UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE, Inc.,

Petitioner

v.

QUALCOMM INCORPORATED,

Patent Owner

Case IPR2018-01250

U.S. Patent No. 8,447,132

DECLARATION OF JOHN VILLASENOR

A. Qualifications

1. My name is John Villasenor. I am a professor at UCLA. I have been retained by Qualcomm Inc. to provide opinions in the *inter partes* review proceedings IPR2018-01250 (the '1250 proceeding) and IPR2018-01251 (the '1251 proceeding) challenging U.S. Patent No. 8,447,132 (the '132 Patent).

2. My work focuses on innovative, high-performance communications, networking, media processing, and computing technologies and their broader implications. Since well before the respective priority dates of the '132 Patent, I have performed research in areas including image processing, machine learning, and delivering content to mobile devices. For example, at UCLA I created and have on many occasions taught courses in image processing that address, among other topics, techniques used in object detection and dynamic range correction. I have also performed research in image processing, and published many papers on various aspects of image processing. I have also done research in machine learning, with substantial experience developing algorithms that adapt in response to changing characteristics in the environment as reflected, for example, through data measured through sensors. In addition, I have performed research in relation to mobile devices since the 1990s. This research included multiple aspects of mobile devices, including wireless communications, sensing information (such as orientation) on mobile devices, and methods for delivering content to mobile

devices, including considerations such as the selection of type of content for transmission to the mobile device. In addition, well prior to the claimed priority date of the '132 Patent, I was engaged in writing graphics applications to run on Silicon Graphics workstations.

3. I have also performed work on mapping complex computational processes into pipelined hardware implementations, subject to constraints on factors including speed, chip area, power consumption, memory access, and the precision of the computations.

4. I received my B.S. in Electrical Engineering from the University of Virginia in 1985, and M.S. and Ph.D. in Electrical Engineering from Stanford University in 1986 and 1989, respectively.

5. While at Stanford, I concentrated my research on digital signal processing and communications.

6. Between 1990 and 1992, I worked for the Jet Propulsion Laboratory in Pasadena, CA, where I helped to develop techniques for imaging and mapping the earth from space. Since 1992, I have been on the faculty of the Electrical Engineering Department of the University of California, Los Angeles (UCLA). Between 1992 and 1996, I was an Assistant Professor; between 1996 and 1998, an Associate Professor; and since 1998, I have been a full Professor.

7. For several years starting in the late 1990s, I served as the Vice Chair of the Electrical Engineering Department at UCLA. I also hold an appointment in the Department of Public Policy within the UCLA School of Public Affairs. In addition, I teach in the UCLA Anderson School of Management.

8. Since joining the UCLA faculty in 1992, my research has addressed software, algorithms, hardware, networking, protocols, and other aspects of systems and devices that acquire, store, process, transmit, and display information.

9. I am an inventor on approximately 20 issued and pending U.S. patents in areas including signal processing, data compression, communications, and cybersecurity. I have published over 150 articles in peer-reviewed journals and academic conference proceedings.

10. In addition to my work at UCLA, I am a nonresident senior fellow at the Brookings Institution in Washington, D.C. Through Brookings I have examined a wide range of topics at the technology/policy intersection including cybersecurity, wireless mobile devices and systems, intellectual property, financial inclusion for "unbanked" populations, digital media policy, "drones," critical infrastructure security, driverless cars, and digital currencies and emerging payment methods. I have published articles and commentary related to technology policy in venues including Billboard, the Brookings Institution, the Chronicle of Higher Education,

Fast Company, Forbes, the Huffington Post, the Los Angeles Times, Scientific American, Slate, and the Washington Post.

11. I also have substantial experience in early-stage technology venture capital, including in the years preceding and at approximately the same time frame as the priority date for the ’132 Patent. In that work I frequently engaged with, including performing technical due diligence on, companies working in the technical areas addressed by the ’132 Patent.

12. My attached curriculum vita (Ex. 2002) details my over expertise and experience in the field of computer graphics and image processing.

B. Materials reviewed

13. I have reviewed each Petition submitted in each proceeding, as well the Patent Owner Preliminary Response submitted in the ‘1251 proceeding.

14. I have reviewed the ‘132 Patent that is included as Exhibit 1001 in each of the ‘1250 and ‘1251 proceedings, and the prosecution history for the ‘132 Patent that is included as Exhibit 1002 in each of the ‘1250 and ‘1251 proceedings.

15. I have reviewed each declaration of Dr. Bovik, which is Ex. 1003 in the ‘1250 proceeding and Ex. 1017 in the ‘1251 proceeding.

16. I have reviewed each Institution Decision entered by the Panel in each of the ‘1250 and ‘1251 proceedings.

17. I have reviewed the transcript of Dr. Bovik's deposition conducted as part of the '1250 and '1251 proceedings.

18. A complete listing of the documents I reviewed is as follows:

Proceeding	Pr/ Ex	Title
1250 Proceeding	2	Petition
1250 Proceeding	6	Institution Decision
1250 Proceeding	1001	U.S. Pat. No. 8,447,132
1250 Proceeding	1002	'132 Patent Prosecution History
1250 Proceeding	1003	Bovik Declaration
1250 Proceeding	1004	Needham (US 2002/0181801)
1250 Proceeding	1005	Nonaka (US 2008/0007634)
1250 Proceeding	1006	Gallagher (US 6891977)
1250 Proceeding	1007	Dvir (US 2008/0291287)
1250 Proceeding	1011	Patent Owner's Infringement Contentions
1251 Proceeding	2	Petition
1251 Proceeding	6	Patent Owner Preliminary Response
1251 Proceeding	7	Institution Decision
1251 Proceeding	1008	Zhang (2010/0266207)
1251 Proceeding	1009	Konoplev (8265410)
1251 Proceeding	1010	Select Chapters of Digital Image Processing
1251 Proceeding	1012	Konoplev Provisional (61/224853)
1251 Proceeding	1013	Konoplev Provisional Claim Chart
1251 Proceeding	1017	Bovik Declaration

C. Grounds on which *inter partes* review has been instituted

19. I understand that the Panel has instituted review on the following grounds in the '1250 proceeding, which are all of the grounds requested by the Petition:

i. Whether claims are anticipated by the Needham patent

20. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are anticipated by Needham: claims 1 and 5-7.

ii. Whether claims are obvious in view of the combination of Needham with other references

21. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are obvious in view of Needham and Nonaka: claims 1 and 5-7 (Ground 1A).

22. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are obvious in view of Needham and Dvir: claim 8 (Ground 1B).

23. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are obvious in view of Needham, Nonaka, and Dvir: claim 8 (Ground 1B).

24. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are obvious in view of Needham and Gallagher: claim 13 (Ground 1C).

25. I understand that the Panel instituted review in the '1250 proceeding as to whether the following claims of the '132 Patent are obvious in view of Needham, Nonaka, and Gallagher: claim 13 (Ground 1C).

D. Understanding of the law of anticipation and obviousness

26. I understand that for a prior art reference to anticipate a claim, elements of a claim must be disclosed within the reference either expressly or inherently. For a claim element to be inherent in a reference, I understand that the claim element must be necessarily present in the reference.

27. I understand that a claim may be written in functional language by reciting a means for performing a function. For a claim written this way to be anticipated, I understand that a prior art reference must disclose the identical function as stated in the claim.

28. I understand that for a combination of prior art references to render a claim *prima facie* obvious, all elements of that claim must be disclosed in the references that make up the combination.

29. I further understand that there must be a clear articulation of the reason or reasons why the claimed invention would have been obvious. I understand that some rationales that may support a conclusion of obviousness include: (A) Combining prior art elements according to known methods to yield predictable results; (B) Simple substitution of one known element for another to obtain

predictable results; (C) Use of known technique to improve similar devices (methods, or products) in the same way; (D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (E) "Obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; (G) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

E. Level of ordinary skill in the art

30. It is my opinion that one of ordinary skill for the '132 Patent has a Bachelor of Science degree in electrical engineering, computer science, or a related discipline, and 2-3 years' experience in image processing.

31. I note that Apple's definition of one of ordinary skill in the art differs from my definition. In particular, the Bovik Declaration defines a person of ordinary skill in the art as having a Bachelor of Science degree in electrical engineering, computer science, computer engineering, or a closely-related field, and at least two

years of work or research experience in the field of image processing or a closely related field.

32. Despite the differences in the definition of one of ordinary skill in the art, I do not believe that there is a meaningful change of outcome using one definition of a person of ordinary skill in the art or the other.

F. Opinions about the cited references

i. Needham (Ex. 1004)

33. I have reviewed U.S. Patent Application Publication No. 2002/0181801 (the Needham reference) and is Ex. 1004 in the '1250 proceeding. Needham generally describes weighting different recognized objects in an image to allow enhancements that improve the visibility of higher weighted objects. The examples of corrections in Needham describe the maximizing of intensity dynamic range of human faces and buildings according to these weighting factors.

ii. Nonaka (Ex. 1005)

34. I have reviewed U.S. Patent Application Publication No. 2008/0007634 (the Nonaka reference) and is Ex. 1005 in the '1250 proceeding. Nonaka has a differential processing system that uses two different processing approaches (one for the monitored image, the other for the captured image). Nonaka discloses a system in which the image processing goals associated with displaying a scene while monitoring that scene for potentially photographing it are different than the image processing goals associated with capturing the image. More specifically,

Nonaka is directed to using a different amount of correction for a captured image than for a monitored image.

iii. Dvir (Ex. 1007)

35. I have reviewed U.S. Patent Application Publication No. 2008/0291287 (the Dvir reference) and is Ex. 1007 in the '1250 proceeding. Dvir describes using "[a] cascade of filters of ascending scale [] to obtain the desired dynamic range enhancement, while preserving edge detail, as needed, by optionally specifying the number of filters in the cascade." APPLE-1007 at 5.

iv. Gallagher (Ex. 1006)

36. I have reviewed U.S. Patent No. 6,891,977 (the Gallagher reference) and is Ex. 1006 in the '1250 proceeding. Gallagher describes "a method of sharpening a digital image" that satisfies "a need for an improved image sharpening method that adjusts the amount of sharpening based on both the material content of the image and the amount of noise in the image." *See* APPLE-1006 at 2:21-40.

G. Opinions about the grounds for institution

37. It is my opinion that none of Grounds 1A, 1B, or 1C render the Challenged Claims unpatentable.

i. Claims are not anticipated by Needham

38. In my opinion, the claims alleged to be anticipated by Needham are not in fact anticipated by Needham.

a. Claim 1

39. Needham does not disclose "applying a first amount of the correction, corresponding to the physical object of the predetermined type, to the first portion of the digital image data, and applying a second, different amount of the correction to a second portion of the digital image data" as recited in claim 1.

40. The Petition cites Needham's paragraph 22 reproduced below:

> Different image features may also be considered with different importance. For example, human faces may be considered as more important than buildings in the input image 110. To accomplish this for example, **weights may be assigned to different image features** to specify their relative importance. Such weights may be used to control the correction parameter(s) during the correction. For instance, **if the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings and a human face feature has a higher weight than a building feature, the intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image**. In this way, the human faces may be corrected so that they become more visible than buildings. (APPLE-1004 at 0022) (emphasis original in the Petition)

41. I disagree that these weights when assigned to human face features are a disclosure of the different amounts of correction recited in claim 1. As an initial matter, the statement in Needham that "weights may be assigned to different image features" does not disclose the claimed "amounts." Needham states that the reason for assigning weights to image features is "to specify their relative importance." (APPLE-1004 at 22.) These "weights" are different from an amount of a determined correction to apply to two different regions of the image. Dr. Bovik seems to likewise understand based on his usage of the term "correction" that a correction fixes an image or portion of image rather than weights a portion of an image based on user preferences. Bovik at 18:5-6. The weights may be a consideration in determining the correction applied, but Needham does not disclose an algorithm for how to determine an amount of correction to be applied from the weights, and in fact Needham has several other factors that may affect the correction being applied to the image. *See* APPLE-1004 at figure 2. Needham's statements are too generic to indicate that the different image features will receive differing amounts of the same correction as required in claim 1.

42. The Petition also cites to paragraph 22's disclosure that:

> …if the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings and a human face feature has a higher weight than a building feature, the

> intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image… (APPLE-1004 at 22)

43. However, this language in Needham is also not as specific as the language of claim 1. On the one hand, Needham states that "the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings." On the other hand, Needham states that "the intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image."

44. However, if the intensity dynamic range is to be maximized for both human faces and buildings, that means that the post-correction dynamic range cannot be larger for one set of features (faces) than another (building). "Maximizing" the intensity dynamic range means using the full range of intensity levels. It makes little sense to speak of a "larger" dynamic range among two dynamic ranges that are both maximized. Further, Needham's disclosed correction techniques take into account many variables without any disclosure how the variables operate together. As the Petition notes "Needham … does not explain in detail any particular technique for determining the amount of gain to apply." Pet. at 25. Thus, it cannot

be conclusively determined from Needham how any change in one variable, such as weights, impacts the overall correction.

45. Needham's disclosure that "the intensity dynamic range used for correcting human faces in an image may be *larger* (corresponding to higher contrast) than that used for correcting buildings in an image" is ambiguous in light of the Needham disclosure in the very same sentence describing "maximizing intensity dynamic range." If the result of the dynamic range correction is that the post-correction dynamic range is maximized, it is only possible to know the amount of the correction if the pre-correction dynamic range and the relationship of that range to the weights is known—something which is not addressed in Needham beyond ambiguous statements such as those cited above.

46. Claim 1 requires "applying a first amount of the correction to the first portion of the digital image data; and applying a second amount of the correction to a second portion of the digital image data, wherein the first amount differs from the second amount." This is not disclosed in the paragraphs cited in the Petition. Needham's disclosure is ambiguous and fails to disclose the claim language requiring application of a first and second amount of correction, "wherein the first amount differs from the second amount."

47. The Petition cites to Bovik's Declaration at paragraphs 45-63 to support the allegation that this claim element is disclosed in Needham. Paragraphs 45-52 of

the Bovik Declaration are directed to describing Needham, and do not provide any specific reasoning relating to this claim language. Paragraphs 53-57 of the Bovik Declaration are directed to describing Nonaka, and again do not discuss specific claim language. Paragraphs 58-63 of the Bovik Declaration are directed to the combination of Needham and Nonaka.

48. Referring specifically to paragraph 61, the Bovik Declaration states:

> Thus, if Needham's teachings regarding applying weights to control correction parameters do not satisfy the claimed features that led to allowance, i.e., "applying a first amount of the correction to the first portion of the digital image data" and "applying a second amount of the correction to a second portion of the digital image data, wherein the first amount differs from the second amount, and wherein the first amount corresponds to a physical object of the predetermined type," such features were commonly known in similar prior art digital image processing systems such as those shown by Nonaka. (APPLE-1003 at 61)

49. As described above, an assertion that Needham discloses "applying weights" as made in the Bovik Declaration does not satisfy claim 1. Needham clearly states that the reason for assigning weights to image features is "to specify their relative

importance." (APPLE-1004 at 22.) This statement is too vague to convey that the image features will be processed in the manner required by claim 1.

50. In fact, the Bovik Declaration recites essentially the same conclusion when stating that "Needham and the combination of Needham and Nonaka provide a system for dynamic range correction of an image, **but does not explain in detail any particular technique for determining the amount of gain to apply**" (APPLE-1003 at 73). The Petition recites a similar statement: "Needham and the Needham-Nonaka combination provide a system for dynamic range correction of an image, but does not explain in detail any particular technique for determining the amount of gain to apply." (Petition, page 25.) These admittedly-missing details indicate that Needham fails to anticipate claim 1.

51. Needham also does not disclose that the "determined correction is matched to the predetermined type" as required by claim 1. A POSITA would understand that "matched" in this context means that a particular type of correction is predetermined or assigned to a particular image feature. The fact that in one instance a contrast adjustment is applied to a face is not evidence that a contrast adjustment is matched to faces. Needham describes the use of correction parameters for corrections applied to image features. (APPLE-1004 at 19-20, 24, 26-27, 31, 35.) Needham never discloses a predetermined mapping that each image feature of a particular type will receive a matched correction. Needham's

paragraphs [0019]-[0020] describe that "correction operations may also be defined for each image feature" such that "contrast and brightness may be corrected for a specific image feature such as a human face." However, this example is only stating that a particular face in the image receives certain corrections, and not any matching. Needham's paragraph [0026] describes that "based on the feature description 260, the feature-based correction unit 270 performs one or more specified correction operations according to the correction parameter(s) 240." However, there is no disclosure of these correction parameter(s) being matched. Needham's paragraph [0027] describes that "the statistical properties of the detected features may be used to determine how the overall correction may be performed." However, this is too vague to indicate that the overall correction is matched to a detected feature as in claim 1 because in one example scenario the detected features may include two features (e.g., a building and a face), and if the overall correction is determined from the combined statistical properties of the building and the face, then the overall correction is not matched to either the building or the face. Needham's paragraph [0031] describes generally the construct of a correction parameter, but no matching. Needham's paragraph [0035] describes generically applying correction operations on various image features, but not that a particular image feature is matched to a correction. This understanding is further evidenced by the fact that Needham discloses multiple

objects of the same type receiving different corrections in the example of Needham's paragraph [0032]. This understanding is still further evidenced by the fact that, as Dr. Bovik testified, corrections could be applied whether any object was detected at all. Bovik at 112:3-20.

b. Claim 5

52. Claim 5 is not anticipated by Needham for at least the same reasons as claim 1 based on claim 5 depending from claim 1.

53. The Petition fails to demonstrate that Needham discloses "applying the determined correction to the first portion of the digital image data comprises applying a first amount of a parameter to the first portion to enhance the visual characteristic, wherein the first amount of the parameter is different from a second amount of the parameter applied to a second portion of the digital image data, resulting in a first portion of a digital image that corresponds to the first portion of digital image data being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data." In particular, Needham fails to disclose that any corrections result "in a first portion of a digital image that corresponds to the first portion of digital image data being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data."

54. The Petition alleges that:

> Needham teaches applying a first amount (e.g., feature weight assigned to human face features) of a parameter (e.g., intensity dynamic range) to the first portion (e.g., a detected human face) to enhance the visual characteristic, where the first amount of the parameter is different from a second amount (e.g., feature weight assigned to building features) of the parameter applied to a second portion (e.g., the detected buildings) of the digital image data. APPLE-1004, [0019]-[0020], [0022], [0026]-[0027], [0029]-[0031], [0035], Figs. 2, 6. Needham discloses that "[i]n this way, the human faces may be corrected so that they become more visible than buildings." Id., [0022]. Thus, Needham teaches that applying different amounts of the parameter to different portions results in the first portion being more visible than the second portion. (Petition, page 18)

55. However, this allegation fails to address all of the language recited in claim 5. The Petition asserts that "applying different amounts of the parameter to different portions results in the first portion being ***more visible*** than the second portion." Rather, claim 5 recites "the first portion of digital image data ***being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data***." The Petition fails to address the language of claim 5.

56. Claim 1 requires that the first portion, once it has been subjected to a correction by "applying a first amount of a parameter to the first portion to enhance the visual characteristic" is "brighter than if the second amount of the parameter were applied to" the first portion. In other words, when evaluating claim 5 the "first portion" must be examined under two scenarios: a first scenario involving applying a first amount of a parameter to a first portion; and a second scenario involving applying a *second amount of a parameter to a first portion*.

57. In the first scenario, the first portion is subjected to a correction by "applying a first amount of a parameter to the first portion to enhance the visual characteristic." In the second scenario, the first portion is subjected to a correction in which "the second amount of the parameter" is applied to the first portion. If the resulting first portion is brighter under the first scenario than under the second scenario, then the claim 5 language is met. Otherwise, this claim 5 language is not met. The Petition does not demonstrate such scenarios are disclosed by Needham. Further, the Bovik Declaration never addresses the language of claim 5 with respect to Needham.

c. Claim 6

58. Claim 6 is not anticipated by Needham for at least the same reasons as claim 1 based on claim 6's dependency from claim 1.

d. Claim 7

59. Claim 7 is not anticipated by Needham for at least the same reasons as claim 1 based on claim 7 depending from claim 1.

60. Claim 7 recites, in part, "determining a different amount of gain to apply to the second portion than an amount of gain determined for the first portion." This aspect of claim 7 is not disclosed in Needham. The Petition alleges that "[f]or the reasons discussed above with respect to element [1c], Needham alone and/or Needham in view of Nonaka provides element [7b]." (Petition at 22.) However, claim element [1c] and claim element [7b] are not identical, nor are either disclosed in Needham. For at least the same reasons as described regarding claim 1 not disclosing different amounts of correction, Needham does not disclose claim 7, which recites determining different amounts of gain, because Needham does not describe determining different gains for different amounts of the same correction to different portions of an image.

ii. Not Rendered Obvious by Needham in view of Nonaka

a. Claim 1 Not Obvious in View of Needham and Nonaka Because a POSITA Would Not Combine Nonaka with Needham

61. There are multiple reasons why a POSITA would not be motivated to modify Needham in light of the disclosure in Nonaka as I describe below.

62. The Petition asserts that "[a] POSITA would have been led by Nonaka to modify Needham to apply amplifying correction and contrast emphasis (i.e.,

dynamic range correction), enabling both the person and landscape portions of an image to be more easily distinguished and perceived." (Petition at 51). In alleged support of this, the Petition cites the Bovik Declaration at paragraphs 61-62. However, these paragraphs do not support the proposition that a POSITA would be motivated to modify Needham in view of Nonaka's disclosure.

63. Paragraph 61 of the Bovik Declaration says nothing at all about why "a POSITA would have been led by Nonaka to modify Needham." Rather, paragraph 61 simply assumes that the combination is being made, without explaining why a POSITA would be motivated to make such a combination.

64. Paragraph 62 of the Bovik Declaration asserts that "[i]ncorporation of Nonaka's teachings improves Needham's system by providing functionality for improving visibility of a person in a backlit scene." However, Needham already recognizes the challenges of backlit scenes, and identifies solutions to address those challenges, which undermines any alleged motivation to undertake the burden of making modifications from Nonaka that also accomplish that result. For example, Needham states:

> However, there are various situations in which only portions of a digital image present an undesirable quality. For example, images of people in a *back-lit digital photo* may appear to be almost completely indiscernible i.e. their faces are dark while the background in the same

> digital photo may be simultaneously adequate. In this case, only selected portions of the digital photo need to be enhanced and applying such an enhancing operation throughout the entire digital photo may yield an equally, yet different, unsatisfactory outcome. Furthermore, different portions of a digital image may need different types of enhancement. For instance, in a *back-lit digital photo*, the image of a person's face may be underexposed and the image of the sky may be overexposed. For the former, contrast needs to be improved. For the latter, the brightness of the image of the sky may need to be reduced. (APPLE-1004 at 4)

65. Thus, a POSITA would understand that Needham already recognizes the challenge of backlit photographs, and addresses them by using a set of different corrections applied, for example, to faces and the sky. The POSITA would therefore not be motivated to seek out Nonaka, which is directed to a "camera which can cope with photographing of a scene such as a backlight scene having a large luminance difference." (APPLE-1005 at 3)

66. Another reason a POSITA would not have been led to modify Needham in view of Nonaka is that a POSITA would recognize that Nonaka discloses a system that is both more complex than and incompatible with Needham. Nonaka discloses a system in which the image processing goals associated with displaying a scene

while monitoring that scene for potentially photographing it are different than the image processing goals associated with capturing the image. More specifically, Nonaka is directed to using a different amount of correction for a captured image than for a monitored image. In order to accomplish this, Nonaka includes complex hardware and control paths, such that these two different types of corrections can be implemented at the appropriate times and places.

67. Nonaka aims to address the potential benefit of making different modifications to the image signal that is to be shown on a display as opposed to the image signal that will be recorded in the capture process. Nonaka is directed to a camera in which "an acquired image signal is corrected or modified so as to raise luminance of the signal, or brightness of the image represented by the signal, in accordance with the luminance of each region, a correction amount of the image signal for use as a photographed image is smaller than that of an image signal for use as a monitor image." (APPLE-1005 at 8)

68. In considering whether a combination is obvious, a POSITA would know to look not only at *what* each reference aims to accomplish, but *how* the reference accomplishes it. A POSITA looking at Nonaka, which describes processing systems, would look at the architectures disclosed in Nonaka and recognize that to modify Needham to incorporate those architectures would require a very substantial amount of reengineering, for the reasons explained above relating to the

two different processing approaches (one for the monitored image, the other for the captured image).

69. The POSITA would understand that, by contrast, in Needham the "input image" has already been captured, and that Needham discloses post-processing techniques that are to be performed in a computing device (such as a "personal computer, a laptop, a hand held device, or a camera" (APPLE-1004 at 15)) after capture of the input image.

70. Given these differences, I disagree with the assertion in the Bovik Declaration that "[d]esign incentives would also have prompted a POSITA to look to Nonaka to improve the camera of Needham." (APPLE-1003 at 63). In my opinion, "design incentives" would have taught *away* from such a combination. The fact that Nonaka pertains to a camera and Needham lists a camera as an example of a "computing device" is not sufficient to provide design incentives favorable to the combination.

71. Rather, it is necessary to look at the functionality and architecture of the respective references. As noted above, Nonaka is directed to an architecture aimed at enabling differential processing for two copies of an image signal at the time of image capture. By contrast, Needham is directed to processing occurring after an image has already been captured. Thus, design incentives would lead a POSITA away from such a combination, as the result of the combination would be a

redundant system that unnecessarily provides for more image correction than is needed and in more places in the processing chain than is needed.

72. The system of Needham involves a single processing path (as shown in Figure 2). Nonaka has multiple processing paths, which are made necessary by the goal in Nonaka of performing different processing for an image to be viewed in a monitor as opposed to the image that is to be recorded by the camera. Neither the Petition nor the Bovik Declaration addresses why a combination would allegedly be performed in light of this architectural differences.

73. Incorporating both of the Nonaka signal paths into Needham would mean introducing an extra signal path. This can be illustrated in Figure 8, of Nonaka, which includes a substantial amount of processing (boxes S10 through S20) that is used when *not* in "photographing mode," yet bypassed entirely when the system is in photographing mode. Conversely, Nonaka additionally has a substantial amount of processing (boxes S4 through S7 and S21 through S25) that is used when *in* "photographing mode," yet bypassed entirely when the system is *not* in photographing mode. Thus, incorporating Nonaka would be wasteful, regardless of which of the two processing chains was actually used in the combination. There would be no reason to bring into Needham an entire extra processing chain that would generate an output that was never needed or used. This would be a use of resources that would be wasteful and that a POSITA would be motivated to avoid.

74. An additional disincentive to incorporating Nonaka into Needham is that, as Figure 4A shows, it illustrates applying a gain to amplify the intensity of various regions of the image. One consequence of this is the possibility of saturation—that is, of amplifying intensities so that they are clipped by the maximum value that can be represented in the system at issue. This is a very significant drawback for image quality, as it results in the loss of ability to distinguish details that are "washed out" by the saturation process. In fact, these gain values from Nonaka are dependent on sufficient pre-brightening of the image to have visible faces. (APPLE-1005 at 42.) The use of these gains on any image that would be processed by Needham would produce unknown results because the pre-brightening does not exist in Needham's system. For example, without the pre-brightening of Nonaka faces may not be detected on which to apply matched corrections. Dr. Bovik appears to agree about the need for pre-brightening. Bovik at 170:7-14.

75. Nonaka not only recognizes this saturation problem, but notes that in the narrow context of the application of Nonaka, it is not necessarily detrimental: "Therefore, even if a background part is saturated, the photographing is not directly influenced." (APPLE-1005 at 69) The saturation is not considered a problem in Nonaka because there is a different signal path used for the image capture. Yet if the processing in Nonaka were incorporated into Needham, the result would be that that application of the gain arising from the Nonaka portion of

the combination would sometimes create saturated images. This something that a POSITA would be highly motivated to avoid given the detrimental impact to image quality.

76. Attempting to modify Needham's system to include visibility enhancements of Nonaka's techniques would produce a redundant system that unnecessarily provides for duplicative image correction that would result in multiple processing chains operating independently to produce the same goal. This redundancy that increases the processing would slow down image processing time. Further, additional processing techniques employed in the image processing chain would create unpredictable results. For example, the image processing of one technique may be adversely impacted by the parameters chosen for a technique applied earlier in the processing chain. This may result in oversaturation of a portion of an image which had brightness adjusted too much such that image features were lost and dynamic range reduced. Apple has not presented any evidence that the techniques of Needham and Nonaka would indeed create the predictable result that Apple alleges.

77. Additionally, a POSA would have no reason to modify Needham's image correction techniques with Nonaka's image correction techniques because both Needham and Nonaka are directed to backlight control and improving dynamic range as described above, and yet Needham already maximizes the dynamic range

of an image. With Needham already maximizing the dynamic range, there is no reason to add any further processing or change any processing in Needham based on Nonaka's techniques. That is, with dynamic range already maximized there is no reason to further improve dynamic range.

78. In light of these differences I do not think that a POSITA would have sought to modify Needham using the disclosure of Nonaka.

b. Claim 5 not obvious in view of Needham and Nonaka

79. Claim 5 is not obvious in view of Needham and Nonaka because claim 1, which claim 5 depends from, is not rendered obvious by Needham and Nonaka.

80. As described above, Needham does not disclose claim 5, and more specifically does not disclose a correction "resulting in a first portion of a digital image that corresponds to the first portion of digital image data being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data."

81. Nonaka cannot cure the deficiency of Needham because in my opinion a POSITA would not combine Needham with Nonaka for the reasons described above.

c. Claim 6 not obvious in view of Needham and Nonaka

82. Claim 6 is not obvious in view of Needham and Nonaka because claim 1, which claim 6 depends from, is not rendered obvious by Needham and Nonaka.

Further, Nonaka cannot cure the deficiency of Needham because in my opinion a POSITA would not combine Needham with Nonaka for the reasons described above.

d. Claim 7 not obvious in view of Needham and Nonaka

83. Claim 7 is not obvious in view of Needham and Nonaka because claim 1, which claim 7 depends from, is not rendered obvious by Needham and Nonaka. Further, Nonaka cannot cure the deficiency of Needham because in my opinion a POSITA would not combine Needham with Nonaka for the reasons described above.

iii. Claims not Obvious in View of Needham (or Combinations Involving Needham) and Dvir

a. Not Obvious to Combine Needham or Needham/Nonaka with Dvir

84. I disagree with the assertion that a POSITA would be motivated to include Dvir on the grounds that it would "further improve[]" either Needham or Needham/Nonaka.

85. Dvir describes image processing with "multiple nonlinear edge preserving filters, and nonlinear pixel point operations," and in which "multiple low-pass filters are used, being applied to surrounding neighborhoods of the current pixel of narrow and of wide extent." (APPLE-1007 at abstract) When deciding whether to perform the reengineering necessary to modify Needham or Needham/Nonaka to include these steps, the POSITA would consider the additional processing burden

that would be employed, the additional complexity of the new hardware and/or software, the effectiveness of the methods in Dvir, the complexity involved in choosing the parameters associated with those methods, and the extent, if any, to which those methods produced improved results over the disclosure already present in in Needham or Needham/Nonaka. The Petition and Bovik Declaration do not address these tradeoffs, and instead focus only on the purported benefits of the modification. In my experience, this is not how a POSITA would approach the evaluation of the combination.

86. In addition, in my experience edge-preserving filters have mixed results—that is, sometimes they can lead to significant degradations. This is because edge-preserving filters attempt to identify edges and leave them more or less unchanged, while at the same time creating changes in non-edge portions of an image. This process is imperfect for multiple reasons, including the difficulty of localizing edges, both in terms of false positives and false negatives. Thus, based on my experience implementing edge-preserving filters in multiple contexts, it can be very hard to identify suitable parameter choices. In other words, adding the hardware or software to implement an edge-preserving filter is only part of task. Additional challenges include the selection of parameters to use such filters successfully, as well as being able to recognize when the characteristics of a particular image mean that there is no good parameter choice that can avoid

unwanted image degradation—in which case the harms of using an edge-preserving filter can outweigh the benefits..

87. Being aware of these issues, it is my opinion that a POSITA would not choose to modify Needham or Needham/Nonaka to incorporate Dvir. Not only would those modifications increase the complexity of the system, but successfully tuning the methods of Dvir would further increase the complexity of operating the resulting system.

b. The Petition Provides No Reason to Combine Needham with Dvir

88. The Petition asserts that "[a] POSITA would have been led by Dvir to modify Needham and/or the Needham-Nonaka combination to determine the gain for dynamic range correction using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations in order to achieve superior image quality. APPLE-1003 ¶71-72." (page 24). In alleged support of this, the Petition cites the Bovik Declaration at paragraphs 71-72.

89. Paragraph 71 of the Bovik Declaration does not provide any rationale motivating a POSITA to combine Needham with Dvir. Rather paragraph 71 provides an opinion as to what a POSITA would have obtained upon making the combinations, but is silent regarding why a POSITA would choose to make those combinations in the first place. For the reasons described above, I disagree that a

POSTIA would choose to combine these references in the manner indicated in the Petition and Bovik Declaration.

90. Paragraph 72 of the Bovik Declaration contains three sentences. The first alleges that "[t]he combinations of Needham and Dvir and Needham, Nonaka, and Dvir corrects dynamic range using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations to calculate the pixel gain" without describing why a POSITA would make the combinations. The next two sentences of paragraph 72 allege:

> Incorporation of Dvir's teachings further improves Needham's system (and thus, the combination of Needham and Nonaka) by providing functionality for refining the estimate of the enhancement gain for the current pixel. EX. 1007, [0014]. A POSITA would have recognized that the predictable modification to Needham alone and the combined system of Needham and Nonaka would have included determining the gain for dynamic range correction using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations in order to achieve superior image quality. (APPLE-1003 at 72)

91. The assertions in paragraph 72 of the Bovik Declaration focus only on the additional algorithmic functionality that the combination would purportedly provide, without any consideration at all of the tradeoffs that a POSITA would

weigh. A POSITA would consider whether the additional functionality enabled by adding Dvir would be justified in light of the reengineering and additional complexity that would be involved.

c. Claim 8 not obvious in view of Needham (or Needham/Nonaka) and Dvir

92. The Petition addresses claim 8 in light of the Dvir combinations in two paragraphs on page 27 (there is also a paragraph on page 26, but that paragraph is silent on Dvir):

> For instance, Dvir describes a dynamic range compensation (DRC) unit that includes cascaded two-dimensional low-pass filters. APPLE-1007, [0005]-[0006], [0012]-[0013], [0019]-[0026], Figs. 3, 4. Dvir discloses that the number of cascaded stages of the filters can be adaptively selected depending on the image content to control local contrast of the image. Id., [0033]-[0036]. Dvir also discloses that user preference for the amount of local contrast can also be used to adaptively determine the number of cascaded stages of the filters. Id., [0034].

93. The above does not show that claim 8 is disclosed by the Needham/Dvir combination or by the Needham/Nonaka/Dvir combination. Neither of these two paragraphs describes determining two different gains for the same correction

applied to different portions of an image. In addition, paragraph 71 of the Bovik Declaration, which is cited in these paragraphs, is also silent on gain.

94. Claim 8 requires "***determining the amount of gain to apply*** to the first portion of the digital image data ***so as to maintain local contrast of the first portion of the digital image data***." The Bovik Declaration at paragraph 69 asserts that "Needham alone and/or Needham in view of Nonaka describe determining the amount of gain to apply to the first portion of the digital image data" but then concedes that Needham alone and/or Needham in view of Nonaka "do not describe maintaining local contrast." The Bovik Declaration then asserts at paragraph 69 that "Dvir teaches such features." I disagree with these statements.

95. Neither the Petition nor the Bovik Declaration provide rationale connecting the "local contrast" control in Dvir at paragraph 33 with the claim language of "determining the amount of gain" in claim 8. This connection is a key aspect of the claim—the gain determination must be done "so as to" maintain local contrast. The only non-conclusory section of the Petition in relation to claim 8 is found on page 27. That page is silent on gain. The Bovik Declaration addresses the Dvir combination in paragraphs 69 through 74 but never mentions "gain" in this section.

96. The portion of Dvir that mentions "local contrast" (i.e., par 33 and 34) makes no mention at all of gain. The disclosure in Dvir of low pass filters (indicated by "LPF" in paragraph 33), other than conveying that the filters would

act to reduce or eliminate certain higher spatial frequencies, does not convey anything specific about gain, or a relationship between determining a gain and maintaining local contrast. Furthermore, the disclosure in Dvir that "the local contrast may be controlled" refers to the local contrast at the *output* of the processing. By contrast, to "maintain" local contrast requires specific consideration of the contrast before the processing as well as affirmative steps to ensure a similar output contrast—something that is not discussed in Dvir.

97. The Petition also alleges:

> Based on the disclosures of Dvir, a POSITA would have been motivated to adaptively select the number of cascaded stages of the filters based on the image content and user preference so as to maintain local contrast of the first portion of the digital image data. APPLE-1003, ¶71. Moreover, to maintain local contrast of the first portion of the digital image data, a POSITA would have corrected dynamic range by employing Dvir's cascaded two-dimensional low-pass filters from which the number of stages can be adaptively selected. *Id.* In these ways, a POSITA would have expected success and improvement through the integration of these features of Dvir into Needham alone, or into the Needham-Nonaka combination. *Id.*

(Petition at 27)

98. I disagree with these statements regarding the reasons a POSITA would combine Needham or Needham/Nonaka with Dvir for the same reasons described above. For example, a POSITA would not be motivated to apply Dvir's adaptive selection of the number of cascaded stages of filters to the Needham disclosure to maintain local contrast. Further, nor would a POSITA have expected "success and improvement through integration of these features of Dvir" into other references.

99. Even if such integration were attempted and succeeded, an additional shortcoming of Dvir is that it does not involve "determining the amount of gain to apply to the first portion of the digital image data so as to maintain local contrast *of the first portion* of the digital image data" as required by claim 8.

100. Dvir is a pixel-based technique. That is, it involves operations performed on pixels. This is in direct contrast with claim 8, which specifically pertains to a "first portion" of an image which, as noted in claim 1, "represents a physical object of the predetermined type." Thus, the combination of Dvir with Needham alone or Needham in view of Nonaka would result in the system of cascaded filters disclosed in Dvir being applied in ways that would mix the processing of objects and non-objects in a way that would undermine the image recognition aspect that is a core feature of claim 1 and all claims that depend from it.

101. Nonaka does not resolve any of the deficiencies described above regarding disclosure of "determining the amount of gain to apply to the first portion of the digital image data so as to maintain local contrast of the first portion of the digital image data" as required by claim 8. As the Bovik Declaration concedes at paragraph 69, "Needham alone and/or Needham in view of Nonaka . . . *do not describe maintaining local contrast*" (emphasis added). I agree that Needham and Needham-Nonaka do not disclose maintaining local contrast.

iv. Claim 13 is not obvious in view of Needham (or the Combination of Needham/Nonaka) and Gallagher

a. Not obvious to combine Needham (or Needham/Nonaka) with Gallagher

102. The assertions in the Petition and the Bovik Declaration regarding the Gallagher combinations are similar to those made in relation to Dvir in that the assertions focus only on the additional algorithmic functionality that the combination would purportedly provide, without any consideration at all of the tradeoffs that a POSITA would weigh. A POSITA would consider whether the additional functionality enabled by adding Gallagher would be justified in light of the reengineering and additional complexity that would be involved.

103. Paragraph 82 of the Bovik Declaration asserts that "a POSITA would have been prompted combine the features of Gallagher with Needham, alone and/or in view of Nonaka, because Needham, Nonaka, and Gallagher all relate to digital

image processing." I disagree that this is a sufficient reason to combine. There are many thousands of references that "relate to digital image processing." In deciding whether to attempt a combination, a POSITA would look to the specific attributes and goals of the references involved—the fact that two or more references all related to image processing would be not be a compelling reason to combine.

104. A POSITA in possession of Needham or Needham/Nonaka would not be motivated to incorporate Gallagher, because the goals of Gallagher, which as the title of Gallagher indicates, is a "method for sharpening a digital image without amplifying noise", is different than the feature-based (in the sense of building, face, sky, etc.) methods that are the focus of Needham.

105. Furthermore, even if Gallagher is in fact combined with Needham or Needham/Nonaka, it would still not yield a system that discloses claim 13. This is because the "gain," and therefore the "gain map," of Gallagher is not the gain map claimed in claim 13 as described in further detail below. Thus, I disagree with the assertion in the Petition that "[a] POSITA would have been led by Gallagher to modify Needham and/or the Needham-Nonaka combination to generate a gain map for dynamic range correction and using the gain map to correct the image as suggested by Gallagher." (page 29) To the contrary, a POSITA would know that the gain map of Gallagher is not used for dynamic range correction, and, is instead used for a different purpose as described in further detail below.

b. Claim 13 not obvious in view of Needham and Gallagher

106. Claim 13 recites "modifying a gain map." Although Gallagher uses the phrase "gain map," the gain map described Gallagher is not the gain map claimed in claim 13.

107. Claim 13 depends from claim 7, which recites "determining a different amount of gain to apply to the second portion than an amount of gain determined for the first portion." The claimed "gain" refers to an attribute that relates to brightening or darkening a region of an image. For example, the '132 Patent refers to performing processing "so that a gain applied to a face is increased digitally. In that case, the face can be made bright and visible without causing loss of information in the bright areas of the image." (APPLE-1001 at 2:14-17.) Other exemplary description from the '132 Patent include "pixel dependent gain or attenuation factors" (APPLE-1001 at 4:21-22) and "the DRC unit 117 computes a gain (or attenuation), G(s), for each sensor pixel." (APPLE-1001 at 5:16-17) Additionally, the '132 Patent describes:

"The DRC unit 117 computes a gain (or attenuation), G(s), for each sensor pixel, s=(i,j). Each color component (Cin) of the input RGB image (Rin, Gin, Bin) is multiplied by G(s) (via multiplier 208) to produce the output color component for that pixel Co(s):

Co(s)=G(s)*Cin,

where C=R, G or B and in the above equation, and following discussion, '*' represents multiplication." (APPLE-1001 at 5:15-24) Further, the '132 Patent describes that "Curved line 702 represents an example the effect of selectively modifying the gain G(s) to increase the intensity of darker portions of an image, such as the face of a person standing in a shadow." (APPLE-1001 at 5:54-60) With a gain referring to an attribute that brightens or darkens a pixel or portion of an image, then a gain map is a map of those gain values, which a POSA would understand to be a representation of a plurality of gain values corresponding to different locations of an image. One example of such a gain map is a two-dimensional matrix with each entry being a gain value that corresponds to a pixel of an image to which the gain map is applied.

108. By contrast, the gain in Gallagher refers to a parameter used in unsharp masking. As Gallagher explains:

> The purpose of the gain map generator 2 is to create a map indicating the gain of the sharpening operation on a pixel-by-pixel or region-by-region basis based on semantic labels derived from pattern recognition. The gain map is a control signal used to determine the level of sharpening to apply on a pixel-by-pixel basis. (APPLE-1006 at 6:26-31)

109. Unsharp masking, the goal of Gallagher, is a technique I have taught many times in my Digital Image Processing graduate course at UCLA, and is a method aimed at making edges more visible. The "gain" in unsharp masking determines the extent to which the processing aims to enhance edge visibility. This is accomplished through processing that is structured in a way that avoids either brightening or darkening regions of the image, and is instead with the specific goal of making edges more visible. Thus, while the term "gain" is used in association with unsharp masking, in that context it has a different meaning than used in claim 13.

110. Importantly, as noted above unsharp masking performed using Gallagher's gain map does not brighten or darken a region of the image; it simply can (to a greater or lesser degree depending on the choice of the gain) attempt to enhance the sharpness of high frequency features such as edges. This is reflected, for example in text that the Petition cites from Gallagher, e.g., "values that indicate the degree of Sharpening to be applied to the image pixels, and using the gain map to *sharpen the image*." APPLE-1006 at 2:37-40, emphasis added.

111. In signing this declaration, I recognize that it will be filed as evidence in a contested proceeding before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I agree to appear within the United States during the time allotted and subject myself to cross-examination.

112. I hereby declare that all the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further 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 Title 18 of the United States Code.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on May 22, 2019

John Villasenor