

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Martin Alles et al.
U.S. Patent No.: 7,561,104 Attorney Docket No.: 50095-0137IP1
Issue Date: July 14, 2009
Appl. Serial No.: 12/026,333
Filing Date: February 5, 2008

Title: METHOD TO MODIFY CALIBRATION DATA USED TO
LOCATE A MOBILE UNIT

SUPPLEMENTAL DECLARATION OF KARTHIK SUNDARESAN

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Dated: 11/15/2024

By: 

Karthikeyan Sundaresan, Ph.D.

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I, Karthikeyan Sundaresan of Atlanta, GA, declare that:

I. INTRODUCTION

1. I have been retained on behalf of Apple Inc. (“Apple”), as an independent expert consultant in this *inter partes* review (“IPR”) proceeding before the Patent Trial and Appeal Board (“PTAB”) of the United States Patent and Trademark Office (“USPTO”). I understand that the proceeding number of this IPR proceeding is IPR2024-00255.

2. I have been asked by Apple’s counsel (“Counsel”) to consider whether certain references describe or make obvious features recited in claim 2 of U.S. Patent No. 7,561,104 (“the ’104 patent”) (APPLE-1001). My opinions and the bases for my opinions are set forth below. My opinions are based on my education, my knowledge and experience in the relevant fields of technology, and my review of the materials considered in preparing this document.

3. I previously submitted a declaration in this proceeding that I signed on October 1, 2023 (“Declaration”). I understand that the Declaration was marked as APPLE-1003. The Declaration contained my opinions and the bases for them. Since submitting the Declaration, I have considered the Declaration of Mr. Mark Alan Sturza (“Sturza Declaration”) (EX-2018), and U.S. Prov. Appl. No. 60/899,379 (“the ’379 Provisional”) (EX-2029), which is cited in the Sturza Declaration. My opinions from my previous Declaration have not changed.

II. BACKGROUND AND QUALIFICATIONS

4. My background and qualifications are set forth in the Declaration. I incorporate that section in this declaration (“Supplemental Declaration”) by reference.

III. INFORMATION CONSIDERED

5. In preparing this Supplemental Declaration, I have considered documentary materials referenced in the table below. In addition, my opinions are further based on my education, training, experience, and knowledge in the relevant fields.

Document Identifier	Description
APPLE-1001	U.S. Patent No. 7,561,104 to Alles et al. (“the ’104 patent”)
APPLE-1002	Excerpts from the Prosecution History of the ’104 Patent (“the Prosecution History”)
APPLE-1004	Complaint, <i>Geoscope Technologies PTE. LTD. v. Apple Inc.</i> , 1-22-cv-01373 (E.D. Va.), Dec. 1, 2022
APPLE-1005	U.S. Pat. App. Pub. No. 2006/0211376 (“Bhattacharya”)
APPLE-1006	Qing-An Zeng & Dharma P. Agrawal, “Chapter 1 - Handoff in Wireless Mobile Networks,” “Handbook of Wireless

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	Networks and Mobile Computing,” John Wiley & Sons, Inc., 2002, 1-25 (“Zeng”)
APPLE-1007	U.S. Pat. App. Pub. No. 2006/0240843 (“Spain”)
APPLE-1008	U.S. Pat. No. 6,799,047 (“Bahl”)
APPLE-1009	U.S. Patent No. 7,783,299 (“Anderson”)
APPLE-1010	Special Mobile Group (SMG) Technical Committee (TC), European Telecommunications Standards Institute, <i>GSM Technical Specification - Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification (GSM 04.08)</i> (Dec. 1995)
APPLE-1011	U.S. Patent No. 6,560,442 (“Yost”)
APPLE-1012	Nico Deblauwe, “GSM-based Positioning: Techniques and Applications, 2008, IBSN: 9789054874942 (“Deblauwe”)
APPLE-1054	Opinion & Order, <i>Geoscope Technologies PTE. LTD. v Apple Inc.</i> , 1:22-cv-01373, (E.D. VA. Jul. 19, 2023)
EX-2018	Declaration of Mr. Mark Alan Sturza
EX-2029	U.S. Prov. Appl. No. 60/899,379 (“the ’379 Provisional”)

IV. LEVEL OF ORDINARY SKILL IN THE ART

6. I set forth a definition of a person of ordinary skill in the art (“POSITA”) in the Declaration, and I incorporate that definition here by reference. I understand that Geoscope and Mr. Sturza disagree with the definition provided in the Declaration, and I address these points in Section VIII.A below.

V. RELEVANT LEGAL STANDARDS

7. I set forth the relevant legal standards in the Declaration, and I incorporate those legal standards here by reference.

VI. SUMMARY OF OPINIONS

8. I have been asked to consider whether the claims of the ’104 patent are anticipated or obvious over certain prior art references. As explained in the Declaration, and in further detail in this Supplemental Declaration, it is my opinion that:

- Claims 1, 3, 4, and 6-11 of the ’104 patent are made obvious by
Bhattacharya and Zeng
- Claims 1-4, and 6-11 of the ’104 patent are made obvious by
Bhattacharya, Zeng, and Spain

VII. OVERVIEW OF THE '104 PATENT

A. Priority Date

9. As explained in the Declaration, for purposes of my analysis, I apply 2/5/2007 (“Critical Date”) as the earliest purported priority date of the '104 patent. All of the prior art relied on in the Declaration were published and/or filed before the Critical Date.

B. Specification

10. I summarized the '104 patent specification in the Declaration, and I incorporate that summary here by reference.

C. Claims

11. I summarized the '104 patent claims in the Declaration, and I incorporate that summary here by reference.

D. Prosecution History

12. I summarized the '104 patent claims in the Declaration, and I incorporate that summary here by reference.

E. '379 Provisional

13. The '104 patent specification references U.S. Provisional Application No. 60/899,379 (“the '379 Provisional”). The '379 Provisional was filed on 2/5/2007, which is the Critical Date applied in the Declaration and in this Supplemental Declaration.

14. I understand that the Sturza Declaration cites to the '379 Provisional to support an interpretation of the “non-uniform grid points” feature recited in claim 2. I address these statements in Section VIII.B.

15. Based on my review of the '379 Provisional, I note that the text of the '379 Provisional is not identical to the text of the '104 patent specification. Based on this review, I also note that the '379 Provisional includes descriptions that are not present in the '104 patent specification. For example, the '379 Provisional describes “[a] method for generating Non-Uniform Grid Points (NUGs) from calibration data.” EX-2029, 5; *see id.*, 5-8. Additionally, the '379 Provisional includes the following description:

The NUGs fully cover the region R and each NUG has statistically similar data accumulated into itself. The geometrical shape and the amount of data accumulated into such NUGs is seen to be variable since these are determined by the statistical similarity of the data allocated to a NUG.

EX-2029, 7. These descriptions from the '379 Provisional are not included in the '104 patent specification. Based on my review of the '104 patent specification, there is no reference to “statistical similarity,” or the use of this term in descriptions relating to generating NUGs for a given region. The '104 patent specification also does not use the term “geometric shape” or any requirement for

an NUG to have variable geometric shapes. Instead, I note that the general description of an NUG in the '104 patent specification is the following:

In general, a non-uniform grid point (NUG) may represent the signal characteristics and/or calibration data over a given region.

As illustrated in FIG. 1, a set of NUGs (NUG1, NUG2 and NUG3) are shown as being a part of a larger geographical region (R), which includes various wireless networking components (e.g., (MS 11 and BS 20 NUG1), (MSs 12-15 NUG2) and (MSs 16-18 and BS 30 NUG3)). The NUGs represent an area of collected calibration data, which may be stored in a database for easy retrieval during a calibration data comparison operation between the NUG and a received network measurement report (NMR).

APPLE-1001, 3:50-60 (emphasis added); *see also id.*, 3:61-4:6 (describing that NUGs may be “separately defined by a variety of parameters, such as “geographical areas (e.g., mountains, buildings, roads)” and “varying concentrations of MSs”).

VIII. PRIOR ART ANALYSIS

16. The Declaration analyzed how prior art combinations involving Bhattacharya, Meunier, and Spain described the features recited in claims 1-4 and 6-11. I incorporate that analysis here by reference. In this Supplemental Declaration, I further address statements from Mr. Sturza relating to the prior art discussed in the Declaration.

A. Level of Ordinary Skill in the Art

17. As explained in the Declaration, a person of ordinary skill in the art (“POSITA”) would have “at least a Bachelor’s degree in electrical engineering, computer science, or a similar discipline, and at least two years of experience in the field working with working with navigation and/or geolocation systems.”

APPLE-1003, ¶8. I agreed with this POSITA definition when preparing the Declaration, and I continue to hold the opinion that the POSITA definition is both correct and appropriate based on the disclosures of the ’104 patent and the prior art analyzed in the Declaration.

18. My agreement to the POSITA definition in the Declaration is based on at least my knowledge and experience in the field of navigation and/or geolocation systems, and in the field of wireless technology. If I did not agree with the POSITA definition, then it would not have been included in paragraph 8 of the Declaration. Based on my understanding of relevant legal principles, the POSITA definition therefore provides the appropriate perspective of a POSITA regarding the prior art analyses in the Declaration. *See* APPLE-1003, ¶¶9-18 (Legal Principles). As I discuss below, the POSITA definition is also consistent with my review of the ’104 patent and its file history. I also have a good understanding of the capabilities of a POSITA because I have taught, mentored, advised, and

collaborated closely with many such individuals over the course of my career. *Id.*, ¶8.

1. The POSITA Definition Is Correct and Appropriate

19. As explained below, the POSITA definition in the Declaration is correct and appropriate for various reasons. I also address statements from Mr. Sturza regarding the level of ordinary skill in the art for the '104 patent below.

20. Based on my knowledge and experience in the relevant field, a Bachelor's degree in electrical engineering, computer science, or a related field would provide foundational knowledge in signal processing, wireless communications, and potentially geo-location principles. This level of education implies a baseline understanding of signal behavior and basic calibration techniques. The specified two years of practical experience indicates that a POSITA would have hands-on familiarity with navigation and geo-location technologies. This experience would include understanding signal strength measurements, location determination methods, and basic calibration practices used in outdoor environments.

21. The field of navigation and/or geolocation systems would have encompassed knowledge of radio frequency and cellular technologies. Navigation and geolocation systems rely on understanding and utilizing signal propagation, which is fundamental to both radio frequency (RF) and cellular technologies.

Accurate location determination involves analyzing signal strength, timing, and frequency characteristics, all of which are core aspects of RF and cellular engineering. As a result, professionals in navigation and geo-location systems would be expected to have knowledge and/or experience in these technologies to effectively develop and implement positioning solutions across diverse environments.

22. Based on my review of the '104 patent specification, knowledge of “radio frequency and cellular technologies” was within the skill level of the POSITA definition in the Declaration. The '104 patent specification confirms that these technologies were well-known. The '104 patent specification states that “[t]he use of wireless communication devices such as telephones, pagers, personal digital assistants, laptop computers, etc., hereinafter referred to collectively as ‘mobile appliances’ or ‘mobiles stations’ has become prevalent in today's society.” APPLE-1001, 1:19-26. The '104 patent specification also identifies examples of cellular standards, such as “TDMA, GSM, 3GPP.” *See id.*, 4:27-40. Notably, the '104 patent does not delve into issues specific to cellular technologies, such as network infrastructure, cellular signal propagation, or cellular communication protocols. Instead, the '104 patent specification is generally focused on broader challenges associated with signal attenuation in indoor settings and its impact on

geo-location, without attributing these challenges to cellular technology-specific problems.

23. A professional working with geo-location systems around the Critical Date would have been familiar with cellular and wireless protocols because these technologies were important to the functionality of location-based services. By that time, cellular networks, such as GSM and CDMA, had been widely deployed, and protocols like GPS, Wi-Fi, and Bluetooth were commonly used in geo-location to determine or assist in finding a mobile station's position. Additionally, geo-location methods frequently relied on signal strength, timing, and other characteristics from cellular and wireless sources to improve accuracy, especially as location-based services expanded rapidly with mobile device adoption.

24. My review of Bhattacharya and Spain further confirms that knowledge of “radio frequency and cellular technologies” was also within the skill level of the POSITA definition in the Declaration. Bhattacharya describes that its “invention relates to **telecommunications in general**, and, more particularly, to a technique for estimating the location of a wireless terminal.” APPLE-1005, [0001] (emphasis added). Spain includes similar language in describing its disclosed invention. See APPLE-1007, [0001]. Bhattacharya also addresses a “wireless telecommunications system” that “provides wireless telecommunications service to wireless terminals,” which was well-known as of its filing date. APPLE-1005,

[0002]; *see also id.*, FIG. 1, [0002]-[0012]. Spain also describes a “[w]ireless telecommunications system 100 provides wireless telecommunications service to all of geographic region 120, in well-known fashion.” APPLE-1007, [0002].

25. Based on my review of Bhattacharya and Spain, the disclosures of these references helps establish a level of ordinary skill relevant to understanding the ’104 patent. As noted above, both references involve the use of wireless telecommunications systems to estimate the location of mobile or wireless terminals. Bhattacharya specifically addresses techniques for geo-locating wireless terminals within a telecommunications network, which involves knowledge of signal strength, propagation, and attenuation—core concepts relevant to, for example, modifying calibration data for indoor geo-location (as referenced in the ’104 patent). Spain also discusses the deployment of wireless telecommunications systems across geographic regions, which reflects familiarity with wireless infrastructure and the challenges of accurate location determination across different environments.

26. The declaration of Mr. Sturza (“Sturza Declaration”) also confirms that general knowledge of RF and cellular technologies within geo-location systems was within the level of ordinary skill associated with the POSITA definition. Specifically, the Sturza Declaration notes that “[a]t the time of the invention, geolocation using RF signals (e.g., **cellular data**, as opposed to, for

example, GPS information) **was of interest in the field**.” EX-2018, ¶54. Around the Critical Date, RF-based geo-location, including cellular signal-based positioning, was recognized as a promising approach for indoor and urban environments where GPS signals were often unreliable due to signal obstruction. Based on my knowledge and experience in the field, professionals would have been familiar with RF and cellular technologies as tools for achieving more accurate location determination in challenging environments. Familiarity with RF and cellular concepts would thus be expected, as these technologies were important to advancements in geo-location systems, especially in providing alternative solutions to GPS limitations.

2. *Mr. Sturza’s Alternative POSITA Definition*

27. The Sturza Declaration identified an alternative POSITA definition than the definition proposed in my original Declaration. This alternative POSITA definition is below:

A POSITA would have been (1) someone knowledgeable in wireless networks, cellular radio systems, mobile communication devices and radio navigation systems, (2) having at least a bachelor’s degree in electrical engineering, with a background in radio frequency communications and/or navigation system technology as well as approximately two years of industry experience working on radio communication and/or navigation systems.

EX-2018, ¶46.

28. As explained above, I agree with the POSITA definition in the Declaration. In my opinion, and based on my review of the documents analyzed in the Declaration, the original POSITA definition is a sufficient representation of the level of ordinary skill for an individual in order to perform the prior art analysis provided in the Declaration. In preparing this Supplemental Declaration, I have also considered the alternative POSITA definition proposed in the Sturza Declaration in relation to the prior art analysis provided in the Declaration.

29. Based on my review of the materials cited in the Declaration, the alternative POSITA definition proposed in the Sturza Declaration is also a sufficient representation of the level of ordinary skill for an individual in order to perform the prior art analysis provided in the Declaration. To be clear, I agree with the prior art analysis in the Declaration regardless of whether the original POSITA definition or the alternative POSITA definition are used to reflect the level of ordinary skill in the art. As I have explained above, geo-location systems were known around the Critical Date to use cellular and wireless protocols because these technologies were important to the functionality of location-based services. Based on this understanding, either POSITA definition would be relevant to the prior art analysis in the Declaration.

30. Specifically, the analysis of Bhattacharya and Spain in the Declaration is relevant to each of the fields of “wireless networks, cellular radio systems,

mobile communication devices and radio navigation systems” that are referenced in the alternative POSITA definition. EX-2018, ¶46. Additionally, an individual having a Bachelor’s degree in electrical engineering” and a background in “radio frequency communications and/or navigation system technology as well as approximately two years of industry experience working on radio communication and/or navigation systems” would have similarly been capable of assessing the disclosures of Bhattacharya and Spain (alone or in combined) in relation to the claims of the ’104 patent.

31. As previously discussed, Bhattacharya and Spain each disclose that their respective inventions relate to “telecommunications in general.” APPLE-1005, [0001]; APPLE-1007, [0001]. The disclosures of Bhattacharya and Spain each also reference cellular protocols and geolocation systems. See APPLE-1005, [0052], [0056], [0095], [0129], [0130], [0138], [0164]; APPLE-1007, [0007], [0042]. Based on my review of Bhattacharya and Spain, the disclosures of each reference focus on location estimation within a telecommunications infrastructure, which is encompassed by “wireless networks, cellular radio systems, mobile communication devices and radio navigation systems,” as referenced in the alternative POSITA definition. Bhattacharya and Spain addresses these fields by integrating signal measurement, location databases, GPS assistance, and cellular radio components, which support mobile communications and navigation across

wireless and cellular networks. The Bhattacharya and Spain systems also adapt signal-based location techniques traditionally used in one or more of these fields to improve accuracy and reliability in estimating device locations across diverse physical and radio environments.

B. “Non-Uniform Grid Points”

32. As explained in the Declaration, certain terms recited in the claims of the ’104 patent were construed in a counterpart district court proceeding. APPLE-1003, ¶¶26-29. Based on my review of the ’104 patent specification, the file history, and the court’s claim construction order, I agree with the constructions issued by the court. I also agree with the analysis of “non-uniform grid points” in the Declaration.

33. In this Supplemental Declaration, I address interpretations of “non-uniform grid points” that were introduced in this proceeding after the Declaration. The first interpretation is by a three-judge panel of the PTAB (“Panel”). Counsel has explained to me that the Panel interpreted “non-uniform grid points” to mean “grid points that are non-uniformly spaced throughout a geographic region.” An alternative interpretation is one that provided in the Sturza Declaration, which states that a “non-uniform grid point” is “a point associated with representative calibration data for an area whose boundaries are determined from evaluation of the calibration data.” EX-2018, ¶¶82-85. I have reviewed each interpretation in

relation to the '104 patent specification and its file history (including the '379 Provisional).

34. Based on my knowledge and experience in the relevant fields, and my review of the '104 patent specification and its file history (including the '379 Provisional), I agree with the interpretation of “non-uniform grid points” as “grid points that are non-uniformly spaced throughout a geographic region” is consistent with the claim language. The term “non-uniform grid points” refers to a type of “grid point.” The adjective “non-uniform” modifies the term “grid point,” which, as explained in the Declaration, was by construed to mean “a point associated with representative calibration data for an area.” APPLE-1003, ¶27 (citing APPLE-1054). Based on this construction, an individual “grid point” represents “a point...for an area.” The phrase “non-uniform grid points” reflects a type of arrangement of multiple grid points within a corresponding area, and specifically, a *non-uniform* arrangement. Based on the claim language, a POSITA would have understood “non-uniform grid points” to represent “grid points that are non-uniformly spaced throughout a geographic region.” This description is consistent with the '104 patent and the '379 Provisional (discussed below). See Section VIII.B.1.

35. The interpretation of “non-uniform grid points” meaning “grid points that are non-uniformly spaced throughout a geographic region” is also supported

by usage of the term within the '104 patent specification. The interpretation is also consistent with various examples of “non-uniform grid points” (NUGs) described in the '104 patent specification. The interpretation is also consistent with the analysis of Bhattacharya and Spain in the Declaration in relation to claim 2. That is, the analysis of the Bhattacharya-Spain combination in relation to claim 2 satisfies the interpretation of “non-uniform grid points” as meaning “grid points that are non-uniformly spaced throughout a geographic region.” This analysis is discussed in more detail in Section VIII.D.

36. Additionally, I disagree with the alternative interpretation of provided in the Sturza Declaration that a “non-uniform grid point” is “a point associated with representative calibration data for an area whose boundaries are determined from evaluation of the calibration data.” EX-2018, ¶¶82-85. As explained in Section VIII.B.2 below, this alternative interpretation overlooks descriptions in the '104 patent specification that would have better informed a POSITA's understanding of the scope of “non-uniform grid points” within claim 2.

1. Interpretation of “Non-Uniform Grid Points”

37. Counsel has explained to me that the Panel interpreted “non-uniform grid points” to mean “grid points that are non-uniformly spaced throughout a geographic region.” Based on my knowledge and experience in the relevant fields, this interpretation is consistent with the '104 patent specification.

38. The interpretation of “non-uniform grid points” meaning “grid points that are non-uniformly spaced throughout a geographic region” is consistent with the descriptions in the ’104 patent specification. For example, the ’104 patent specification describes that different NUGs “may be separately defined by a **variety of parameters**.” APPLE-1001, 3:61-4:6 (emphasis added); APPLE-1003, ¶¶69-70. The “parameters” are described in reference to two examples that represent a “factor in deciding the boundaries of a NUG.” APPLE-1001, 3:61-4:6. One factor is “geographical areas (e.g., mountains, buildings, roads)...” *Id.* Another factor is “varying concentrations of [mobile stations (MSs)].” *Id.*

39. A set of NUGs with boundaries defined by a factor representing “geographical areas (e.g., mountains, buildings, roads)” is an example of grid points that are non-uniformly spaced throughout a geographic region. APPLE-1001, 3:61-4:6. This is because geographic areas have irregular boundaries, as opposed to a regular grid system where grid points are uniformly spaced throughout a region. Geographic attributes (which may be natural or man-made) may also have unique shapes and spatial limitations. A set of NUGs with boundaries that are determined based on geographical areas can therefore be generated such that the boundaries are naturally spaced according to the terrain’s contours and obstructions (rather than a uniform pattern). This leads to non-uniform spacing of individual NUGs throughout a region.

40. Additionally, a set of NUGs with boundaries defined by a factor representing “varying concentrations of [mobile stations (MSs)]” is also an example of grid points that are non-uniformly spaced throughout a geographic region. APPLE-1001, 3:61-4:6. This is because concentrations of mobile stations often vary within a region depending on the types of areas included (or encompassed) within the region. For example, in high-density areas (e.g., urban centers), mobile stations may be closer together, so it makes sense to have a greater number of base stations to capture more precise location data. In contrast, in low-density areas (e.g., suburban areas), fewer mobile stations may be present (and further spaced out from each other). In low-density areas, it makes sense to have grid points that are spaced farther apart because fewer devices are present. If a region includes different types of areas (e.g., a region that includes an urban center and a suburban area), then variability in mobile station concentrations within the region leads to irregular, or non-uniform, spacing of grid points across the region.

41. Based on my knowledge and experience in the field, and my review of the '104 patent specification, a POSITA would have recognized that the '104 patent specification (e.g., 3:61-4:6) contemplates multiple distinct types of NUGs, and at least some of these types have boundaries that may be determined without necessarily evaluating calibration data (e.g., network measurement data associated with a geographic location). As discussed above, two examples of factors that may

be used to identify boundaries of NUGs include “geographical areas” and “varying concentrations of [mobile stations (MSs)].” APPLE-1001, 3:61-4:6. These examples suggest that the boundaries of NUGs do not necessarily depend on calibration data collected from mobile stations, and can instead be determined based on information that is unrelated to network measurement data.

42. For example, a grid point may have boundaries that are determined based on static characteristics of a physical environment, such as the presence of a mountain or a building within a region. Boundary determination in this example would not require evaluation of network measurement data because mountains and buildings are examples of fixed geographic attributes (i.e., they do not change over certain periods of time).

43. As another example, a grid point may have boundaries that are determined based on a distribution of mobile stations within a region. Boundary determination in this example similarly would not require evaluation of network measurement data because such information can be identified through other well-known techniques. One example of such a technique of identifying device distributions within a region includes use of call detail records (CDRs) provided by telecommunications providers for billing and service optimization. Another example involves adapting traffic flow and mobility models (typically used for

urban planning) to approximate general population distribution and predict mobile traffic in certain areas.

44. Additionally, a POSITA would have recognized that the '104 patent specification does not suggest that calibration data (or its evaluation) is required for determining the boundaries for every type of NUG. Use of calibration data is presented as an available option to enhance accuracy in specific scenarios. For NUGs with boundaries that are determined based on static geographical attributes (e.g., mountains), calibration data is unnecessary because these boundaries do not change frequently.

45. Additionally, a POSITA would have understood that the '104 patent teaches NUGs with boundaries that may be determined based on static factors, dynamic factors, or both. Regardless of whether static factors or dynamic factors are used for boundary determination, there are still examples of NUGs for which boundaries may be determined without evaluating calibration data. For example, as discussed above, an NUG with boundaries that are determined based on static geographic attributes is an example of boundary determination based on a static factor without requiring evaluation of calibration data. As another example, an NUG with boundaries that are determined based on varying mobile station concentration is an example of boundary determination based on a dynamic factor that also does not require evaluation of calibration data. Calibration data may be

useful for boundary determination based on dynamic factors, but it not required for defining or maintaining all types of NUG boundaries, making its evaluation optional.

46. The '104 patent specification also describes that “[i]n general, a non-uniform grid point (NUG) may represent the signal characteristics and/or calibration data over a given region.” APPLE-1001, 3:61-4:6. Based on this description, the '104 patent specification contemplates at least two examples of NUGs. The first example is NUGs that that represent “signal characteristics.” A second example is NUGs that represent “calibration data.”

47. Each of the two examples of NUGs described in 3:50-60 are examples of grid points that are non-uniformly spaced throughout a geographic region. This is because “signal characteristics” and “calibration data” reflects unique, spatially variable factors that may not be uniformly spaced across a geographic region. NUGs representing “signal characteristics” and “calibration data” are each non-uniformly spaced as they each respond to location-specific requirements, reflecting the heterogeneous nature of geographic regions and their varying signal conditions. For example, NUGs representing “signal characteristics” may be non-uniformly spaced because signal strength varies with factors like distance from signal sources, obstructions (buildings, terrain), and interference. These factors cause grid points to be placed closer together in areas with high signal variability or

attenuation, and farther apart in more consistent areas, creating a non-uniform pattern. As another example, NUGs representing “calibration data” may be non-uniformly spaced because calibration is tailored to specific conditions at different locations. High-density calibration points may also be placed in areas with complex signal environments (like urban centers) to improve accuracy, while fewer points are needed in simpler environments, leading to a pattern that is likewise irregular across the region. Thus, whether a particular NUG represents “signal characteristics” or “calibration data,” that particular NUG may also represent grid points that are non-uniformly spaced throughout a geographic region.

2. *Mr. Sturza’s Alternative Interpretation of “Non-Uniform Grid Points”*

48. The Sturza Declaration states that “the claim term ‘non-uniform grid point’ should be construed as ‘a point associated with representative calibration data for an area whose boundaries are determined from evaluation of the calibration data.’” EX-2018. ¶82. I disagree with this statement for the reasons discussed below.

49. The alternative interpretation of “non-uniform grid points” limits a ***one or more non-uniform grid points*** feature recited in claim 2 of the ’104 patent to NUGs “whose boundaries are determined from evaluation of the calibration

data.” This limiting interpretation is not supported by at least the descriptions of the ’104 patent that I identified in Section VIII.B.1. As described in 3:61-4:6 of the ’104 patent specification, an example of an NUG is one with boundaries defined by the factor of “geographical areas (e.g., mountains, buildings, roads)...” APPLE-1001, 3:61-4:6. In this example, boundary determination of the NUG does not specifically require evaluation of calibration data because the boundaries may be determined based on, for example, natural divisions that shape grid boundaries independently of any calibration data gathered from signal measurements. Similarly, another example of an NUG is one with boundaries defined by the factor of “varying concentrations of [mobile stations (MSs)].” *Id.* In this example, boundary determination of the NUG similarly does not specifically require evaluation of calibration data because the boundaries may be determined based on, for example, the distribution of mobile stations within a region (which can be determined without using calibration data, such as by using CDRs or adapting traffic flow and mobility models).

50. Additionally, 3:50-60 the ’104 patent specification describes that “a non-uniform grid point (NUG) may represent the signal characteristics and/or calibration data **over a given region.**” APPLE-1001, 3:50-60 (emphasis added). From this description, a POSITA would have recognized that the specification contemplates NUGs are generated to represent information, e.g., “signal

characteristics,” “calibration data,” over a geographic region. This description does not indicate that calibration data is required to be evaluated in generating NUGs.

51. I also disagree with statements in the Sturza Declaration’s opinions regarding the ’379 Provisional. See EX-2018, ¶¶62-69, 94-106. In paragraph 67 of the Sturza Declaration, Mr. Sturza states that “a **fundamental characteristic** of a claimed grid point is that the geographical boundaries of the area it represents must be determined by evaluating the calibration data collected in a region.” EX-2018, ¶67 (emphasis added). In paragraph 85, he also states “the intrinsic record makes clear that a **fundamental aspect** of the claimed non-uniform grid points is that they represent a particular area, within a broader region, that is determined by evaluating calibration data that has been previously gathered in that region and grouping similar clusters of calibration together.” *Id.*, ¶85 (emphasis added). In paragraph 92, he then states “how the claimed grid points are generated is **fundamental** to what they are.” *Id.*, ¶92 (emphasis added); see also *id.*, ¶104. To support these characterizations, the Sturza Declaration cites to the ’379 Provisional and the ’753 Patent. See EX-2016 (’753 patent), Abstract, 2:43-50, 9:34-39, 10:39-11:6, 12:7-14.

52. As I explained in Section VII.E, the text of the ’379 Provisional is not identical to the text of the ’104 patent specification. The ’379 Provisional also includes descriptions that are not present in the ’104 patent specification. For

example, the '379 Provisional describes “[a] method for generating Non-Uniform Grid Points (NUGs) from calibration data.” EX-2029, 5; *see id.*, 5-8. The '379 Provisional also references the phrases “statistical similarity” and “geometric shape.” *Id.* However, based on my review of the '104 patent specification, there is no reference to “statistical similarity,” or the use of this term in descriptions relating to generating boundaries of NUGs for a region. Because the descriptions relating to “statistical similarity” from the '379 Provisional are not present in the '104 patent specification, I disagree with the statement in the Sturza Declaration that “a **fundamental characteristic** of a claimed grid point is that the geographical boundaries of the area it represents **must be** determined by evaluating the calibration data collected in a region.” EX-2018, ¶67 (emphasis added). If this characterization were true, then the '104 patent specification would not have described various examples of different types of NUGs, some of which have boundaries that are not necessarily determined based on evaluation of calibration data. *See* §VIII.B.1 (discussing examples of NUGs in at least 3:50-60 and 3:61-4:6 of the '104 patent specification).

53. Additionally, the '379 Provisional includes descriptions that contradict statements in at least paragraphs 62-69 and 80-101 of the Sturza Declaration regarding the alternative interpretation of “non-uniform grid points.” For example, in one paragraph (following the portion of the '379 Provisional cited

in paragraph 94 of the Sturza Declaration), the '379 Provision indicates that the inventors “consider the method of generating NUGs **based not on statistical consistency but on other conditions**...” EX-2029, 8 (emphasis added). This descriptions suggests that determination of NUG boundaries based on “statistical consistency” is one of multiple examples described in the '379 Provisional.

54. The '379 Provisional also describes that “the method of using statistical consistency or similarity or data clustering” can be “**combined with** any of these other conditions.” EX-2029, 8 (emphasis added). Use of the phrase “combined with” confirms that “statistical consistency or similarity or data clustering” is not the exclusive or exhaustive method of determining the boundaries of an NUG. If statistical consistency, similarity, or data clustering were the only methods for determining the boundaries of an NUG, combining them with other boundary determination techniques based on “other conditions” would be redundant.

C. Combination of Bhattacharya and Zeng

1. Motivation to Combine

55. I identified reasons for combining Bhattacharya and Zeng in the Declaration, and I incorporate that analysis here by reference. APPLE-1003, ¶¶66-76.

56. As explained in the Declaration, the combination of Bhattacharya and Zeng is a combination of known elements (the Bhattacharya system) and known methods (Zeng's handoff functionality). The Bhattacharya system includes a mobile switching center, which would have been known to perform handoff operations based on suggestions in at least [0054] and [0095] of Bhattacharya. Based on these suggestions, it would have been predictable to configure Bhattacharya's mobile switching center to perform handoff operations using the known methods described in Zeng. This configuration would have improved the Bhattacharya system by improving location estimation near boundary conditions. This improvement was also predictable because a POSITA would have recognized the challenges associated with location estimation near boundary conditions.

57. I understand that the Sturza Declaration includes statements regarding the Bhattacharya-Zeng combination and reasons for why, according to Mr. Sturza, a POSITA would have been motivated to combine the teachings of the references in the manner discussed in the Declaration. EX-2018, ¶¶110-27. I disagree with various statements in the Sturza Declaration, as discussed below.

58. I disagree with the statement in paragraph 127 of the Sturza Declaration that "handoff functionality in cellular networks is specified by complex standards that must be closely followed." EX-2018, ¶127. In my opinion, compliance with the requirements of cellular standards represents an

implementation detail in designing any geolocation system that used such cellular standards for geolocation (e.g., the Bhattacharya system). By the Critical Date, cellular standards already provided POSITAs with clear guidelines and specifications that allowed geolocation systems to leverage cellular networks for obtaining necessary data for estimating mobile station locations. Compliance with these specifications would have been considered by a POSITA to be straightforward because it ensured interoperability and reliable functionality within existing cellular infrastructures without requiring novel system design. The fundamental principles and protocols for cellular communications and handoffs were also well-documented and widely understood. Standardized protocols provided detailed specifications for network interactions, enabling straightforward integration and configuration without requiring inventing of new methods. Additionally, commercially available hardware and software tools supported these standards, enabling a POSITA to readily apply routine engineering practices to build and configure a compliant geolocation system efficiently.

59. I also disagree generally with Mr. Sturza's testimony in paragraphs 119-25 of the Sturza Declaration. For example, in paragraph 118, Mr. Sturza states that "[signal strength measurement reports (SSMRs)] and handoff functionality are cellular technology concepts that **have nothing to do with** 'navigation and/or geolocation systems.'" Ex-2018, ¶118 (emphasis added). I disagree with this

statement because paragraph [0095] of Bhattacharya discusses the reception of SSMRs by wireless switching center 211 as part of “a mobile-assisted handoff process” in the context of the location estimation. This description demonstrates that SSMRs are relevant to geolocation because they provide crucial data about a mobile station’s position relative to surrounding base stations, allowing the system to assess proximity and signal conditions. These are factors in estimating the device’s location. Integration of SSMRs within the handoff process also supports geolocation capabilities by enabling continuous location tracking and adjustment, thus undermining any claim that SSMRs are irrelevant to geolocation systems.

60. As another example, I disagree with the statement in paragraph 119 of the Sturza Declaration that Bhattacharya is “concerned with obtaining signal-strength measurements from two or more nearby wireless telecommunications systems to help estimate the location of the wireless terminal.” EX-2018, ¶119. However, in paragraph [0054], Bhattacharya describes that its teachings in this paragraph are focused on “**alternative embodiments** of the present invention that use two or more systems to obtain signal-strength measurements.” APPLE-1005, [0054] (emphasis added). A POSITA would have recognized that “alternative embodiments” contemplates non-alternative embodiments that use, for example, a single system to obtain signal-strength measurements.

61. Additionally, Bhattacharya’s description in paragraph [0095] confirms Mr. Sturza’s characterization of Bhattacharya in paragraph 119 is too narrow. In paragraph [0095], Bhattacharya discloses a configuration where “wireless terminal 201 provides a temporal series...of Signal-Strength Measurement Reports to wireless switching center 211, in well-known fashion, as part of the GSM protocol and the mobile-assisted hand-off process.” APPLE-1005, [0095]. Nothing in this paragraph indicates that handoff functionality is specifically limited to embodiments involving “obtaining signal-strength measurements from two or more nearby wireless telecommunications systems.” EX-2018, ¶119.

62. I also disagree with statements in paragraph 122 of the Sturza Declaration that “the Zeng reference does not discuss adjacent cellular systems” and that “[Zeng] discusses handoff between base stations that appear to be in the same network or system.” EX-2018, ¶122. Zeng recognizes that “[h]andoffs are broadly classified into two categories—hard and soft handoffs[,]” and “hard handoff can be further divided into two different types—**intra- and intercell handoffs**.” APPLE-1006, 1 (emphasis added). This disclosure contemplates different handoff scenarios. Some of these scenarios occur within a single system (e.g., an “intracell” handoff, or a handover within one sector or between different sectors of the same cell). Other scenarios may occur between different systems

(e.g., a “intercell” handoff, or a handoff when a terminal moves into an adjacent cell and all of the terminal's connections must be transferred to a new base station).

63. The statements in paragraph 122 of the Sturza Declaration are also incorrect because an inter-cell handover can occur between multiple cellular systems, which would have been understood by a POSITA to be an inter-RAT (Radio Access Technology) inter-cell handover or inter-system handover. This type of handover allows a device to move from a cell in one network technology (e.g., LTE) to a cell in a different network technology (e.g., 5G or 3G), often managed by different radio systems.

64. I also disagree with the statement in paragraph 125 of the Sturza Declaration that “nothing in Zeng or Bhattacharya explains why Zeng’s handoff process would be relevant to Bhattacharya’s location estimation.” EX-2018, ¶125. This statement overlooks Bhattacharya’s description in [0095], which describes use of a mobile-assisted handoff process by wireless switching center 211 and that this may be accomplished “in a well-known fashion.” *Id.*, [0095]. This description indicates that Bhattacharya contemplates handoff functionality as part of its system. Additionally, Zeng describes that “[t]here are **numerous methods for performing handoff**, at least as many as the kinds of state information that have been defined for MSs, as well as the kinds of network entities that maintain the state information.” APPLE-1006, 4. One of these types is a “mobile-assisted

handoff process,” where a mobile station “makes measurements and the network makes the decision.” *Id.* Taken together, paragraph [0095] of Bhattacharya indicates that its wireless switching center 211 can perform handoff functionality through a mobile-assisted handoff process, which is one of the techniques described in Zeng as performing handoff initiation.

2. *Reasonable Expectation of Success*

65. I explained that the combination of Bhattacharya and Zeng would have involved routine knowledge within the skill level of a POSITA in the Declaration, and I incorporate that analysis here by reference. APPLE-1003, 76.

66. As noted in the previous section, the combination of the teachings of Bhattacharya and Zeng would have involved only routine knowledge because Bhattacharya already suggests handoff functionality as being incorporated into its disclosed system. APPLE-1005, [0054], [0095]. Bhattacharya even describes that use of a mobile-assisted handoff process by wireless switching center 211 may be accomplished “in a well-known fashion.” *Id.*, [0095]. Zeng further indicates that the type of handoff functionality involved in the Bhattacharya-Zeng combination was well-known. Zeng recognizes that “numerous methods for performing handoff” were known by its filing date, including “at least as many kinds of state information that have been defined for [mobile stations (MSs)]....” APPLE-1006, 4. As explained in the Declaration, “[a] POSITA would have understood and found

obvious that handoff functionality was available in Bhattacharya's wireless switching center 211." APPLE-1003, ¶76.

67. I disagree with the statement in paragraph 110 of the Sturza Declaration that the POSITA definition in paragraph 8 of the Declaration "does not necessarily have the requisite level of skill to combine the asserted references." EX-2018, ¶110. This statement is contradicted by the '104 patent and Bhattacharya. The systems described in both are examples of a geolocation system that use "cellular technologies or telecommunications" to estimate the location of a mobile device. See Section VIII.A above (addressing the level of skill). Examples of cellular technologies referenced in each of '104 patent and Bhattacharya were also well-known by the Critical Date, as explained above.

68. I also disagree with a statement in paragraph 115 of the Sturza Declaration that "[a] POSITA with a background in navigation and geolocation may not be familiar with the mobile-assisted hand-off process of the GSM protocol and if that were the case would not understand how to perform specific handoff operations." EX-2018, ¶115. Use of hand-off processes by a geolocation system was conventional by the Critical Date. This is confirmed by Bhattacharya's disclosure, which, in paragraph [0095], would have taught a POSITA that wireless switching center 211 may be configured to use the "GSM protocol and the mobile-assisted hand-off process" to receive "Signal-Strength Measurement Reports "in a

well-known fashion.” APPLE-1005, [0095] (emphasis added). Bhattacharya’s reference to “IS-41 protocol” in paragraph [0054] also confirms that its system supports handoff functionality. Together, the disclosures in paragraphs [0054] and [0095] of Bhattacharya indicate that its system would have been capable of managing mobile device handoffs between cellular base stations, which was important for maintaining continuity in communication as devices moved across different coverage areas. Handoff capability is also important to enabling accurate, real-time geolocation since it allowed location tracking of mobile stations across network boundaries. A POSITA would have understood that handoff functionality was an important and well-established feature for reliable geolocation by the Bhattacharya system. Handoff functionality would have ensured positional accuracy as devices transitioned between network zones.

69. I disagree with the statement in paragraph 126 of the Sturza Declaration that “a person with experience in navigation and geolocation does not have knowledge of cellular technologies or how handoffs function in cellular technologies.” EX-2018, ¶126. This statement assumes a POSITA would not have had knowledge about aspects of conventional cellular technology and known to be used in the types of geolocation systems claimed in the ’104 patent. As explained in the previous section, the disclosures of ’104 patent and Bhattacharya each

confirm that use of cellular technology for location estimation of mobile stations using geolocation was well-known by the Critical Date.

70. As explained above, I also disagree with the statement in paragraph 127 of the Sturza Declaration that “handoff functionality in cellular networks is specified by complex standards that must be closely followed.” EX-2018, ¶127. The Sturza Declaration does not identify implementation challenges regarding the use of handoff functionality of the GSM protocol that is expressly contemplated in paragraph [0095] of Bhattacharya. APPLE-1005, [0095].

D. Application of The Bhattacharya-Zeng-Spain Combination to Claim 2

71. As previously noted in the Declaration, Spain teaches locations within a region may “have different shapes and sizes, and represent different areas” of the region. APPLE-1003, ¶142. Partitioning of a region within Spain that provides these different shapes and sizes renders the *one or more non-uniform grid points* feature recited in claim 2 obvious because such partitioning provides locations that are non-uniformly spaced throughout a geographic region. *See id.*, ¶¶139-43. For example, by partitioning a geographic region into areas of varying shapes and sizes, the locations within the partition provide non-uniform spacing.

72. Additionally, Spain’s partitioning techniques is consistent with examples of techniques for determining boundaries of NUGs within the ’104

patent specification. Spain teaches that boundaries of partitioned regions can be based on various factors, including “natural and man-made physical attributes of [a] geographic region,” “legal laws governing [the] geographic region,” and “data regarding the location and movement of individuals...and vehicles in [the] geographic region...” APPLE-1007, [0086]. Similarly, the ’104 patent specification teaches that “a factor in deciding the boundaries of a NUG” include “geographical areas (e.g., mountains, buildings, roads).” APPLE-1001, 3:61-4:6. A POSITA would have recognized that Spain and the ’104 patent specification teach the same exemplary technique of determining a boundary of a partitioned region using geographic attributes of a region.

73. The Sturza Declaration also does not address paragraph 139 of the Declaration, which notes that the ’104 patent specification describes that the term “uniform grid points” can “represent the signal characteristics and/or calibration data over a given region” APPLE-1003, ¶139 (citing APPLE-1001, 3:50-60). Instead, the Sturza Declaration focuses on three distinctions that are premised upon the alternative interpretation of NUGs that is discussed above in Section VIII.B.2. See EX-2018, ¶128-38. These paragraphs do not provide any analysis or explanation on Spain’s disclosure in relation to the interpretation of “non-uniform grid points” meaning “grid points that are non-uniformly spaced throughout a geographic region.”