial availability of barometric sensors, CMRS providers question the accuracy of the current generation of sensors and argue that it will take significant time to develop and standardize barometrically-generated vertical location information for 911 calls. These commenters stress that barometer readings must be calibrated in order to provide first responders with meaningful information, a process which is currently unstandardized. However, NENA and several vendor commenters submit that calibration is not a difficult process, and that while calibrated data would provide more accurate information and is preferable, even uncalibrated data would be useful to first responders.

109. The Roadmap, Addendum, and additional filings reflect the parties' preference for using dispatchable location as the primary means to provide vertical location information, but they also make specific and measureable commitments to develop and deploy capabilities to determine z-axis vertical location information. First, in the Amended Roadmap, the CMRS provider parties commit to develop and deliver uncompensated barometric pressure sensor data to PSAPs from compatible handsets that support such a delivery capability within three years. Second, they commit ''to develop a specific z-axis location accuracy metric that would be used as the standard for any future deployment of z-axis solutions.'' To demonstrate progress along this path, the parties agree to ''promote the development and approval of standards'' for barometer-based solutions within 18 months. The parties also agree to complete (i) a study within six months to evaluate options for using barometric pressure data to obtain a z-axis, and (ii) a further study within 24 months that would include test bed evaluation of barometric and other z-axis solutions. The Addendum further commits the nationwide CMRS providers to deploy z-axis solutions according to specific benchmarks for major population centers in the event they are unable to provide dispatchable location. The Addendum provides a quantifiable z-axis backstop if a provider has not met the dispatchable location benchmark by year 6 in any of the most populous 50 CMAs. Further, a CMRS provider ''will be deemed to have implemented a Z-axis location solution in that CMA if its Z-axis solution provides coverage for at least 80% of the population of the CMA within 8 years'' and ''at least 50% of all new handset model offerings everywhere must be z-capable by year 7, and 100% of all new handset models by year 8.''

110. Numerous commenters oppose the Roadmap's vertical location provisions, particularly objecting to the fact that the Roadmap proposes no specific standard for providing vertical location information in the event that a dispatchable location solution cannot be achieved. On the other hand, the parties to the Roadmap offer a vigorous defense of its vertical location proposals. For example, Verizon submits that ''Roadmap opponents that support the NPRM's proposed vertical location rules . . . disregard critical facts that would limit the availability of barometric pressure sensor-based solutions like NextNav's and Polaris Wireless's to consumers in even the best of circumstances,'' as well as ''vendors' dependence on spectrum licenses; their ability and willingness to deploy their solution throughout its licensed area; and a PSAP's need to update its own system and equipment to handle the vertical information.'' NENA argues that the Roadmap adequately addresses

vertical location and does not foreclose the possibility of the four nationwide CMRS providers providing a comprehensive vertical location accuracy solution independent from dispatchable location. Also, CCA supports a requirement for non-nationwide providers operating in the top 25 to 50 CMAs ''to count uncompensated barometric pressure data towards meeting additional [z-axis] requirements'' following the 36 month assessment of dispatchable location solutions. Several other parties offer their support for the Roadmap's proposals for vertical location, including two public safety commenters. iPosi suggests a compromise that there be a vertical location accuracy ''target'' of 10 meters within two years of the adoption of rules. Further still, several commenters raise concerns that the Addendum fails to offer specific benchmarks for vertical location. Polaris Wireless believes that CMRS providers are restricting indoor solutions to just a fraction of their networks and questions the impact on communities, including two-thirds of state capitols, that are not included within the top 50 CMAs. TruePosition argues that the Addendum proposes to use ''an alternative z-axis solution, but one that is far inferior and much later in availability than what the FCC has proposed.''

111. We also sought comment in the *Third Further Notice* on whether PSAPs are ready to accept z-axis information today, and if not, how long it will take for a sufficient number of PSAPs to develop this capability so that it would be reasonable to impose a z-axis requirement on CMRS providers. Some commenters argue that PSAPs could receive and process vertical location information immediately on existing consoles, even if they have not upgraded to NG911. Other commenters argue that even if vertical location information were available, a majority of PSAPs will not be able to use it effectively. Verizon argues that any implementation deadlines for vertical location information should be tied to PSAP readiness across large regional areas. APCO argues that even if many PSAPs currently cannot process vertical location information, the Commission should establish vertical location accuracy requirements and timetables now because PSAPs are unlikely to make the necessary upgrades to their systems without certainty that CMRS providers will begin delivery of such information by a specified deadline.

b. Discussion

112. Based on the record, we find that there is a need for vertical location information in connection with indoor 911 calls, and that adopting clear timelines for providers to deliver vertical location information is in the public interest. The Amended Roadmap affirms the importance and need for floor-level location information to be provided to emergency responders. Moreover, the Roadmap, the Addendum, and additional filings provide a backstop mechanism using both uncompensated barometric data and a specific z-axis location accuracy metric to obtain vertical location information for PSAPs as an alternative to dispatchable location. Therefore, while 911 calls that provide dispatchable location information, as discussed in Section III.B.2 above, will count towards the vertical location accuracy requirement, the vertical location rules adopted herein are also designed to provide for a potential alternative to the Road Map parties' preferred solution.

113. We find that it is reasonable to establish a z-axis metric standard for vertical accuracy as an alternative to providing floor-level accuracy by means of dispatchable location. Although some commenters support immediate adoption of a three-meter standard to provide PSAPs with accurate floor-level information, we believe that, in light of the substantial dispute in the record about the feasibility of achieving a z-axis metric on the timetable proposed in the *Third Further Notice,* additional testing and standardization are appropriate in order to determine the appropriate accuracy benchmark. Although market availability of devices with barometric devices has increased, and multiple vendors, including those who participated in the CSRIC test bed, have continued to develop and test vertical location technologies, challenges remain. We note that vertical location information can be provided at varying levels of accuracy. For example, uncalibrated barometric pressure data provides some idea of the vertical height of a device, but would become more accurate with calibration. Even more accurate than calibrated barometric data would be floor-level information included as part of the programmed dispatchable location of a fixed beacon or Wi-Fi access point, which could be validated as the proper location by a barometric pressure sensor on the phone. We recognize the challenges with standardization and achieving sufficient handset penetration to be able to implement a calibrated barometric pressure-based solution within three years, as proposed in the *Third Further Notice.* We find that at present, vertical technologies are not as tested nor widely deployed as horizontal ones, which justifies applying tailored implementation timeframes for achieving indoor location accuracy in the two different dimensions, as reflected in the Addendum proposals and the rules we adopt here. We conclude that more than three years is likely to be needed for industry to deploy infrastructure, to change out handset models, and to configure networks and location systems to incorporate vertical location information.

114. Therefore, we adopt rules that (1) require the provision of uncompensated barometric pressure readings to PSAPs from capable devices within three years of the Effective Date, and (2) require CMRS providers to meet a specific z-axis metric and deploy such technology in major CMAs beginning six years from the Effective Date.

115. *Uncompensated Barometric Data.* Within three years of the Effective Date, all CMRS providers must provide uncompensated barometric data to PSAPs from any handset that has the capability of delivering barometric sensor data. This codifies the commitment that CMRS providers have made in the Roadmap and Parallel Path to provide such data. The record indicates that handsets with barometric sensors are already widely available and we expect the total number of handsets with this capability to increase over the next three years. Moreover, while some commenters assert that uncompensated barometric data is not reliable, NENA notes that uncompensated barometric pressure data would be useful to first responders searching for a 911 caller within a building, because once in the building, the first responders could compare barometric readings from their own devices to the barometric readings from the caller's handset in the same building, eliminating the need for compensated data. Uncompensated barometric data also serves as a readily available data point for calls for which dispatchable location is not available or a z-axis metric solution has not yet been deployed. Nevertheless, we do not require CMRS providers to begin delivery of uncompensated barometric data immediately. Although barometric sensors are available in handsets today, CMRS providers, service providers, and PSAPs alike will need time to incorporate and configure this new data into their systems. We believe that a three-year deadline provides sufficient time for development of these

capabilities. We also recognize that non-nationwide CMRS providers seek an additional year before being required to provide this information, but we find that is not necessary. The rule we adopt today applies only to devices with barometric sensors and delivery capability that the CMRS provider may choose to offer to consumers and does not require any CMRS provider to make such devices available to subscribers.

116. *Z-Axis Metric.* Within three years of the Effective Date, we require nationwide CMRS providers to use an independently administered and transparent test bed process to develop a proposed z-axis accuracy metric and to submit the proposed metric to the Commission for approval. We believe the testing, standard setting process and formal showing to the Commission will ensure industry-wide cooperation to determine the most feasible z-axis metric that can be established within the timeframes adopted today. We intend that the proposal will be placed out for public comment. Any such z-axis metric approved, and, if adopted by the Commission, will serve as an alternate six- and eight-year benchmark for vertical location should dispatchable location not be utilized by a CMRS provider for compliance.

117. Within six years of the Effective Date, nationwide CMRS providers will be required to either (1) meet the dispatchable location benchmark described herein; or (2) deploy z-axis technology that achieves any such Commission-approved z-axis metric in each of the top 25 CMAs and covers 80 percent of the population in each of those CMAs. Within eight years of the Effective Date, nationwide CMRS providers will be required to either meet the dispatchable location benchmark described herein, or (2) deploy z-axis technology that achieves any such Commission approved z-axis metric in the top 50 CMAs and covers 80 percent of the population in each of those CMAs. The same requirements will apply to non-nationwide CMRS providers serving the top 25 and top 50 CMAs, except that the six- and eight-year benchmarks will be extended to 7 and 9 years, respectively. Taken together, and based on the progress identified to date in concert with the rapid rollout of VoLTE phones, it is our predictive judgment that the extended six- and eight-year timetable for compliance will be more than adequate for nationwide CMRS providers, as will the extension by one year each for non-nationwide CMRS providers. Our solution recognizes the substantial but still incomplete technological progress achieved to date and makes the most effective use of the Amended Roadmap to work toward a backstop solution in the event the failure of a dispatchable location approach requires it. It also provides reasonable and appropriate incentives for CMRS providers to ensure the success of their preferred dispatchable location solution and/or a z-axis metric alternative.

118. To further ensure that nationwide CMRS providers are on track to provide a proposed z-axis metric for vertical location at three years, we require that they report to the Commission on their progress towards testing and developing the proposed metric 18 months from the Effective Date. As part of the 18-month report, at a minimum, CMRS providers must show how they are testing and developing z-axis solutions and, consistent with their commitment in the Roadmap, demonstrate their efforts to promote the development and approval of standards to support such solutions. We find that the requirements and adjusted timeframe we adopt today sufficiently address concerns raised by commenters with regard to technical feasibility, the time necessary for standards development and deployment of new technologies, and for integration into PSAP systems and procedures.

119. We also find that the current limitations on the ability of PSAPs to use vertical location information fail to justify delaying adoption of vertical location accuracy requirements beyond the timeframes adopted in this order. Indeed, public safety commenters argue that even imperfect vertical location information would be of use to them. We believe the provision of uncompensated barometric pressure data mitigates that problem in the near term. We also agree with APCO that PSAPs are unlikely to invest in upgrading their equipment and software unless there are requirements in place to ensure that the information will soon be available to them. While PSAPs may not be able to utilize vertical location information immediately, the six-year timeframe associated with this requirement provides ample time for PSAPs to develop such capability.

120. Finally, although we adopt a nationwide requirement for all CMRS providers to provide uncompensated barometric pressure data to PSAPs from any capable handset, we decline to apply a similar requirement at this time to the deployment of z-axis metric solution. We anticipate that the provision of dispatchable location obviates the need for nationwide deployment within the timeframes adopted today. Again, we find that the requirements and adjusted timeframe adopted herein sufficiently take into account concerns raised by commenters with regard to technical feasibility, the time necessary for standards development and deployment of new technologies, and for integration into PSAP systems and procedures even in rural areas.

5. Implementation Issues

a. Compliance Testing for Indoor Location Accuracy Requirements

121. *Background.* In the *Third Further Notice,* we found that CSRIC WG3 demonstrated the feasibility of establishing a test bed for purposes of evaluating the accuracy of different indoor location technologies across various indoor environments. Accordingly, we found that a test bed approach, representative of real-life call scenarios, would be the most practical and cost-effective method for testing compliance with indoor location accuracy requirements. We proposed two approaches based on representative real-life call scenarios, one centered on participation in an independently administered test bed program and the second centered on alternative but equivalent testing methodologies. Under either proposal, certification would provide a ''safe harbor'' in which CMRS providers, upon certification that a technology meets our location requirements and has been deployed in a manner consistent with the test bed parameters, would be presumed to comply with the Commission's rules, without the need for the provider to conduct indoor testing in all locations where the technology is actually deployed.

122. Commenters generally support the establishment of a test bed for technology vendors and CMRS providers to demonstrate indoor location accuracy. CMRS providers urge establishment of an independent test bed, and argued that requiring testing in all markets served by CMRS providers could delay or impede identifying candidate technologies. A number of commenters agree that testing in representative environments that include rural, suburban, urban and dense urban morphologies provides an acceptable proxy to conducting market-by-market testing. Other commenters argue that live 911 call data should be compared to any certified results achieved in a test bed environment in order for PSAPs to determine if service providers are meeting compliance requirements in their area.

123. In June 2014, CSRIC IV WG1 released its Final Report on specifications for an indoor location

accuracy test bed that included recommendations for methodology, management framework, funding, and logistical processes. CSRIC IV recommended adopting the CSRIC III test methodology and establishing permanent regional test bed facilities in six representative cities distributed across the U.S. While CSRIC IV focused on development of the test bed for experimental testing, it did not extend the scope of its recommendations to the potential use of test bed data to demonstrate compliance with location accuracy benchmarks.

124. The Roadmap provides for establishment of a test bed modeled on the CSRIC III recommendations. The Roadmap test bed would facilitate testing of both indoor and outdoor 911 location technologies and would include both experimental testing and compliance components. The Roadmap signatories pledge to establish the test bed by November 2015 and to operate it in a technology neutral manner in order to test and validate existing and future location technologies, including ''OTDOA/A–GNSS, dispatchable location solutions, and other possible location solutions (including but not limited to technologies described in PS Docket No. 07–114).'' The Roadmap also provides for use of the test bed data to demonstrate CMRS provider compliance with location accuracy performance benchmarks. However, rather that measuring compliance based on test data alone, the Roadmap would measure compliance based on actual use of the tested technologies in live 911 calls.

125. Most commenters approve of the Roadmap's commitment to establish a test bed consistent with CSRIC III's recommendations. However, some commenters question whether test bed performance data can provide sufficient certainty that the tested technologies will perform as well in the real world environment as in the test environment. Other commenters contend that the Roadmap test bed proposal has limited value because the Roadmap does not contain sufficiently rigorous requirements to deploy successfully tested technologies. Some commenters contend that the Roadmap test bed proposal leaves out key performance indicators which serve to demonstrate whether a technology meets Commission benchmarks. Finally, rural CMRS providers express concern that due to the limited number of test bed locations, there will be no test bed facilities in their service areas and they therefore may be forced to conduct more expensive individualized testing.

126. *Discussion.* The record strongly supports establishing a test bed regime modeled on the CSRIC III recommendations that CMRS providers can use to test and verify that location technologies are capable of meeting our indoor accuracy requirements. CSRIC III demonstrated the feasibility of establishing a test bed and methodology for purposes of evaluating the accuracy of different indoor location technologies across various indoor environments. CSRIC IV WG1 further validated this approach, formally recommending that the Commission adopt CSRIC III's methodologies and outlining additional recommendations regarding the management, funding and logistical aspects of operating a test bed. The Roadmap builds on these recommendations with its commitment to establish a test bed regime consistent with the CSRIC principles.

127. *Test Bed Requirements.* While the Roadmap establishes an appropriate framework for development of a test bed regime, we believe that the test bed must conform to certain minimal requirements in order for test results derived from the test bed to be considered valid for compliance purposes. Specifically, the test bed must (1) include testing in representative indoor environments; (2) test for certain performance attributes (known as key performance indicators, or KPIs); and (3) require CMRS providers to show that the indoor location technology used for purposes of its compliance testing is the same technology (or technologies) that it is deploying in its network, and is being tested as it will actually be deployed in the network.

128. *Representative Environment.* The test bed shall reflect a representative sampling of the different real world environments in which CMRS providers will be required to deliver indoor location information. Therefore, each test bed should include dense urban, urban, suburban and rural morphologies, as defined by the ATIS–0500013 standard. We believe these morphologies are sufficiently representative and inclusive of the variety of indoor environments in which wireless 911 calls are made.

129. *Performance Attributes.* Testing of any technology in the test bed must include testing of the following key performance attributes: Location accuracy, latency (Time to First Fix), and reliability (yield). For purposes of determining compliance with location accuracy and latency requirements, testing should at a minimum follow the CSRIC III test bed methodology. With respect to yield, the CSRIC test bed defined the ''yield of each technology . . . as the [percentage] of calls with delivered location to overall 'call attempts' at each test point.'' As with indoor calls in real-world scenarios, however, not all test call attempts will actually connect with the testing network established for the test bed and therefore constitute ''completed'' calls. In view of the difficulties that CSRIC III encountered in testing indoor locations, we adopt the following definition of yield for testing purposes: The yield percentage shall be based on the number of test calls that deliver a location in compliance with any applicable indoor location accuracy requirements, compared to the total number of calls that successfully connect to the testing network. CMRS providers may exclude test calls that are dropped or otherwise disconnected in 10 seconds or less from calculation of the yield percentage (both the denominator and numerator). We require CMRS providers to measure yield separately for each individual indoor location morphology (dense urban, urban, suburban, and rural) in the test bed, and based upon the specific type of location technology that the provider intends to deploy in real-world areas represented by that particular morphology.

130. *Testing to Emulate Actual Network Deployment.* CMRS providers must show both (1) that any indoor location technology used in compliance testing is the same technology that will be deployed in its network, and (2) that the technology is being tested as it will actually be deployed in the CMRS provider's network. In order to count use of any tested technology towards any of our accuracy thresholds, CMRS providers must certify that they have deployed the technology throughout their networks in the same manner as tested. CMRS providers must also update their certifications whenever they introduce a new technology into their networks or otherwise modify their technology use in such a manner that previous compliance testing in the test bed would no longer be representative of the technology's current use.

131. *Confidentiality of Test Results.* In the *Third Further Notice,* we noted that under the CSRIC III test bed regime, all parties agreed that raw test results would be made available only to the vendors whose technology was to be tested, to the participating CMRS providers, and to the third-party testing house. In order to protect vendors' proprietary information, only summary data was made available to all other parties. At this time, we will not require CMRS providers to make public the details of test results for technologies that have been certified by the independent test bed administrator. We believe the test administrators'

certification is sufficient notification that a technology meets our key performance indicators.

132. With regard to non-nationwide CMRS providers that cannot participate directly in the test bed, we find that the test bed administrator shall make available to them the same data available to participating CMRS providers and under the same confidentiality requirements established by the test bed administrator. This will enable such CMRS providers to determine whether to deploy that technology in their own networks. Enabling non-nationwide CMRS providers to access test data under the same confidentiality conditions as participating CMRS providers obviates the need for individual testing by those providers.

b. Use of Live 911 Call Data To Verify Compliance

133. *Background.* The Roadmap submitted by the four nationwide providers commits to collecting and reporting live 911 call data in six test cities recommended by ATIS ESIF on a quarterly basis to NENA and APCO, including data on the ''positioning source method'' used to deliver each wireless 911 call.

134. In response to the Roadmap, multiple commenters support the collection and reporting of live call data. For example, Cisco submits that ''[l]ive call data is an important step and necessitated by the commitments made in the Roadmap.'' NASNA contends that CMRS providers should report live call data to NASNA and the Commission as well, consistent with existing outdoor location accuracy reporting requirements. The Lackawanna County, PA District Attorney argues that this information should also be made available to law enforcement upon request. Small and rural CMRS providers, however, argue that live 911 call tracking and reporting would be overly burdensome for them. For example, though it supports the use of live call data, CCA notes that its members ''may not hold licenses for spectrum or otherwise operate in any of the six ATIS ESIF regions, much less the single location ultimately selected for the test bed,'' and therefore, the Commission should improve upon the proposal included in the Roadmap to accommodate smaller CMRS providers. In its Parallel Path proposal, CCA suggests that non-nationwide providers would also collect and report data if a given provider operates in one of the six regions, and if it operates in more than one it would collect and report only in half of the regions (as selected by the CMRS provider) in order to minimize burdens. For those providers not operating in any of the six regions, CCA suggests that a provider would collect and report data based on the largest county within its footprint, and in where serving more than one of the ATIS ESIF morphologies it would also include a sufficient number of representative counties to cover each morphology. They suggest that such reports would be provided within 60 days following each of the two-, three-, five-, and six-year benchmarks.

135. *Discussion.* We adopt a modified version of the Roadmap's commitment to quarterly reporting of aggregate live 911 call data for nationwide providers. We require the nationwide CMRS providers, subject to certain confidentiality protections, to aggregate live 911 call data on a quarterly basis and report that data to APCO, NENA, the National Association of State 911 Administrators (NASNA), and the Commission, with the first report due 18 months after the Effective Date of this requirement. CMRS providers must retain this data for two years. The Commission will not publish provider-specific data, but may publish aggregate data on its Web site.

136. We further adopt the Parallel Path's proposal for non-nationwide CMRS providers. We modify, however, the frequency of reporting for non-nationwide providers to every six months, beginning at 18 months following the Effective Date of the reporting requirement. In this respect, and as herein, we seek to inform our understanding of z-axis technologies by providing clear, real world data to augment the record data to date. While this may represent a slight increase in burden for smaller providers, we find that the clear benefit of this actual data in our future review of z-axis metrics outweighs those considerations. However, as discussed in Section IV.D, all CMRS providers must retain and will be required to produce live call data to requesting PSAPs in their service areas as a check on such certification.

137. We will use this data as a complement to the test bed in determining compliance. The performance of positioning source methods, whether based on geodetic coordinate information or dispatchable location, will first be determined based on performance of the technology in the test bed. CMRS providers must then certify to the Commission that they have deployed the tested technology throughout their service areas in a manner that is consistent with the deployment of that technology in the test bed, such that the test bed results can be reasonably relied upon as representative of the technology's real-word performance. Each CMRS provider must make this certification on or before our three- and six-year benchmarks, and will need to re-certify when implementing new technology or otherwise making a significant change to its network, such that previous test bed performance is no longer representative of the network or technology as now deployed. The certification will establish a presumption that 911 location performance results derived from live call data from the six ATIS ESIF test cities are representative of the CMRS provider's E911 location performance throughout in areas outside the reporting areas.

138. In this respect, submission of test and live call data will augment our understanding of the progress of such technologies as we consider the providers' proposal for a six-year benchmark when filed in the future. In order to maximize the utility of such data for those purposes, as well as for compliance, while balancing the potential burden of such reporting, we require all providers to include the following in their reports.

139. First, the live call data will include identification of the positioning source method or methods used for each call. The test bed performance of each positioning source method will then determine the degree to which that method can be counted towards the required location accuracy thresholds each time that positioning source method is used.

140. Second, to the extent available, live call data for all providers shall delineate based on a per technology basis accumulated and so identified for: (1) Each of the ATIS ESIF morphologies; (2) on a reasonable community level basis; *or* (3) by census block. In this respect, we expect that data will provide a viable, real world evaluation of particular indoor location technologies that will inform our ability to evaluate the nationwide providers' six-year bench mark proposal, and to prove out the various claims in the record as to technical achievability.

141. Finally, in order to verify compliance based on dispatchable location, we adopt the Addendum's proposed calculation regarding reference point ''density'' within a CMA. We require that nationwide CMRS providers include such calculation for relevant CMAs in their quarterly reporting. We find that this formulation will be reasonably representative of the capability of a

provider to utilize dispatchable location in a particular CMA.

c. Enforcement of Location Accuracy Requirements

142. *Background.* Under Section 20.18(h) of the Commission's rules, licensees subject to Section 20.18(h) must satisfy the existing E911 Phase II requirements at either a county- or PSAP-based geographic level. In the *Third Further Notice,* we proposed to adopt this same approach to enforcement for indoor location accuracy requirements, noting that CMRS providers could choose different technologies to best meet the needs of a given area based on individualized factors like natural and network topographies. We also recognized, however, that a county- or PSAP-based requirement may be difficult to verify if testing is performed within a more geographically constrained test bed, as discussed above. Ultimately, we proposed that enforcement of our indoor location accuracy requirements would be measured with actual call data within a PSAP's jurisdiction, but as a precondition, the PSAP would be required to demonstrate that they have implemented bid/re-bid policies that are designed to obtain all 911 location information made available to them by CMRS providers pursuant to our rules. We observed that accurate and reliable delivery of E911 location information depends upon the willingness and readiness of PSAPs and CMRS providers to work together.

143. In response, NASNA supports enforcement on a county/PSAP-level basis, and ''agrees with the concept of a CMRS provider being required to demonstrate compliance with the test,'' but also expresses concern that any presumptive compliance demonstrated in the test bed ''not hinder or prevent a state or local jurisdiction from taking effective action to resolve a problem with any carrier that does not meet the location accuracy requirements.'' NextNav submits that applying a PSAP-level enforcement regime to indoor calls ''would ensure that compliance testing reflects the actual makeup in each county and would ensure the performance fulfills the expectations of the callers in each area,'' as well as ''facilitate comparison of county or PSAP level compliance testing with the actual daily operational results experienced in each county or PSAP service area.''

144. On the other hand, several commenters argue that the proposed test bed approach would obviate the need for a county- or PSAP-level enforcement regime. Verizon states that compliance testing at the county- or PSAP-level ''is not feasible without different test bed parameters for each county or PSAP,'' and therefore, enforcement at this level would ''defeat the purpose and promised efficiencies of a test bed in the first place.'' Sprint submits that the *Third Further Notice* ''does not explain how the specific morphology associated with a particular county or PSAP will be defined,'' and that ''[t]here will be PSAPs and counties that contain multiple different morphologies, which will make it more difficult to assess overall compliance.'' Sprint then suggests that ''building morphology districts be identified within PSAP jurisdictions. Within each morphology district, the various building use types and any exempt spaces within a specific building should be identified.'' AT&T argues that the number of jurisdictions and PSAPs creates an ''administrative nightmare'' and that ''the only realistic and reasonable way to measure compliance would be to establish an independently administered and FCC-sanctioned test-bed mechanism that accounts for all the morphologies by which conformance to the standards could be fairly measured for all PSAPs.''

145. With respect to whether enforcement should be preconditioned on PSAPs' use of all available location data, APCO ''understands the Commission's desire to ensure that PSAPs use rebidding before filing complaints, but is concerned that the proposed standard is vague as there may be differing views regarding what constitutes a 'rebidding policy.' Moreover, the proposed rebidding condition on complaints will be irrelevant and unnecessary to the extent that future location technologies do not require rebidding to meet accuracy requirements.''

146. We also sought comment in the *Third Further Notice* on whether we should establish a specialized complaint process as part of our E911 enforcement strategy. We proposed that, with the filing of an informal complaint, PSAPs would have to demonstrate that they have implemented bid/re-bid policies designed to enable PSAPs to obtain the 911 location information that CMRS providers make available. Some public safety groups support this approach, in hopes of encouraging expeditious resolution of location accuracy issues, but CMRS providers generally oppose such a process. For example, CTIA submits that ''the test bed safe harbor approach will become useless if the FCC entertains complaints seeking in-building field testing in particular markets. Such a complaint process would effectively require CMRS providers to test deployments in all markets, which would be inconsistent with the Commission's findings that ubiquitous testing is both costly and impractical.'' Verizon and CCA argue that ''a PSAP that believes it is experiencing degraded performance in its area should first bring its concerns to the service provider before lodging an informal complaint with the Commission, so that the provider has an opportunity to work in good faith to timely address it.''

147. *Discussion.* Consistent with our existing E911 requirements, the rules we adopt today will be enforced by measuring the provider's performance at the county or PSAP level. In response to commenters' arguments that the test bed regime obviates the need for enforcement at a more granular level, we note that a CMRS provider's test bed results create only a presumption of compliance with the location accuracy standards with respect to a particular technology used within the provider's network. If that presumption can be rebutted with live call data or other objective measurements showing lack of compliance with our location accuracy requirements, we must be able to enforce our rules.

148. We agree with Verizon and CCA, however, that PSAPs should first engage with relevant service providers to see whether an issue could be resolved without Commission involvement. As discussed above, we require CMRS providers to collect live call data to the extent of their coverage footprint in the six ATIS ESIF test cities, for purposes of compliance and quarterly reporting to NENA, APCO, NASNA, and the Commission. In addition, we require CMRS providers to collect live 911 call data for its entire service area to make available to PSAPs upon request. By enabling PSAPs to obtain meaningful data regarding the quality of location fixes delivered with 911 calls, we intend to facilitate the ability of PSAPs and CMRS providers to troubleshoot and identify issues regarding E911 location accuracy. Accordingly, before a PSAP may seek an enforcement action through the Commission, PSAPs should first attempt to resolve the issue with the CMRS provider. We also require that, before seeking enforcement action, a PSAP must show that (1) it has implemented policies (whether through re-bidding or other mechanisms) to retrieve all location information being made available by the CMRS provider in conjunction with 911 calls and (2) provide the CMRS provider with [30] days written notice of the PSAP's intention to seek Commission enforcement, which shall include all of

the documentation upon which the PSAP intends to rely in demonstrating the CMRS provider's noncompliance to the Commission. We believe these conditions will serve to foster cooperation and transparency among the parties.

149. PSAPs may also file an informal complaint pursuant to the Commission's existing complaint procedures. We find that our existing informal complaint procedures should be sufficient to address PSAP concerns. At the same time, however, given the critical importance of addressing any concerns regarding the delivery of location information in connection with wireless 911 calls, we encourage parties submitting informal complaints to provide copies to PSHSB staff directly. In this regard, we seek to ensure that PSAPs and other stakeholders receive immediate consideration in the event there is an issue regarding E911 location accuracy.

150. Finally, we emphasize that CMRS providers and other stakeholders, such as SSPs, share responsibility to ensure the end-to-end transmittal of wireless 911 call location information to PSAPs, in compliance with our E911 location accuracy requirements. All stakeholders must collaborate to ensure the delivery of accurate location information, as well as the delivery of associated data to help PSAPs interpret location information, such as confidence and uncertainty data. PSAP call-takers must be able to quickly evaluate, trust, and act on such information to dispatch first responders to the correct location. In the event any party in the end-to-end delivery of location information fails to satisfy its obligation under our E911 location accuracy requirements, we reserve the right to pursue enforcement action or take other measures as appropriate.

d. Liability Protection

151. *Background.* In general, liability protection for provision of 911 service is governed by state law and has traditionally been applied only to local exchange carriers (LECs). However, Congress has expanded the scope of state liability protection by requiring states to provide parity in the degree of protection provided to traditional and non-traditional 911 providers, and more recently, to providers of NG911 service.

152. We understand commenters' arguments that liability protection is necessary in order for CMRS providers to fully comply with location accuracy requirements. In the *Third Further Notice,* we noted that the recent NET 911 Act and Next Generation 911 Advancement Act significantly expanded the scope of available 911 liability protection, and that we believe this provides sufficient liability protection for CMRS providers. Nevertheless, we sought comment on whether there are additional steps the Commission could or should take—consistent with our regulatory authority—to provide additional liability protection to CMRS providers. We also sought comment on liability concerns that may be raised in conjunction with the possible adverse effect on indoor location accuracy from signal boosters, as CMRS providers commenting in the *Signal Booster Report and Order* were concerned about liability for location accuracy when those capabilities are affected by signal booster use.

153. The record in response to the *Third Further Notice* contains little substantive comment with regard to liability protection issues. CTIA calls for a nationwide liability protection standard for entities providing 911 service. BRETSA emphasizes that liability protection for 911 services should be a matter of state—not federal—law. Qualcomm states that ''[t]o the extent the Commission seeks to encourage CMRS providers to incorporate potentially inaccurate Wi-Fi location information into the location determinations calculus, clarification of liability for such unreliable data sources will be needed.'' No commenter discussed how liability protection would be impacted by the use of signal boosters.

154. *Discussion.* In our *Text-to-911 Order,* we construed the Next Generation 911 Advancement Act's definition of ''other emergency communication service providers'' as inclusive of over-the-top interconnected text providers to the extent that they provide text-to-911 service. Similarly, we believe that the term ''other emergency communications service providers'' also reasonably includes any communications service provider to the extent that it provides E911 service. We believe that the liability protection set forth in the Next Generation 911 Advancement Act and other statutes provide adequate liability protection for CMRS providers subject to our rules. Moreover, we find that the rules we adopt today serve to mitigate or eliminate any regulatory uncertainty about 911 indoor location accuracy requirements. We take no action at this time with regard to liability protection of E911 service providers.

e. Specialized Waiver Process

155. *Background.* We sought comment in the *Third Further Notice* on whether we should adopt a specific waiver process for CMRS providers who seek relief from our indoor location accuracy requirements. In general, the Commission's rules may be waived for good cause shown, pursuant to a request or by the Commission's own motion. In the context of its E911 Phase II requirements, the Commission recognized that technology-related issues or exceptional circumstances could delay providers' ability to comply with the requirements, and that such cases could be dealt with through individual waivers as implementation issues were more precisely identified. Accordingly, we sought comment on whether and what criteria would be appropriate for any E911-specific waiver process, as well as whether providers who believe they cannot comply with a particular indoor location accuracy benchmark, despite good faith efforts, may submit a certification to this effect six months prior to the applicable benchmark.

156. A number of commenters support, or at least do not oppose, the idea of an E911-specific waiver relief process. TruePosition identifies several factors specific to indoor 911 location that may be appropriate as a basis for an E911-specific waiver process: ''if a carrier has ordered the necessary equipment (network hardware, handsets, etc.) that would, if delivered on time, meet the indoor safety standards, that type of 'good faith' effort should be considered as fair grounds for granting the service provider additional time.'' BRETSA submits a similar argument for ''good faith efforts'' as a basis for granting waiver relief. RWA submits that the Commission ''should adopt a safe harbor for waiver applicants based on a showing of technical infeasibility or financial difficulty,'' which should ''on its own should justify a waiver.'' NTCA notes that ''for the small rural carriers who comprise NTCA's membership, the expense of a waiver can impose a substantial financial burden, and the regulatory uncertainty can be disruptive to business planning and operations,'' but nevertheless supports the adoption of a streamlined waiver process if the Commission were to adopt the location requirements. However, CTIA opposes the establishment of a specific waiver process, arguing that ''a waiver standard that requires a commitment to achieve compliance within a specific timeframe . . . is problematic given the uncertainties associated with technology availability and deployability.'' CTIA argues further that ''the waiver process should not be a

weigh station [*sic*] on the way to enforcement.''

157. *Discussion.* Any CMRS provider that is unable to comply with the rules or deadlines adopted herein may seek waiver relief. The Commission may grant relief pursuant to the waiver standards set forth in Sections 1.3 and 1.925 of its rules, and we believe these provisions are sufficient to address any requests for relief of the indoor location accuracy requirements, which we will evaluate based on the facts and circumstances of the particular request. Therefore, we decline to adopt additional waiver criteria at this time that would be specific to waiver requests of our indoor accuracy requirements.

C. Benefits and Costs of Indoor Location Accuracy

158. In this section, we demonstrate that the benefits of building upon the Amended Roadmap and Parallel Path with the wireless location accuracy rules we adopt today outweigh the costs. In developing a regulatory framework for indoor location accuracy, our objective is to implement rules that serve the public safety goals established by Congress. While in the *Third Further Notice* we acknowledged the potential difficulty of quantifying benefits and burdens, we sought to measure how the availability of indoor location information will benefit the public through reduced emergency response times, as well as how to maximize these benefits, while taking into consideration the burden of compliance to CMRS providers. We discuss these issues here.

1. Benefits of Improved Indoor Wireless Location Accuracy

159. *Background.* In the *Third Further Notice,* we sought comment on the extent to which improvements in indoor location accuracy would result in tangible benefits with respect to the safety of life and property. We also noted our belief that improving location accuracy for wireless calls to 911, including from indoor environments, would be particularly important for persons with disabilities and for those who may not be able to provide their address or otherwise describe their location and sought comment on the increased value and benefits of providing more accurate location information for certain populations, such as people with disabilities, victims of crime, senior citizens and children.

160. We cited to a study examining emergency incidents during 2001 in the Salt Lake City area which found that a decrease in ambulance response times reduced the likelihood of mortality (*Salt Lake City Study*). From the results of this study, we reasoned that the location accuracy improvements we proposed could save approximately 10,120 lives annually, at a value of $9.1 million per life, for an annual benefit of approximately $92 billion. We also noted a 2002 study focusing on cardiac emergencies in Pennsylvania, which showed that when location information was provided contemporaneously with a 911 call, the reduction in response time correlated with a reduction in mortality rates from cardiac arrest (*Cardiac Study*). Based on this study, we estimated that for cardiac incidents alone, the proposed indoor location rules may well save at least 932 lives nationwide each year, yielding an annual benefit of almost $8.5 billion. Furthermore, as location information quality improves and latency declines, we noted our expectation that this will result in an even greater improvement in patient medical outcomes. We sought comment on the reasonableness of our analyses of these studies and our underlying assumptions, as well as on whether the time benefit of vertical location, given the spread in horizontal location, is likely to be more, less, or comparable to the estimated gains in the *Salt Lake City Study and the Cardiac Study* when moving from basic 911 to enhanced 911 services.

161. The large majority of commenters affirm the importance of improvements to indoor location accuracy. Several commenters state that improved location accuracy would lead to more rapid response time by eliminating time and resources spent pursuing incorrect addresses and locations. The Commission's expectation that improving location information quality would lead to a decline in latency was further confirmed by recent testing conducted by public safety representatives in the CSRIC test bed. Many commenters also agree that shorter response times lead to not only reductions in mortality, but better prognoses for many non-life-threatening cases. Many commenters also concur that improved location information can be particularly important for saving the lives of persons with disabilities and for those who may not be able to adequately communicate their location to a 911 call-taker. AT&T is the only commenter that does not agree that the *Salt Lake City Study's* findings are indicative of benefits that the public should expect from the implementation of tighter location accuracy requirements.

162. *Discussion.* We conclude that the location accuracy rules we adopt today will improve emergency response times, which, in turn, will improve patient outcomes, and save lives. Requiring location information for wireless calls to 911 from indoors is thus consistent with our statutory goal of ''promoting safety of life and property.'' Further, we must be more inclusive in our requirements than those proposed by the Roadmap because its five-year and six-year location accuracy metrics risk stranding non-VoLTE consumers without the life-saving benefits of improved wireless indoor location accuracy technology. Finally, by providing a z-axis metric as a backstop to dispatchable location for identifying floor level of 911 calls from multi-story buildings, we ensure that vertical location accuracy is achieved within the timeframe laid out by the Roadmap. These commercially reasonable requirements ensure that the full benefits of improved wireless indoor location accuracy are realized by addressing gaps in the Roadmap proposal while adopting and codifying its major elements and adapting our rules to its overall timeframe.

163. The location accuracy rules we adopt today are a measured response to the critical public safety need for improved wireless indoor location accuracy. While AT&T makes an array of arguments against the benefits the Commission has identified as a likely result of improved indoor location accuracy, we find that the *Salt Lake City Study* offers a relevant basis upon which to base the projected benefits of the location accuracy requirements we adopt in this item, and that the value of statistical life (VSL) offers an appropriate measurement for the public's valuation of lives saved as a result of these rules.

164. The *Salt Lake City Study* demonstrates that faster response time lowers mortality risk. Changes in cellphone usage patterns do not undermine this finding. AT&T argues that even if the *Salt Lake City Study* demonstrated that delayed response time might increase mortality, it does not necessarily follow that improved response times would *reduce* mortality. However, the record shows that for certain medical emergencies like sudden cardiac arrest (SCA), the length of response time may be determinative of whether or not a patient survives. Sudden cardiac arrest is the leading cause of death of American adults over age 40, with 9 out of 10 incidents resulting in death. The Sudden Cardiac Arrest Foundation states that ''SCA victims can survive if they receive immediate CPR and are treated quickly with defibrillators,'' but caveats that ''[t]o be effective, this treatment must be delivered quickly—ideally, within three to five minutes after collapse.''

Considering the high mortality rate and time-sensitive nature of this increasingly widespread health risk, it follows that improved location accuracy leading to shorter response times would reduce mortality rates for this very large group of medical emergencies. We also disagree with AT&T's argument that the *Salt Lake City Study's* findings are inapposite because the increase in wireless cellular phone usage has already shortened the amount of time that individuals delay before calling 911. The time that it takes for an individual to respond appropriately to an unexpected emergency is a function of a wide variety of factors beyond cellphone proximity.

165. The DoT's VSL was designed to calculate the value of preventing injuries or deaths. That makes VSL an appropriate metric for our analysis of the projected benefits of the wireless location accuracy rules we adopt today. AT&T argues that our use of DoT's VSL statistic is inapposite because those affected by our wireless location accuracy rules have already contracted a disease or been seriously injured. As stated by AARP, however, the relevant timeframe during which a life should be valued for the purpose of our analysis is not the moment at which that individual dials 911, but the time when a presumptively healthy consumer decides whether to buy a given cellphone product based at least in part on their perception that they will be able to use that cellphone to timely summon life-saving assistance.

166. We conclude that the location accuracy improvements we adopt today have the potential to save approximately 10,120 lives annually, at a value of $9.1 million per life, for an annual benefit of approximately $92 billion, or $291 per wireless subscriber. We find that our reliance on the *Salt Lake City Study* to arrive at those figures is well-placed, and that our analysis as to the applicability of that study to the rules we adopt today is fundamentally sound. We are not persuaded by AT&T's counterarguments with respect to the projected benefits because of its unsupported assumptions about the relationship between response time and mortality risk, and its misguided approach to valuing human life that presupposes life-threatening conditions. Even if we were to adopt AT&T's perspective, however, it still stands to reason that the average wireless subscriber would likely be willing to pay $291 per year to live an extra 23.7 days, the average increase in life expectancy that the *Salt Lake City Study* leads us to believe should be expected to result from the rules we adopt today.

2. Costs of Improved Indoor Wireless Location Accuracy

167. *Background.* In the *Third Further Notice* we noted that implementation of stricter indoor location accuracy requirements will likely impose significant costs on providers and sought comment generally on the costs of such requirements, as well as detailed information on all of the costs providers estimate our proposed indoor location rules would impose on them, and how these costs were determined. We also sought comment on what universal costs would be necessary across all indoor location technologies, as well as on any specific costs that are unique to different technologies; and on whether additional costs would be passed on to consumers, resulting in higher rates and, if so, how much rates would increase. Finally, we indicated our belief that any costs imposed by our rules might be mitigated, at least to some degree, by the fact that providers are already undertaking significant indoor location technology research and development on their own for commercial, non-911 reasons and sought further comment on the degree to which commercial development—unrelated to any Commission indoor location capability requirement—could be leveraged to mitigate the costs of compliance. We asked whether additional costs would be imposed by the potential indoor location requirements set forth in the *Third Further Notice* above and beyond the costs that CMRS providers would already have in implementing indoor location capabilities for commercial purposes.

168. *Technology-Specific Costs.* While commenters do not make nuanced statements about costs that will confront the industry in order to attain compliance with our proposed indoor location accuracy standards, they offer a variety of opinions on the costs presented by the adoption of specific technologies. Commenters agree that barometric pressure sensors are already ''relatively inexpensive,'' and, consistent with the general cost-based observations made in Section III.B.4.a above, conclude that the price should be expected to continue to fall at a rate of approximately 15 percent per year as adoption grows. Commenters also agree that establishing improved wireless indoor location accuracy through a solution utilizing terrestrial beacons would entail an additional per-unit cost of $1,500–$3,000, plus additional site lease charges. According to NextNav, receivers utilizing UTDOA are already deployed within CMRS networks and are already supported by handsets, and such a ''broadcast-only location network requires no additional transmitters or spectrum, nor does it entail expensive backhaul, or extensive antennae arrays.'' Commenters also state that consumer handsets already contain GPS receivers, and the technology has robustly responded to technological change, proving highly reliable results across multiple generations of technology, and avoiding the risk of stranded investment. Finally, Rx Networks, on behalf of smaller CMRS providers, advocates for the establishment of a centralized and standardized service to process location requests. Such a clearinghouse solution would entail a base station almanac of Cell-IDs and Wi-Fi access point locations, and cost-effective provisioning of A–GNSS and barometric pressure data among CMRS providers. Rx Networks asserts that such a solution bridges technical gaps, and simplifies business relationships while minimizing capital outlays.

169. *Cost Mitigation.* Commenters agree that CMRS provider costs can be diminished through the sharing of infrastructural solutions and that the growth in national demand for these technologies will eventually drive these costs down. Commenters also agree that CMRS providers are already in the midst of a transition to all-digital, all-IP networks, and have already begun work to improve location accuracy within their systems for commercial reasons. For these reasons, according to Motorola, CMRS providers have already added the permanent employees needed to engineer and manage the processes required for further improvements to location accuracy. Additionally, TruePosition opines that one of the benefits of today's proceeding is that it may entail cost savings upwards of $100 billion for CMRS providers who ultimately retire their traditional circuit-switched copper-loop networks and complete their transition to an all-digital IP ecosystem. Moreover, according to NENA, ''[u]nlike 2000, handsets today can already leverage existing capabilities for horizontal and, in some cases, vertical location determination. This means that carriers need only close the gap between already-deployed capabilities and the Commission's proposed requirement, rather than starting from scratch.''

170. *Discussion.* We find that among the myriad potential costs posed by the variety of location accuracy technologies discussed in this section, all share the commonality that their price will decline as demand grows. In light of our commitment to technology neutrality, as we emphasized in the

Third Further Notice, we do not mandate any particular model for implementing the location accuracy rules we adopt today, and apply these requirements on a technologically neutral and provider-neutral basis. That said, we note that NextNav reports on their Web site that it recently secured $70 million in funding to maintain and operate its MBS network. This indicates that there are solutions available to achieve the indoor wireless location accuracy standards we adopt today at a cost that is far less than their $92 billion minimum benefit floor. Finally, we acknowledge that the costs imposed by the rules we adopt today may present a proportionately greater burden to smaller CMRS providers, including the costs associated with participation in the test bed. So, although the cost of meeting our indoor location accuracy rules has not yet been determined to a dollar amount, commenters provide the Commission with a paradigm for understanding the shape that such costs will take.

IV. Improving the Delivery of Phase II Location Information

171. In the following sections, we adopt measures to ensure that PSAPs receive Phase II information in a swift and consistent format, and to improve the quality of the Phase II information. Through these measures, we seek to ensure that PSAPs receive the full breadth of information they need to respond swiftly and effectively to emergency calls.

A. Latency (Time to First Fix)

172. *Background.* The Commission's current E911 location accuracy rules do not require CMRS providers to test for or to meet a specific latency threshold, commonly known as ''Time to First Fix'' (TTFF). In the *Third Further Notice,* we proposed to require CMRS providers to deliver Phase II-compliant location information to the network's location information center within 30 seconds in order for the location fix to count in a CMRS provider's calculation of percentage of calls that comply with our rules. We also proposed to exclude from this compliance calculation any wireless 911 calls lasting 10 seconds or less, an interval which is often too short for a CMRS network to feasibly generate and deliver a location fix to its location information center. We ultimately proposed to include calls lasting more than 10 seconds in the calculation.

173. A number of public safety and industry commenters support a maximum latency of 30 seconds for obtaining a location fix as reasonable based on the performance of current handset and network-based technologies. Some commenters, however, urge the Commission to set maximum latency at less than 30 seconds. Industry commenters also oppose the proposal to exclude only calls of less than 10 seconds. They argue that it is unreasonable to allow CMRS providers up to 30 seconds to obtain a location fix while also including calls lasting more than 10 but less than 30 seconds in the compliance calculation. AT&T submits that ''all calls should be given at least 30 seconds for purposes of calculating the location-accuracy success rate'' and that to ''do [otherwise] would unfairly mischaracterize the provider's compliance with location-accuracy benchmarks.''

174. *Discussion.* We add a maximum latency requirement of 30 seconds to the existing E911 Phase II rules applicable to outdoor calls, but we conclude it is premature to include this requirement as part of the new rules adopted in this order for indoor location. Thus, for a 911 call to meet Phase II requirements, a CMRS provider must deliver Phase II-compliant information to its location information center within 30 seconds, as measured from the start of the call to when the information is delivered to the location information center. In calculating percentages of Phase II-compliant calls, CMRS providers must include calls lasting 30 seconds or more for which they are unable to deliver a Phase II location fix. We apply this requirement only to our existing E911 regime, which determines compliance based on outdoor measurements only. Thus, compliance with our TTFF requirement will be based on the results of outdoor testing, and will not be measured from the live 911 call data from the six test cities.

175. We find that a 30-second maximum latency period appropriately balances the need for first responders to obtain a prompt location fix and the need to allow sufficient time for location accuracy technologies to work effectively. Excessive delay in the provision of location information can undermine or negate its benefits to public safety, but providing sufficient time for location technologies to work can lead to improved accuracy that reduces overall response time. As CSRIC III noted, 30 seconds is ''generally accepted as the *de facto* standard for maximum latency in E9–1–1 location delivery.'' The record in this proceeding similarly indicates that a maximum latency interval of 30 seconds is technically achievable using current location technology, and that improved chipsets in devices will further reduce the frequency of calls where the TTFF takes longer than 30 seconds.

176. In fact, we expect technology to reduce latency for many wireless 911 calls to significantly less than 30 seconds. CMRS providers indicate that new satellite positioning technologies they are planning to implement in conjunction with deployment of VoLTE will likely reduce latency fix for wireless 911 calls from outdoor locations. For example, newer-generation A–GNSS may be capable of generating a location fix within 12–15 seconds. Nevertheless, even in such cases, allowing up to 30 seconds provides additional time to refine the location information and potentially return a more accurate location fix. On balance, we find that a 30-second maximum latency period will encourage solutions that deliver location information to first responders quickly while providing flexibility for solutions that can deliver greater accuracy over a modestly longer time interval. Establishing a maximum latency period will also ensure that PSAPs and CMRS providers have the same expectations regarding the timeframe for delivering location information.

177. While we adopt the 30-second maximum latency period for outdoor calls as proposed in the *Third Further Notice,* we decline to adopt our proposal to exclude calls of 10 seconds or less while including calls of 10 to 30 seconds in the compliance calculation. We agree with industry commenters that where a call lasts less than 30 seconds, we should not penalize the provider for failing to obtain a Phase II-compliant fix that requires up to 30 seconds to generate and that would count towards compliance if the call lasted 30 seconds or more. Therefore, we will allow CMRS providers to exclude from their compliance calculation any wireless 911 call lasting less than 30 seconds for which the provider is unable to deliver a Phase II-compliant fix. On the other hand, to provide an incentive for CMRS providers to reduce latency below 30 seconds, CMRS providers may count any Phase II-compliant call in which the location fix is delivered in less than 30 seconds, regardless of the duration of the call.

178. Finally, as noted above, we limit the scope of the 30-second latency requirement to wireless 911 calls covered by our existing Phase II rules, as we believe it is premature to impose a latency standard for indoor calls at this time. Compliance will be measured by evaluating the results of each CMRS providers' outdoor drive testing. CMRS providers have yet to test location for latency, among other metrics, in

generating dispatchable location information derived from various indoor access points or beacons. Moreover, although location information from beacons and small cells could likely be determined almost instantaneously, the various new technologies that are included in ''heightened location accuracy technologies'' under the Roadmap have not yet been tested for latency. Therefore, while the record suggests that existing and developing indoor location technologies should be capable of delivering accurate location information in 30 seconds or less for most calls, we conclude that consideration of this issue should be deferred. Once there has been an opportunity to evaluate the performance of indoor location technologies based on test bed results and live call data from the six geographic test regions, we will be better able to determine whether to extend latency requirements to these new location technologies.

B. Retaining E911 Phase II Location Accuracy Standards for Outdoor Measurements

179. *Background.* In light of advancements made in A–GPS technology and the migration of some CMRS providers from GSM networks and network-based location to 4G and LTE networks and handset-based location, the *Third Further Notice* sought comment on whether all CMRS providers reasonably could comply with a 50-meter accuracy/67 percent reliability requirement within two years pursuant to a unitary location accuracy requirement for both indoor and outdoor calls. Prior to the submission of the Roadmap, some public safety and industry commenters supported a unitary accuracy standard. Other commenters expressed that it is premature for the Commission to establish such a standard. However, because CMRS providers do not yet have the technical capability to distinguish indoor from outdoor calls, we address below the reasons for retaining our existing E911 location rules that are based on outdoor testing measurements.

180. *Discussion.* We find that it is premature to eliminate the current E911 Phase II rules and replace them with a unitary location accuracy standard at this time. The current E911 Phase II rules provide a set of established outdoor-focused location accuracy benchmarks for CMRS providers using either network-based or handset-based location technologies and allow the network-based CMRS providers to switch to handset-based technologies. The current outdoor-based rules thus serve to maintain regulatory certainty for CMRS providers that continue to provide service on their legacy systems while they are planning to migrate to VoLTE networks. The major CMRS providers that either have initiated VoLTE service or plan to deploy it in 2015 must also continue to comply with the benchmarks under the Commission's rules for measuring the accuracy of outdoor calls. Thus, the additional location accuracy requirements we adopt in this order, which focus on improving indoor location accuracy, will serve to complement rather than replace the existing Phase II rules based on outdoor testing measurements.

181. We recognize that the six-year timeframe adopted in this order for indoor-focused accuracy standards may ultimately moot the issue of whether to replace the current outdoor-based accuracy requirements for E11 Phase II. The five and six-year benchmarks in the new rules, set to take effect in 2020 and 2021, will require 50-meter accuracy for 70 and 80 percent of all wireless 911 calls, respectively, and will apply to indoor and outdoor calls, thus exceeding the current Phase II handset-based standard of 50-meter accuracy for 67 percent of calls, based on outdoor measurements only. The last handset-based benchmark under the current Phase II requirements will occur in January 18, 2019. Thus, once the last Phase II benchmark has passed, we may revisit the issue of when to sunset date the current Phase II requirements and establish a unitary accuracy standard.

C. Confidence and Uncertainty (C/U) Data

182. *Background.* The Commission's current E911 Phase II rules require that CMRS providers provide confidence and uncertainty (C/U) data on a per-call basis upon PSAP request. C/U data reflects the degree of certainty that a 911 caller is within a specified radius of the location provided by the CMRS provider. The *Third Further Notice* recognized, however, that C/U data is not always utilized by PSAPs and that sought comment on how C/U data could be provided in a more useful manner. In particular, we sought comment on the provision of C/U data for all wireless 911 calls, whether outdoor or indoor, on a per-call basis at the request of a PSAP, with a uniform confidence level of 90 percent. Additionally, the *Third Further Notice* sought comment on standardization of the delivery and format for C/U data to PSAPs.

183. In response, most public safety and industry commenters agree that a standardized confidence level of 90 percent would provide important, useful information to PSAPs in interpreting the quality of location information and would rectify the current CMRS provider practice of using varying confidence levels in providing uncertainty data.

184. *Discussion.* We find that requiring CMRS providers to furnish C/U data based on a standardized confidence value will provide significant benefits to PSAP call-takers and can be furnished to PSAPs at minimal cost to CMRS providers. We therefore require that C/U data for all wireless 911 calls—whether placed from indoors or outdoors—be delivered on a per-call basis at the request of a PSAP, with a uniform confidence level of 90 percent. The record reflects that CMRS providers currently use varying levels of confidence in their C/U data, resulting in potential confusion among call-takers. We find that a uniform confidence level will help PSAPs understand and better utilize location information. By standardizing confidence levels, call-takers will more easily be able to identify when a location fix is less trustworthy due to larger uncertainties. As TCS explains, with a standardized confidence value, ''if the uncertainty of the location fix . . . is within a reasonable margin,'' the PSAP ''call taker should have enough assurance to dispatch emergency services.'' Further, the magnitude of the uncertainty value varying with a standardized confidence value could also convey meaningful information to the call-taker regarding the type of location fix being provided. For example, in the event a CMRS provider is delivering dispatchable location information, the uncertainty value would either be zero or a very tight geometric figure with a radius less than 50 meters.

185. Moreover, the record indicates that a standardized 90 percent confidence value will serve to eliminate confusion on the part of emergency call-takers and is supported by numerous commenters. As ATIS explains, a 90 percent confidence level will provide ''for the consistent interpretation of location data by the PSAP staff without significantly affecting the integrity of the calculated [uncertainty].'' We note that some commenters recommend an even higher standardized confidence value, *e.g.,* 95 percent, either in the near term or as new technologies are implemented in the long-term. On the other hand, RWA alleges in its initial comments that ''[a] confidence level of 90% is too high for rural carriers to meet without the expensive construction of additional cell sites.'' We find that a

confidence level of 90 percent, while accompanied by an uncertainty radius that will vary, strikes an appropriate balance. While we recognize that a standardized value of 90 percent will result in larger reported uncertainties for some 911 calls, there will be a greater probability that callers will be found within the area of uncertainty. As technology evolves and as location accuracy improves over time, we may revisit whether to adopt an even higher required confidence level.

186. In light of these public interest benefits, we disagree with commenters who oppose standardizing a set of confidence and uncertainty values. For example, while Verizon ''agrees that there may be value'' in establishing a uniform confidence level, it nevertheless asserts that the delivery of C/U data should be ''appropriately left to standards or best practices, as PSAP[s] need to determine what approach makes sense . . .'' Others contend that further study is necessary, especially as location technologies evolve. We see no reason to delay the delivery of more uniform C/U data. By reducing the variability in C/U information, we can help ensure that call-takers more fully understand the location information that is provided to them, enabling them to respond more efficiently to emergencies.

187. Requiring a standardized confidence level of 90 percent (with varying uncertainty values) will also provide CMRS providers with regulatory certainty as they configure C/U data using newly implemented location technologies. Ensuring the continued provision of C/U data, in a manner that allows PSAPs to fully utilize and understand that data, is particularly timely as providers migrate to 4G VoLTE networks. CSRIC IV WG1 reports that ''[t]he content of the Phase II location estimate delivered to the PSAP'' for a VoLTE 4G network ''includes the same position, confidence, and uncertainty parameters used in 2G/3G networks for technologies that directly generate geographic (*i.e.,* X,Y) location.'' CSRIC IV adds that these parameters can be ''formatted appropriately for legacy PSAPs as well as NG9–1–1 PSAPs.''

188. We find that the costs of implementing a standardized confidence level should be minimal. Because CMRS providers are currently required to deliver C/U data to requesting PSAPs on a per-call basis, they have already programmed their networks to furnish a confidence value, with some CMRS providers already either delivering or testing for it with a 90 percent confidence level. Moreover, RWA does not offer support for its allegation that a 90 percent standard confidence level would necessitate the construction of additional cell sites and therefore create a burden on small CMRS providers. Likewise, we find that the costs for SSPs to continue to transport C/U data to ensure its delivery to PSAPs would be minimal. Like CMRS providers, SSPs currently must ensure that PSAPs receive C/U data on a per-call basis. The requirement we adopt for C/U data will continue to apply to all entities responsible for transporting C/U data between CMRS providers and PSAPs, including LECs, CLECs, owners of E911 networks, and emergency service providers, to enable the transmission of such data to the requesting PSAP.

189. Finally, we note that commenters generally support the delivery of C/U data to PSAPs using a consistent format. As discussed above, we believe that consistency in the delivery of C/U data will promote PSAP call-takers' ability to more readily evaluate the C/U data being delivered. We therefore urge stakeholders to work together to develop a consistent format for the delivery of C/U data that considers the different capabilities of PSAPs to receive both geodetic and dispatchable location information. We also encourage the public safety community to continue to take measures to ensure that PSAP call-takers can fully benefit from the availability of C/U data, including obtaining upgraded CPE and programming, as well as providing relevant education and training.

D. Provision of Live 911 Call Data

190. *Background.* The *Third Further Notice* sought comment on whether the Commission should require providers to periodically report E911 Phase II call tracking information, and if so, on the scope of information that should be reported. Numerous commenters support this proposal. For instance, Verizon submits that such data could be ''helpful in evaluating . . . delivery issues associated with particular PSAPs, or in assessing if a location solution faces particular topology and RF challenges in a particular geographic area.'' NextNav submits that reporting the TTFF, yield, and type of technology used to obtain a location fix should be sufficient to evaluate whether a CMRS provider's performance is consistent with test bed performance. RWA, however, contends that ''the cost of providing the FCC with call tracking information is high,'' with ''little certainty'' as to its utility to the Commission.

191. *Discussion.* We require all CMRS providers to collect and retain for two years 911 call tracking data for all wireless 911 calls placed on their networks. This requirement is separate from, and in addition to, the provisions for quarterly reporting of live call data by CMRS providers in the six test cities as discussed in Section III.B.5.b above, though for CMRS providers in the six test cities, some of the data will overlap. Aside from those quarterly aggregate reporting requirements, we do not require CMRS providers to report general call tracking data. However, upon request of a PSAP within a CMRS provider's service area, the CMRS provider must provide the PSAP with call tracking data for all 911 calls delivered to that PSAP. The call tracking data should include, but need not be limited to: (1) The date, time, and length of each call; (2) the class of service of the call (*i.e.,* whether a call was delivered with Phase I or Phase II information, or other type of information); (3) the percentage of calls lasting 30 seconds or more that achieved a Phase II-compliant fix; (4) confidence and uncertainty data for each call; and (5) the positioning source method used for determining a location fix. In order to comply with this requirement and to be able to provide such data upon individual PSAP request, CMRS providers must collect data on all 911 calls throughout their service area. Some commenters suggest that delivering this additional information in real time may be confusing to PSAP call-takers, but our requirement requires only that CMRS providers collect this information; the PSAP must request to receive some or all of the data in real time, or in the aggregate on a monthly or quarterly basis.

192. In sum, our call tracking requirements will empower multiple stakeholders to monitor and ensure that location information is compliant with our E911 requirements, and will provide PSAPs and CMRS providers with an objective set of data that can help inform decision-making in the event of a service issue or dispute between the parties as to E911 compliance. In this regard, our call tracking requirement will serve to encourage transparency, accountability, and cooperation among stakeholders.

E. Outdoor Compliance Testing and Reporting

193. *Background.* In the *Third Further Notice,* we proposed that periodic testing would be necessary as providers upgrade their networks and migrate to handset-based technologies. We also sought comment on the

recommendations set forth in CSRIC WG3's *Outdoor Location Accuracy Report.* CSRIC WG3's central recommendation was that ''[a]lternative testing methods replace full compliance testing'' every 24 months, using a testing scheme that rested on certain ATIS Technical Reports. Subsequently, CSRIC IV WG1 found the ''location performance with VoLTE to be slightly better than or equivalent to 2G and 3G performance,'' and recommended that ''these expectations should be validated via the maintenance testing methodology, including representative testing or 'spot-checking,' '' as previously recommended by CSRIC WG3.

194. Public safety commenters support the periodic testing proposal and suggest that testing requirements should cover both indoor and outdoor location accuracy performance. For instance, APCO agrees with the recommendations in the CSRIC WG3 report and ''urg[ed] the Commission to adopt appropriate rules to implement those recommendations.''

195. CMRS providers oppose the Commission's proposal as costly and unnecessary. For example, RWA and CCA oppose periodic testing as burdensome on small rural CMRS providers. However, both RWA and CCA submit that periodic testing is appropriate in case of substantial network changes.

196. *Discussion.* We believe that conducting periodic testing continues to be appropriate to ensure compliance with outdoor location accuracy parameters. CMRS providers' efforts to measure for, and ensure continuing compliance with, the Commission's outdoor-based location accuracy requirements are critical to public safety, particularly as new networks and technologies are implemented. Further, we find that periodic testing will support the reporting of outdoor call data that is included in the Roadmap as part of the live call data. Because CMRS providers will blend all 911 call data, CMRS providers should incorporate an approach to test for compliance with the current outdoor-based location accuracy standards. For instance, CMRS providers may need to undertake drive testing in certain counties or PSAP service areas where they have migrated to VoLTE and that are outside the six test regions.

197. While we do not codify any particular approach, we find that the ongoing maintenance testing framework set forth in the CSRIC III WG3 and CSRIC IV WG1 recommendations provides a reasonable and adequate basis for ensuring continued compliance with our E911 location accuracy requirements. We urge CMRS providers to undertake periodic testing to ensure continued compliance accordingly. Moreover, such ongoing testing enables CMRS providers to implement testing protocols more efficiently and without the cost burdens associated with periodic testing pursuant to a mandatory, established timetable (*e.g.,* every two years). Consistent with CSRIC's recommendations, CMRS providers should conduct testing upon any significant technology changes or upgrades to their networks, including those changes accompanying the deployment of VoLTE networks. As CSRIC IV WG 1 emphasizes, ''the goal of maintenance testing is to identify a method that verifies continued optimal performance of E9–1–1 location systems at the local level.'' This recommended testing protocol includes several components, including: (1) Key Performance Indicators (KPIs) that ''are routinely monitored to help identify instances where system performance has degraded''; and (2) ''[s]pot-checking using empirical field-testing . . . on an as needed basis, for example, as determined by KPI monitoring or legitimate performance concerns from a PSAP.'' We find that this emphasis on KPI testing will provide CMRS providers with a testing approach that they can apply in a variety of circumstances. Moreover, this ongoing testing approach provides CMRS providers with the means to validate latency (TTFF) and C/U Data, as standardized in the rule changes we adopt today.

198. Finally, consistent with our views on KPI testing, we are revising the Commission's outdoor requirement for C/U data, which currently specifies that ''[o]nce a carrier has established baseline confidence and uncertainty levels in a county or PSAP service area . . . additional testing shall not be required.'' We remove the language excluding additional testing. Although CSRIC III WG3 stated that ''[u]ncertainty estimates, when taken on average over time, can indicate a *trend* that may reflect continued proper system operation or system problems,'' CSRIC III WG3 also noted the importance of C/U data for monitoring location accuracy as one part of a CMRS providers testing program for other KPIs. As discussed above, KPI testing should continue as part of CMRS providers' best practices, along with other recommended testing procedures, such as spot-testing.

F. Roaming Issues

199. The *Third Further Notice* sought comment on whether the provision of Phase II information continues to be a concern for consumers when they are roaming, or whether this concern has been addressed by the evolution of location technology. Specifically, we invited comment on whether the implementation of our indoor location proposals would create any challenges in the roaming context that the Commission should address. The few comments filed generally indicate that the migration to VoLTE networks should resolve the roaming issue because it is probable ''that all emergency calls (routing and location) will either be handled by the visited network or through a location roaming scenario.'' As TruePosition submits, ''it is entirely likely that complementary technologies will exist and operate side-by-side in a given city, town or county.''

200. After considering the views of the commenters, we refrain from taking action with respect to roaming at this time. We believe the better course is to monitor progress on the roaming issue as CMRS providers fully deploy VoLTE, and to examine any problems that may arise during this implementation process. We reserve the right to take action in the future, if necessary, to ensure that accurate location information is provided for wireless calls to 911 while roaming.

V. Procedural Matters

A. Accessible Formats

201. To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an email to *fcc504@fcc.gov* or call the Consumer & Governmental Affairs Bureau at 202–418–0530 (voice), 202–418–0432 (TTY).

B. Paperwork Reduction Analysis

202. This *Fourth Report and Order* contains proposed new information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and OMB to comment on the information collection requirements contained in this document, as required by Paperwork Reduction Act (PRA). In addition, pursuant to the Small Business Paperwork Relief Act of 2002, we seek specific comment on how we might ''further reduce the information collection burden for small business concerns with fewer than 25 employees.''

C. Congressional Review Act

203. The Commission will send a copy of this *Fourth Report and Order* in a report to be sent to Congress and the

Government Accountability Office pursuant to the Congressional Review Act (CRA), *see* 5 U.S.C. 801(a)(1)(A).

VI. Final Regulatory Flexibility Analysis

204. As required by the Regulatory Flexibility Act of 1980, as amended (RFA), an Initial Regulatory Flexibility Analysis (IRFA) was incorporated into the *Third Further Notice of Proposed Rulemaking* in this proceeding. The Commission sought written public comment on the proposals in the Notice, including comment on the IRFA. Any comments received are discussed below. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

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

205. In this *Fourth Report and Order,* the Commission adopts measures that will significantly enhance the ability of Public Safety Answering Points (PSAPs) to accurately identify the location of wireless 911 callers when the caller is located indoors, and strengthen existing E911 location accuracy rules to improve location determination for outdoor as well as indoor calls. These actions respond to major changes in the wireless landscape since the Commission first adopted its wireless Enhanced 911 (E911) location accuracy rules in 1996 and since the last significant revision of these rules in 2010. As consumers increasingly replace traditional landline telephony with wireless phones, a majority of wireless calls are now made indoors, increasing the likelihood that wireless 911 calls will come from indoor environments where traditional location accuracy technologies optimized for outdoor calling often do not work effectively or at all. A significant objective of this proceeding is to close the gap between the performance of 911 calls made from outdoors with similar calls made indoors.

206. The Commission adopts rules applicable to CMRS providers that reflect technical feasibility and are technologically neutral, so that providers can choose the most effective solutions from a range of options. Further, the rules allow sufficient time for development of applicable standards, establishment of testing mechanisms, and deployment of new location technology in both handsets and networks, on timeframes that account for the ability of PSAPs to process enhancements in the location data they receive. In determining the appropriate balance to strike between its requirements and timeframes, the Commission gave significant weight to the ''Roadmap for Improving E911 Location Accuracy'' (Roadmap) that was agreed to in November 2014 by the Association of Public Safety Communications Officials (APCO), the National Emergency Number Association (NENA), and the four national wireless CMRS providers, as well as the ''Parallel Path for Competitive Carriers' Improvement of E911 Location Accuracy Standards'' (''Parallel Path'') that was submitted by the Competitive Carriers Association (CCA). At the same time, in order to provide greater certainty and accountability in areas that the Amended Roadmap does not fully address, the rules incorporate ''backstop'' requirements derived from the Commission's original proposals in the *Third Further Notice.*

207. The rules the Commission adopts are designed to increase indoor location accuracy in a commercially reasonable manner by leveraging many aspects of the Amended Roadmap. They do not change, or seek to change, the commitment that the four nationwide CMRS providers voluntarily entered into and have already made progress towards. The Amended Roadmap is intended to build confidence in the technical solutions outlined therein, and it establishes clear milestones to gauge progress and ensure that if the signatory parties fail to deliver on their commitments, there is clear accountability for the integrity of location accuracy using metrics adopted at earlier stages in this proceeding. The rules the Commission adopts are in addition to, not a replacement of, its existing E911 location rules applicable to outdoor calls, which remain in effect, unless otherwise amended herein. In establishing these requirements, the Commission's objective is that all Americans using mobile phones—whether they are calling from urban or rural areas, from indoors or outdoors—have technology that is functionally capable of providing accurate location information so that they receive the support they need in times of emergency.

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

208. No comments were submitted specifically in response to the IRFA. Nevertheless, small and rural CMRS providers suggested that compliance with the rules (as proposed in both the *Third Further Notice* and the Roadmap) could be burdensome:

- Blooston believes ''that substantial investments in new E911 equipment that small rural carriers will be required to make in order to comply with the proposed new E911 requirements will soon become unrecoverable stranded investments when NG911 technology is deployed.''
- CCA is concerned that small and rural CMRS providers may not hold licenses for spectrum or otherwise operate in the single location defined implied in the Roadmap and will thus be forced to commit to individualized testing of a particular heightened location accuracy technology should it utilize any component of their network (such as an RF-based technology), possibly placing a substantial burden on these smaller CMRS providers.
- Several small and regional CMRS providers argue that it would also be appropriate either to exclude rural areas from indoor location accuracy requirements, or to phase-in any requirements.
- Regarding technology-specific costs, Rx Networks proposes establishment of a central and standardized service to process location requests. Such a clearinghouse solution would entail a base station almanac of Cell-IDs and Wi-Fi access point locations, and cost-effective provisioning of A–GNSS and barometric pressure data among CMRS providers, which could bridge technical gaps while minimizing capital outlays.
- Small and rural CMRS providers generally believe that live 911 call tracking and reporting will be overly burdensome for them.
- Regarding outdoor compliance and reporting, RWA and CCA oppose periodic testing as burdensome on small rural CMRS providers, but both agree that periodic testing is appropriate in case of substantial network changes.
- SouthernLINC Wireless believes that any delays in implementing any adopted rules by the nationwide carriers will necessarily create downstream delays for regional and rural carriers that are beyond the smaller carriers' control.

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

209. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules. The RFA generally defines the term ''small entity'' as having the same meaning as the terms ''small business,'' ''small organization,'' and ''small governmental jurisdiction.'' In addition, the term ''small business'' has the same meaning as the term ''small business concern'' under the Small Business Act. A small business

concern is one which: (1) Is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).

210. *Small Businesses, Small Organizations, and Small Governmental Jurisdictions.* Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards. First, nationwide, there are a total of approximately 27.9 million small businesses, according to the SBA. In addition, a ''small organization'' is generally ''any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.'' Nationwide, as of 2007, there were approximately 1,621,315 small organizations. Finally, the term ''small governmental jurisdiction'' is defined generally as ''governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.'' Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States. We estimate that, of this total, as many as 88,506 entities may qualify as ''small governmental jurisdictions.'' Thus, we estimate that most governmental jurisdictions are small.

1. Telecommunications Service Entities

a. Wireless Telecommunications Service Providers

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

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

213. *Wireless Telecommunications Carriers (except satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees. For this category, census data for 2007 show that there were 11,163 establishments that operated for the entire year. Of this total, 10,791 establishments had employment of 999 or fewer employees and 372 had employment of 1000 employees or more. Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small entities that may be affected by our proposed action.

214. *Incumbent Local Exchange Carriers (Incumbent LECs).* Neither the Commission nor the SBA has developed a small business size standard specifically for incumbent local exchange services. The appropriate size standard under SBA rules is for the category Wired Telecommunications Carriers. Under that size standard, such a business is small if it has 1,500 or fewer employees. Census Bureau data for 2007, which now supersede data from the 2002 Census, show that there were 3,188 firms in this category that operated for the entire year. Of this total, 3,144 had employment of 999 or fewer, and 44 firms had had employment of 1000 or more. According to Commission data, 1,307 carriers reported that they were incumbent local exchange service providers. Of these 1,307 carriers, an estimated 1,006 have 1,500 or fewer employees and 301 have more than 1,500 employees. Consequently, the Commission estimates that most providers of local exchange service are small entities that may be affected by the rules and policies proposed in the Notice. Thus under this category and the associated small business size standard, the majority of these incumbent local exchange service providers can be considered small.

215. *Competitive Local Exchange Carriers (Competitive LECs), Competitive Access Providers (CAPs), Shared-Tenant Service Providers, and Other Local Service Providers.* Neither the Commission nor the SBA has developed a small business size standard specifically for these service providers. The appropriate size standard under SBA rules is for the category Wired Telecommunications Carriers. Under that size standard, such a business is small if it has 1,500 or fewer employees. Census Bureau data for 2007, which now supersede data from the 2002 Census, show that there were 3,188 firms in this category that operated for the entire year. Of this total, 3,144 had employment of 999 or fewer, and 44 firms had had employment of 1,000 employees or more. Thus under this category and the associated small business size standard, the majority of these Competitive LECs, CAPs, Shared-Tenant Service Providers, and Other Local Service Providers can be considered small entities. According to Commission data, 1,442 carriers reported that they were engaged in the provision of either competitive local exchange services or competitive access provider services. Of these 1,442 carriers, an estimated 1,256 have 1,500 or fewer employees and 186 have more than 1,500 employees. In addition, 17 carriers have reported that they are Shared-Tenant Service Providers, and all 17 are estimated to have 1,500 or fewer employees. In addition, 72 carriers have reported that they are Other Local Service Providers. Of the 72, seventy have 1,500 or fewer employees and two have more than 1,500 employees. Consequently, the Commission estimates that most providers of competitive local exchange service, competitive access providers, Shared-Tenant Service Providers, and Other Local Service Providers are small entities that may be affected by rules adopted pursuant to the Notice.

216. *Broadband Personal Communications Service.* The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a ''small business'' for C- and F-Block licenses as an entity that has average gross revenues of $40 million or less in the three previous calendar years. For F-Block licenses, an additional small business size standard for ''very small business'' was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than $15 million for the preceding three calendar years. These small business size standards, in the context of

broadband PCS auctions, have been approved by the SBA. No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks. On April 15, 1999, the Commission completed the reauction of 347 C-, D-, E-, and F-Block licenses in Auction No. 22. Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

217. On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status. Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses. On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71. Of the 12 winning bidders in that auction, five claimed small business status and won 18 licenses. On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78. Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.

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

219. *AWS Services (1710–1755 MHz and 2110–2155 MHz bands (AWS–1); 1915–1920 MHz, 1995–2000 MHz, 2020–2025 MHz and 2175–2180 MHz bands (AWS–2); 2155–2175 MHz band (AWS–3)).* For the AWS–1 bands, the Commission defined a ''small business'' as an entity with average annual gross revenues for the preceding three years not exceeding $40 million, and a ''very small business'' as an entity with average annual gross revenues for the preceding three years not exceeding $15 million. In 2006, the Commission conducted its first auction of AWS–1 licenses. In that initial AWS–1 auction, 31 winning bidders identified themselves as very small businesses. Twenty-six of the winning bidders identified themselves as small businesses. In a subsequent 2008 auction, the Commission offered 35 AWS–1 licenses. Four winning bidders identified themselves as very small businesses, and three of the winning bidders identified themselves as a small business. For AWS–2 and AWS–3, although we do not know for certain which entities are likely to apply for these frequencies, we note that the AWS–1 bands are comparable to those used for cellular service and personal communications service. The Commission has adopted size standards for the AWS–2 or AWS–3 bands similar to broadband PCS service and AWS–1 service due to the comparable capital requirements and other factors, such as issues involved in relocating incumbents and developing markets, technologies, and services. In the AWS–3 auction, 70 applicants were found qualified to participate, and 46 of those have claimed themselves eligible for a designated entity bidding credit.

220. *Rural Radiotelephone Service.* The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service. A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (''BETRS''). In the present context, we will use the SBA's small business size standard applicable to Wireless Telecommunications Carriers (except Satellite), *i.e.,* an entity employing no more than 1,500 persons. There are approximately 1,000 licensees in the Rural Radiotelephone Service, and the Commission estimates that there are 1,000 or fewer small entity licensees in the Rural Radiotelephone Service that may be affected by the rules and policies adopted herein.

221. *Wireless Communications Services.* This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses in the 2305–2320 MHz and 2345–2360 MHz bands. The Commission defined ''small business'' for the wireless communications services (WCS) auction as an entity with average gross revenues of $40 million for each of the three preceding years, and a ''very small business'' as an entity with average gross revenues of $15 million for each of the three preceding years. The SBA has approved these definitions. The Commission auctioned geographic area licenses in the WCS service. In the auction, which commenced on April 15, 1997 and closed on April 25, 1997, there were seven bidders that won 31 licenses that qualified as very small business entities, and one bidder that won one license that qualified as a small business entity.

222. *700 MHz Guard Band Licenses.* In the *700 MHz Guard Band Order,* the Commission adopted size standards for ''small businesses'' and ''very small businesses'' for purposes of determining their eligibility for special provisions such as bidding credits and installment payments. A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding $40 million for the preceding three years. Additionally, a ''very small business'' is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than $15 million for the preceding three years. SBA approval of these definitions is not required. An auction of 52 Major Economic Area (MEA) licenses commenced on September 6, 2000, and closed on September 21, 2000. Of the 104 licenses auctioned, 96 licenses were sold to nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses commenced and closed in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.

223. *Upper 700 MHz Band Licenses.* In the *700 MHz Second Report and Order,* the Commission revised its rules regarding Upper 700 MHz licenses. On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12

Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block. The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed $15 million for the preceding three years) and winning five licenses.

224. *Lower 700 MHz Band Licenses.* The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. The Commission defined a ''small business'' as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding $40 million for the preceding three years. A ''very small business'' is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than $15 million for the preceding three years. Additionally, the lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (MSA/RSA) licenses—''entrepreneur''—which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than $3 million for the preceding three years. The SBA approved these small size standards. An auction of 740 licenses (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)) was conducted in 2002. Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business or entrepreneur status and won licenses. A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses. Seventeen winning bidders claimed small or very small business status, and nine winning bidders claimed entrepreneur status. In 2005, the Commission completed an auction of 5 licenses in the Lower 700 MHz band. All three winning bidders claimed small business status.

225. In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order.* An auction of A, B and E block 700 MHz licenses was held in 2008. Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed $15 million and do not exceed $40 million for the preceding three years). Thirty three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed $15 million for the preceding three years).

226. *Offshore Radiotelephone Service.* This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico. There are presently approximately 55 licensees in this service. We are unable to estimate at this time the number of licensees that would qualify as small under the SBA's small business size standard for the category of Wireless Telecommunications Carriers (except Satellite). Under that SBA small business size standard, a business is small if it has 1,500 or fewer employees. Census data for 2007, which supersede data contained in the 2002 Census, show that there were 1,383 firms that operated that year. Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

227. *Wireless Telephony.* Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite). Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees. According to *Trends in Telephone Service* data, 413 carriers reported that they were engaged in wireless telephony. Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees. Therefore, more than half of these entities can be considered small.

228. The second category, *i.e.,* ''All Other Telecommunications,'' comprises ''establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or Voice over Internet Protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.'' For this category, Census Bureau data for 2007 show that there were a total of 2,623 firms that operated for the entire year. Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by rules proposed in the *Third Further Notice.*

b. Equipment Manufacturers

229. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* The Census Bureau defines this category as follows: ''This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: Transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.'' The SBA has developed a small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing which is: All such firms having 750 or fewer employees. According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for part or all of the entire year. Of this total, 784 had less than 500 employees and 155 had more than 100 employees. Thus, under this size standard, the majority of firms can be considered small.

230. *Semiconductor and Related Device Manufacturing.* These establishments manufacture ''computer storage devices that allow the storage and retrieval of data from a phase change, magnetic, optical, or magnetic/optical media. The SBA has developed a small business size standard for this category of manufacturing; that size standard is 500 or fewer employees storage and retrieval of data from a phase change, magnetic, optical, or magnetic/optical media.'' According to data from the 2007 U.S. Census, in 2007, there were 954 establishments engaged in this business. Of these, 545 had from 1 to 19 employees; 219 had from 20 to 99 employees; and 190 had 100 or more employees. Based on this data, the Commission concludes that the majority of the businesses engaged in this industry are small.

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

231. In this *Fourth Report and Order,* we require nationwide CMRS providers

report to the Commission on their plans for implementing improved indoor location accuracy no later than 18 months from the date when the rules contained herein become effective. To address concerns raised by small and regional CMRS providers, non-nationwide CMRS providers will have an additional six months to submit their plans. These initial reports will include details as to the CMRS provider's implementation plan to meet our requirements in the three- and six-year timeframes, and these one-time reports will ensure that each CMRS provider (including small and/or rural) makes at least some progress toward improving indoor location accuracy in the near term. Furthermore, all CMRS providers must also report to the Commission on their progress toward implementation of their plans no later than 36 months from the Effective Date. We believe the global data provided through these reports may enable the Commission to identify efficiencies and facilitate coordination among providers, and may help ensure that CMRS providers do not invest too heavily in duplicative technologies or in technology and system design that proves unusable.

232. The rules we adopt today require that:

- All CMRS providers must provide (1) dispatchable location, or (2) x/y (horizontal) location within 50 meters, for the following percentages of wireless 911 calls within the following timeframes, measured from the Effective Date of rules adopted in this *Fourth Report and Order:*
  - ○ Within 2 years: 40 percent of all wireless 911 calls.
  - ○ Within 3 years: 50 percent of all wireless 911 calls.
  - ○ Within 5 years: 70 percent of all wireless 911 calls.
  - ○ Within 6 years: 80 percent of all wireless 911 calls.
- Non-nationwide CMRS providers (regional, small, and rural providers) can extend the five and six-year deadlines based on the timing of VoLTE deployment in the networks.

233. All CMRS providers must meet the following requirements for provision of vertical location information with wireless 911 calls:

- ○ Within 3 years, all CMRS providers must make uncompensated barometric data available to PSAPs from any handset that has the capability to deliver barometric sensor data.
- ○ Within 3 years, nationwide CMRS providers must use an independently administered and transparent test bed process to develop a proposed z-axis accuracy metric, and must submit the proposed metric to the Commission for approval.
- ○ Within 6 years, nationwide CMRS provides must deploy either (1) dispatchable location, or (2) z-axis technology that achieves the Commission-approved z-axis metric, in each of the top 25 CMAs:
  - ▪ The National Emergency Address Database (NEAD) must be populated with a total number of dispatchable location reference points in the CMA equal to 25 percent of the CMA population if dispatchable location is used.
  - ▪ CMRS providers must deploy z-axis technology to cover 80 percent of the CMA population if z-axis technology is used.
- ○ Within 8 years, nationwide CMRS providers must deploy dispatchable location or z-axis technology in accordance with the above benchmarks in each of the top 50 CMAs.
- ○ Non-nationwide carriers that serve any of the top 25 or 50 CMAs will have an additional year to meet the latter two benchmarks (*i.e.,* relating to years 6 and 8).

234. Quarterly reporting of live 911 data will begin no later than 18 months from the date the rules become effective; CMRS providers will also provide quarterly live call data on a more granular basis that allows evaluation of the performance of individual location technologies within different morphologies (*e.g.,* dense urban, urban, suburban, rural). Public Safety Answering Points (PSAPs) will be entitled to obtain live call data from CMRS providers and seek Commission enforcement of these requirements within their jurisdictions, but they may seek enforcement only so long as they have implemented policies that are designed to obtain all 911 location information made available by CMRS providers pursuant to our rules.

235. We adopt a 30-second limit on the time period allowed for a CMRS provider to generate a location fix in order for the 911 call to be counted towards compliance with existing Phase II location accuracy requirements that rely on outdoor testing, but we do not extend this provision to the new indoor-focused requirements adopted in this order. We require that confidence and uncertainty data for all wireless 911 calls—whether placed from indoors or outdoors—be delivered at the request of a PSAP, on a per-call basis, with a uniform confidence level of 90 percent.

236. We require CMRS providers to provide 911 call data, including (1) the percentage of wireless 911 calls to the PSAP that include Phase II location information, and (2) per-call identification of the positioning source method or methods used to derive location coordinates and/or dispatchable location, to any requesting PSAP. Compliance with the 30-second time limit will also be measured from this data.

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

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

238. We received comments from entities representing small and/or rural interests, suggesting that the rules would apply a unique burden on small and/or rural entities, and raising the possibility of exemptions or waivers for small or rural entities. In the *Fourth Report and Order,* we explicitly acknowledge that the costs imposed by the rules adopted herein ''may present a proportionately greater burden to smaller CMRS providers, including the costs associated with participation in the test bed.'' Nevertheless, we conclude that overriding public safety concerns require our rules to apply equally to all CMRS providers, regardless of location or size—911 location accuracy is paramount in all portions of the Nation, and all CMRS providers must be on an equal footing in their ability to provide correct 911 location accuracy.

239. To accommodate the unique circumstances facing small and rural carriers, the rules we adopt today include the following steps that we believe will minimize the impact on such carriers:

- While all CMRS providers (including small providers) must provide dispatchable location or x/y (horizontal) location within 50 meters for certain percentages of wireless 911 calls at Years 2, 3, 5, and 6 after the rules in this *Fourth Report and Order* become effective, non-nationwide CMRS providers (*i.e.,* regional, small, and rural carriers) can extend the five and six-year deadlines based on the

timing of Voice-over-LTE (VoLTE) deployment in their networks.

• Regarding vertical location accuracy, while all CMRS providers (including small providers) must make uncompensated barometric data available to PSAPs from any handset that has the capability to deliver barometric sensor data within 3 years of the rules in this *Fourth Report and Order* becoming effective, small carriers have an additional year beyond what nationwide carriers must comply with (*i.e.,* Year 6 requirements extend to Year 7; Year 8 requirements extend to Year 9).

• While nationwide CMRS providers must report to the Commission on their plans and progress towards implementing improved indoor location accuracy no later than 18 months of the date the rules in this *Fourth Report and Order* become effective, smaller CMRS providers have 24 months.

• While nationwide CMRS providers must aggregate live 911 call data on a quarterly basis and report that data to the Association of Public-Safety Communications Officials (APCO), National Emergency Number Association (NENA), and the National Association of State 911 Administrators (NASNA), small providers must do so on a biannual basis.

240. Regarding the overall scope of the indoor 911 location accuracy rules we adopt in this *Fourth Report and Order,* we note that in the *Third Further Notice,* we proposed to apply the horizontal indoor location accuracy requirements on a nationwide-basis, across all geographic areas. In response, several small and regional CMRS providers proposed that rural areas from indoor location accuracy requirements be excluded from the rules, either entirely or for a certain ''phase-in'' period. Absent any such exclusion, RWA believes the ability of small and rural CMRS providers to achieve compliance with the indoor horizontal location accuracy requirements in the proposed timeframe would be problematic. In response, we state that because the rules we adopt today relate to indoor 911 calls—and therefore are not hindered by naturally-formed physical characteristics—there is no need to adopt similar exclusions. We believe that the design of our indoor location accuracy requirements and the timeframe allotted for compliance adequately addresses commenters' concerns about being able to implement indoor location solutions throughout all morphologies within their coverage footprint. Moreover, applying these requirements uniformly nationwide is consistent with the principle that improving 911 location is just as important in the least populous markets as in the most populous.

241. We sought comment in the *Third Further Notice* on whether we should adopt a specific waiver process for CMRS providers who seek relief from our indoor location accuracy requirements. In particular, we sought comment on whether and what criteria would be appropriate for any E911-specific waiver process, as well as whether providers who believe they cannot comply with a particular indoor location accuracy benchmark, despite good faith efforts, may certify this six months prior to the applicable benchmark. In response, RWA suggests the Commission adopt a safe harbor for waiver applicants based on a showing of technical infeasibility or financial difficulty, while NTCA notes that the expense of a waiver can impose a substantial financial burden for small rural carriers, and the regulatory uncertainty can be disruptive to business planning and operations. We ultimately determined not to adopt a specific waiver standard applicable only to the indoor location accuracy requirements we adopt today, noting that '[a]ny CMRS provider that is unable to meet the deadlines adopted herein may seek waiver relief. The Commission may grant relief pursuant to the waiver standards set forth in Sections 1.3 and 1.925 of its rules, and we believe these provisions are sufficient to address any requests for relief of the indoor location accuracy requirements . . .''

F. Report to Congress

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

VII. Ordering Clauses

243. *It is further ordered,* pursuant to Sections 1, 2, 4(i), 7, 10, 201, 214, 222, 251(e), 301, 302, 303, 303(b), 303(r), 307, 307(a), 309, 309(j)(3), 316, 316(a), and 332, of the Communications Act of 1934, 47 U.S.C. 151, 152(a), 154(i), 157, 160, 201, 214, 222, 251(e), 301, 302, 303, 303(b), 303(r), 307, 307(a), 309, 309(j)(3), 316, 316(a), 332; the Wireless Communications and Public Safety Act of 1999, Public Law 106–81, 47 U.S.C. 615 note, 615, 615a, 615b; and Section 106 of the Twenty-First Century Communications and Video Accessibility Act of 2010, Public Law 111–260, 47 U.S.C. 615c, that this *Fourth Report and Order* is hereby *adopted.*

244. *It is further ordered* that part 20 of the Commission's rules, 47 CFR part 20, *is amended* as specified in this order, effective April 3, 2015, except that those amendments which contain new or modified information collection requirements that require approval by the Office of Management and Budget under the Paperwork Reduction Act *will become effective* after the Commission publishes a notice in the **Federal Register** announcing such approval and the relevant effective date.

245. *It is further ordered* that the Final Regulatory Flexibility Analysis in Appendix C hereto *is adopted.*

246. *It is further ordered* that, pursuant to Section 801(a)(1)(A) of the Congressional Review Act, 5 U.S.C. 801(a)(1)(A), the Commission *shall send* a copy of this Report and Order to Congress and to the Government Accountability Office.

247. *It is further ordered* that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, *shall send* a copy of this *Fourth Report and Order,* including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

List of Subjects in 47 CFR Part 20

Communications common carriers, Communications equipment, Radio.

Federal Communications Commission.

Marlene H. Dortch,

Secretary.

Final Rules

For the reasons discussed in the preamble, the Federal Communications Commission amends 47 CFR part 20 as follows:

PART 20—COMMERCIAL MOBILE RADIO SERVICES

■ 1. The authority for part 20 is revised to read as follows:

Authority: 47 U.S.C. 151, 152(a), 154(i), 157, 160, 201, 214, 222, 251(e), 301, 302, 303, 303(b), 303(r), 307, 307(a), 309, 309(j)(3), 316, 316(a), 332, 615, 615a, 615b, 615c.

■ 2. Section 20.18 is amended by revising paragraph (h)(3) and re-designating paragraphs (i) through (n) as paragraphs (l) through (q), and adding new paragraphs (i) through (k), and revising newly redesignated paragraph (m)(1) to read as follows:

§ 20.18 911 Service.

* * * * *

(h) * * *

(3) *Latency (Time to First Fix).* For purposes of measuring compliance with the location accuracy standards of this paragraph, a call will be deemed to satisfy the standard only if it provides the specified degree of location accuracy within a maximum latency period of 30 seconds, as measured from the time the user initiates the 911 call to the time the location fix appears at the location information center: Provided, however, that the CMRS provider may elect not to include for purposes of measuring compliance therewith any calls lasting less than 30 seconds.

(i) *Indoor location accuracy for 911 and testing requirements*—(1) *Definitions:* The terms as used in this section have the following meaning:

(i) *Dispatchable location:* A location delivered to the PSAP by the CMRS provider with a 911 call that consists of the street address of the calling party, plus additional information such as suite, apartment or similar information necessary to adequately identify the location of the calling party. The street address of the calling party must be validated and, to the extent possible, corroborated against other location information prior to delivery of dispatchable location information by the CMRS provider to the PSAP.

(ii) *Media Access Control (MAC) Address.* A location identifier of a Wi-Fi access point.

(iii) *National Emergency Address Database (NEAD).* A database that utilizes MAC address information to identify a dispatchable location for nearby wireless devices within the CMRS provider's coverage footprint.

(iv) *Nationwide CMRS provider:* A CMRS provider whose service extends to a majority of the population and land area of the United States.

(v) *Non-nationwide CMRS provider:* Any CMRS provider other than a nationwide CMRS provider.

(vi) *Test Cities.* The six cities (San Francisco, Chicago, Atlanta, Denver/Front Range, Philadelphia, and Manhattan Borough) and surrounding geographic areas that correspond to the six geographic regions specified by the February 7, 2014 ATIS Document, ''Considerations in Selecting Indoor Test Regions,'' for testing of indoor location technologies.

(2) *Indoor location accuracy standards:* CMRS providers subject to this section shall meet the following requirements:

(i) *Horizontal location.* (A) Nationwide CMRS providers shall provide; dispatchable location, or ; x/y location within 50 meters, for the following percentages of wireless 911 calls within the following timeframes, measured from the effective date of the adoption of this rule:

(1) Within 2 years: 40 percent of all wireless 911 calls.

(2) Within 3 years: 50 percent of all wireless 911 calls.

(3) Within 5 years: 70 percent of all wireless 911 calls.

(4) Within 6 years: 80 percent of all wireless 911 calls.

(B) Non-nationwide CMRS providers shall provide; dispatchable location or; x/y location within 50 meters, for the following percentages of wireless 911 calls within the following timeframes, measured from the effective date of the adoption of this rule:

(1) Within 2 years: 40 percent of all wireless 911 calls.

(2) Within 3 years: 50 percent of all wireless 911 calls.

(3) Within 5 years or within six months of deploying a commercially-operating VoLTE platform in their network, whichever is later: 70 percent of all wireless 911 calls.

(4) Within 6 years or within one year of deploying a commercially-operating VoLTE platform in their network, whichever is later: 80 percent of all wireless 911 calls.

(ii) *Vertical location.* CMRS providers shall provide vertical location information with wireless 911 calls as described in this section within the following timeframes measured from the effective date of the adoption of this rule:

(A) *Within 3 years:* All CMRS providers shall make uncompensated barometric data available to PSAPs with respect to any 911 call placed from any handset that has the capability to deliver barometric sensor information.

(B) *Within 3 years:* Nationwide CMRS providers shall develop one or more z-axis accuracy metrics validated by an independently administered and transparent test bed process as described in paragraph (i)(3)(i) of this section, and shall submit the proposed metric or metrics, supported by a report of the results of such development and testing, to the Commission for approval.

(C) Within 6 years: In each of the top 25 CMAs, nationwide CMRS providers shall deploy either;) dispatchable location, or ; z-axis technology in compliance with any z-axis accuracy metric that has been approved by the Commission,

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

(2) In each CMA where z-axis technology is used: nationwide CMRS providers must deploy z-axis technology to cover 80 percent of the CMA population.

(D) Within 8 years: In each of the top 50 CMAs, nationwide CMRS providers shall deploy either

(1) Dispatchable location or;

(2) Such z-axis technology in compliance with any z-axis accuracy metric that has been approved by the Commission.

(E) Non-nationwide CMRS providers that serve any of the top 25 or 50 CMAs will have an additional year to meet each of the benchmarks in paragraphs (i)(2)(ii)(C) and (D) of this section.

(iii) *Compliance.* Within 60 days after each benchmark date specified in paragraphs (i)(2)(i) and (ii) of this section, CMRS providers must certify that they are in compliance with the location accuracy requirements applicable to them as of that date. CMRS providers shall be presumed to be in compliance by certifying that they have complied with the test bed and live call data provisions described in paragraph (i)(3) of this section.

(A) All CMRS providers must certify that the indoor location technology (or technologies) used in their networks are deployed consistently with the manner in which they have been tested in the test bed. A CMRS provider must update certification whenever it introduces a new technology into its network or otherwise modifies its network, such that previous performance in the test bed would no longer be consistent with the technology's modified deployment.

(B) CMRS providers that provide quarterly reports of live call data in one or more of the six test cities specified in paragraph (i)(1)(vi) of this section must certify that their deployment of location technologies throughout their coverage area is consistent with their deployment of the same technologies in the areas that are used for live call data reporting.

(C) Non-nationwide CMRS providers that do not provide service or report quarterly live call data in any of the six test cities specified in paragraph (i)(1)(vi) of this section must certify that they have verified based on their own live call data that they are in compliance with the requirements of paragraphs (i)(2)(i)(B) and (ii) of this section.

(iv) *Enforcement.* PSAPs may seek Commission enforcement within their geographic service area of the requirements of paragraphs (i)(2)(i) and (ii) of this section, but only so long as they have implemented policies that are

designed to obtain all location information made available by CMRS providers when initiating and delivering 911 calls to the PSAP. Prior to seeking Commission enforcement, a PSAP must provide the CMRS provider with [30] days written notice, and the CMRS provider shall have an opportunity to address the issue informally. If the issue has not been addressed to the PSAP's satisfaction within 90 days, the PSAP may seek enforcement relief.

(3) *Indoor location accuracy testing and live call data reporting*—(i) *Indoor location accuracy test bed.* CMRS providers must establish the test bed described in this section within 12 months of the effective date of this rule. CMRS providers must validate technologies intended for indoor location, including dispatchable location technologies and technologies that deliver horizontal and/or vertical coordinates, through an independently administered and transparent test bed process, in order for such technologies to be presumed to comply with the location accuracy requirements of this paragraph. The test bed shall meet the following minimal requirements in order for the test results to be considered valid for compliance purposes:

(A) Include testing in representative indoor environments, including dense urban, urban, suburban and rural morphologies;

(B) Test for performance attributes including location accuracy (ground truth as measured in the test bed), latency (Time to First Fix), and reliability (yield); and

(C) Each test call (or equivalent) shall be independent from prior calls and accuracy will be based on the first location delivered after the call is initiated.

(D) In complying with paragraph (i)(3)(i)(B) of this section, CMRS providers shall measure yield separately for each individual indoor location morphology (dense urban, urban, suburban, and rural) in the test bed, and based upon the specific type of location technology that the provider intends to deploy in real-world areas represented by that particular morphology. CMRS providers must base the yield percentage based on the number of test calls that deliver a location in compliance with any applicable indoor location accuracy requirements, compared to the total number of calls that successfully connect to the testing network. CMRS providers may exclude test calls that are dropped or otherwise disconnected in 10 seconds or less from calculation of the yield percentage (both the denominator and numerator).

(ii) *Collection and reporting of aggregate live 911 call location data.* CMRS providers providing service in any of the Test Cities or portions thereof must collect and report aggregate data on the location technologies used for live 911 calls in those areas.

(A) CMRS providers subject to this section shall identify and collect information regarding the location technology or technologies used for each 911 call in the reporting area during the calling period.

(B) CMRS providers subject to this section shall report Test City call location data on a quarterly basis to the Commission, the National Emergency Number Association, the Association of Public Safety Communications Officials, and the National Association of State 911 Administrators, with the first report due 18 months from the effective date of rules adopted in this proceeding.

(C) CMRS providers subject to this section shall also provide quarterly live call data on a more granular basis that allows evaluation of the performance of individual location technologies within different morphologies (*e.g.,* dense urban, urban, suburban, rural). To the extent available, live call data for all CMRS providers shall delineate based on a per technology basis accumulated and so identified for:

(1) Each of the ATIS ESIF morphologies;

(2) On a reasonable community level basis; or

(3) By census block. This more granular data will be used for evaluation and not for compliance purposes.

(D) Non-nationwide CMRS providers that operate in a single Test City need only report live 911 call data from that city or portion thereof that they cover. Non-nationwide CMRS providers that operate in more than one Test City must report live 911 call data only in half of the regions (as selected by the provider). In the event a non-nationwide CMRS provider begins coverage in a Test City it previously did not serve, it must update its certification pursuant to paragraph (i)(2)(iii)(C) of this section to reflect this change in its network and begin reporting data from the appropriate areas. All non-nationwide CMRS providers must report their Test City live call data every 6 months, beginning 18 months from the effective date of rules adopted in this proceeding.

(E) Non-nationwide CMRS providers that do not provide coverage in any of the Test Cities can satisfy the requirement of paragraph (i)(3)(ii) of this section by collecting and reporting data based on the largest county within its footprint. In addition, where a non-nationwide CMRS provider serves more than one of the ATIS ESIF morphologies, it must include a sufficient number of representative counties to cover each morphology.

(iii) *Data retention.* CMRS providers shall retain testing and live call data gathered pursuant to this section for a period of 2 years.

(4) *Submission of plans and reports.* The following reporting and certification obligations apply to all CMRS providers subject to this section, which may be filed electronically in PS Docket No. 07–114:

(i) *Initial implementation plan.* No later than 18 months from the effective date of the adoption of this rule, nationwide CMRS providers shall report to the Commission on their plans for meeting the indoor location accuracy requirements of paragraph (i)(2) of this section. Non-nationwide CMRS providers will have an additional 6 months to submit their implementation plans.

(ii) *Progress reports.* No later than 18 months from the effective date of the adoption of this rule, each CMRS provider shall file a progress report on implementation of indoor location accuracy requirements. Non-nationwide CMRS providers will have an additional 6 months to submit their progress reports. All CMRS providers shall provide an additional progress report no later than 36 months from the effective date of the adoption of this rule. The 36-month reports shall indicate what progress the provider has made consistent with its implementation plan, and the nationwide CMRS providers shall include an assessment of their deployment of dispatchable location solutions. For any CMRS provider participating in the development of the NEAD database, this progress report must include detail as to the implementation of the NEAD database described in paragraphs (i)(4)(iii) and (iv) of this section.

(iii) *NEAD privacy and security plan.* Prior to activation of the NEAD but no later than 18 months from the effective date of the adoption of this rule, the nationwide CMRS providers shall file with the Commission and request approval for a security and privacy plan for the administration and operation of the NEAD. The plan must include the identity of an administrator for the NEAD, who will serve as a point of contact for the Commission and shall be accountable for the effectiveness of the security, privacy, and resiliency measures.

(iv) *NEAD use certification.* Prior to use of the NEAD or any information contained therein to meet such requirements, CMRS providers must

certify that they will not use the NEAD or associated data for any non-911 purpose, except as otherwise required by law.

(j) *Confidence and uncertainty data.* (1) Except as provided in paragraphs (j)(2)–(3) of this section, CMRS providers subject to this section shall provide for all wireless 911 calls, whether from outdoor or indoor locations, x- and y-axis (latitude, longitude) confidence and uncertainty information (C/U data) on a per-call basis upon the request of a PSAP. The data shall specify

(i) The caller's location with a uniform confidence level of 90 percent, and;

(ii) The radius in meters from the reported position at that same confidence level. All entities responsible for transporting confidence and uncertainty between CMRS providers and PSAPs, including LECs, CLECs, owners of E911 networks, and emergency service providers, must enable the transmission of confidence and uncertainty data provided by CMRS providers to the requesting PSAP.

(2) Upon meeting the 3-year timeframe pursuant to paragraph (i)(2)(i) of this section, CMRS providers shall provide with wireless 911 calls that have a dispatchable location the C/U data for the x- and y-axis (latitude, longitude) required under paragraph (j)(1) of this section.

(3) Upon meeting the 6-year timeframe pursuant to paragraph (i)(2)(i) of this section, CMRS providers shall provide with wireless 911 calls that have a dispatchable location the C/U data for the x- and y-axis (latitude, longitude) required under paragraph (j)(1) of this section.

(k) *Provision of live 911 call data for PSAPs.* Notwithstanding other 911 call data collection and reporting requirements in paragraph (i) of this section, CMRS providers must record information on all live 911 calls, including, but not limited to, the positioning source method used to provide a location fix associated with the call. CMRS providers must also record the confidence and uncertainty data that they provide pursuant to paragraphs (j)(1) through (3) of this section. This information must be made available to PSAPs upon request, and shall be retained for a period of two years.

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(m) *Conditions for enhanced 911 services*—(1) *Generally.* The requirements set forth in paragraphs (d) through (h)(2) and in paragraph (j) of this section shall be applicable only to the extent that the administrator of the applicable designated PSAP has requested the services required under those paragraphs and such PSAP is capable of receiving and utilizing the requested data elements and has a mechanism for recovering the PSAP's costs associated with them.

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