

1 UNITED STATES PATENT AND TRADEMARK OFFICE
2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4 MOBILEYE GLOBAL, INC.,
5 Petitioner

6 v.

7 FACET TECHNOLOGY CORP.,
8 Patent Owner

9 Inter Partes Review No. IPR2024-01110
10 U.S. Patent No. 9,335,255

11
12 REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
13 CHARLES E. THORPE, PhD, produced as a witness at the
14 instance of the Patent Owner, Facet Technology Corp.,
15 and duly sworn, was taken in the above-styled and
16 numbered cause on the 30th of May, 2025, from 10:06 a.m.
17 Eastern Time to 12:23 p.m., before Sharon Ross,
18 Certified Shorthand Reporter in and for the State of
19 Texas, reported remotely by computerized stenotype
20 machine, the witness being located in Boston,
21 Massachusetts.

22
23 Reported by:
24 SHARON ROSS, Texas CSR #1961,
Hawaii CSR #432, RMR, CRR, CRC
25 Realtime Systems Administrator

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PROCEEDINGS

THE VIDEOGRAPHER: Good morning. We are going on the record at 10:06 a.m. on May 30th, 2025.

Please note that this deposition is being conducted virtually. Quality of recording depends on the quality of camera and Internet connection of participants. What is seen from the witness and heard on screen is what will be recorded.

Audio and video recording will continue to take place unless all parties agree to go off the record.

This is media unit 1 of the video-recorded deposition of Dr. Charles E. Thorpe, PhD, taken by counsel for Patent Owner in the matter of Mobileye Global, Inc. versus Facet Technology Corp., filed in the US Patent and Trademark Office, Case No. IPR2024-01110.

This deposition is being conducted remotely using virtual technology.

My name is Terry West representing Veritext Legal Solutions, and I am the videographer. The court reporter is Sharon Ross from the firm Veritext Legal Solutions.

I am not related to any party in this action nor am I financially interested in the outcome.

If there are any objections to proceeding,

1 please state them at the time of your appearance.

2 Counsel and all present, including
3 remotely, will now state their appearances and
4 affiliations for the record beginning with the noticing
5 attorney.

6 MR. SAUNDERS: This is Michael Saunders of
7 Dickinson Wright on behalf of Patent Owner.

8 MR. HIGH: This is Robert High of Finnegan
9 on behalf of Petitioner and the witness. Also with me
10 is my colleague, Wyatt Bazrod.

11 THE VIDEOGRAPHER: Good. Will the court
12 reporter please swear in the witness and then counsel
13 may proceed.

14 THE REPORTER: Sir, could you raise your
15 right hand?

16 (Witness sworn.)

17 THE WITNESS: I do.

18 THE REPORTER: Thank you.

19 CHARLES E. THORPE, PhD,
20 having been first duly sworn, testified as follows:

21 THE WITNESS: And I -- I will note for the
22 record that my title is showing as PE. I am not a
23 professional engineer. I am a PhD.

24 *

25 *

EXAMINATION

BY MR. SAUNDERS:

Q. Hi. Good morning, Dr. Thorpe. Can you state your full name for the record?

A. Charles E. Thorpe.

Q. And you're appearing today remotely via Zoom; is that correct?

A. That is correct.

Q. Where are you physically located right now?

A. I am physically located in the Finnegan office in Boston.

Q. And who else is in the room with you today?

A. Wyatt Barzod [sic] is in the room with me today.

Q. And we went over some ground rules yesterday in your deposition on a '328 patent.

Do you understand the same rules apply today?

A. I understand the same rules apply today.

Q. From your extent today, we're here to discuss a declaration you submitted relating to US Patent No. 9,335,255?

A. That is correct.

Q. If I refer to the '255 patent, you understand I'm referring to that patent?

1 A. That is -- that is acceptable. Yes, thank you.

2 Q. Do you have physical paper with you today?

3 A. I do. I have a copy of the patent. I have a
4 copy of the two sources that I cite.

5 Q. Is that the Gallagher reference and the Lumia
6 reference?

7 A. The Gallagher reference, the Lumia reference,
8 and I also should mention I have a physical copy of my
9 declaration.

10 Q. Okay. And do you have access to the Exhibit
11 Share platform?

12 A. I do, and I see there are multiple things
13 posted there.

14 Q. Okay. Do you see -- there should be four
15 things: Exhibit 1001, which is the '255 patent;
16 Exhibit 1003, your declaration; Exhibit 1005, the
17 Gallagher reference; and Exhibit 1104, the Lumia
18 reference.

19 Do you see all those?

20 A. I could double-check to make sure that the
21 number on -- well, let me just double-check it.

22 Exhibit 1005, that does appear to be the
23 Gallagher patent, yes.

24 Q. And so in connection with your theories for
25 claim 15 of the '255 patent, you relied on the Gallagher

1 and Lumia references; is that correct?

2 A. That is correct.

3 Q. So what is the purpose of the Lumia -- the --
4 sorry. Let me withdraw.

5 What is the purpose of the system of the
6 Lumia reference?

7 MR. HIGH: Objection, form.

8 A. The Lumia reference is an excellent reference.
9 If you turn to Page 39 of my declaration, I describe all
10 of the different things that I see in Lumia, the
11 equations, the figures, the purpose that Lumia is
12 designed for, the range of things that Lumia is trying
13 to detect.

14 Q. (BY MR. SAUNDERS) On the -- so just a point
15 for how we're going to talk with each other, in Exhibit
16 1014 there's kind of two different sets of page numbers.

17 I don't know if you see that but, for
18 example, on the page that has the "Abstract," in the
19 bottom left, it says "Page 6 of 17," but in the kind of
20 right there's a Page No. 15.

21 Do you see that?

22 A. Which -- do -- set of numbers do you prefer to
23 use?

24 Q. Yeah, I'm going to try and use those numbers on
25 the bottom right today, the ones that are actually

Page 8

1 printed in the journal article.

2 Will you understand that?

3 A. So, for instance, the Lumia paper starts in
4 journal Page 15?

5 Q. That's right.

6 A. Okay.

7 Q. So if you see on Page 15 of Lumia, the section
8 called "Introduction" -- do you see that?

9 A. I see that.

10 Q. And -- well, actually let's start with the
11 title. The title of the Lumia is "A mobile system for
12 measuring retroreflectance of traffic signs."

13 Do you see that?

14 A. I see that.

15 Q. Is that an accurate description of what the
16 Lumia system is directed to?

17 A. The Lumia system teaches a wide variety of
18 techniques. The specific application that has the most
19 of the focus of Lumia is on traffic signs, but the
20 techniques taught are much wider than just traffic
21 signs.

22 Q. Does Lumia discuss addressing markers other
23 than traffic signs?

24 MR. HIGH: Objection, form.

25 A. Lumia certainly discusses signs of different

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1 colors and shapes, sizes, and placement. So it
2 discusses a wide variety of sensing methods.

3 Q. (BY MR. SAUNDERS) Does Lumia discuss pavement
4 markers?

5 A. I don't know if I opined on that.

6 Q. You don't know one way or another?

7 A. I'm relying on the scientific teachings of
8 Lumia which are general teachings on measuring
9 illuminance and measuring retroreflectivity, relying on
10 those more than I am relying on a specific
11 implementation.

12 Q. So let's start with retroreflectivity. How
13 does Lumia measure retroreflectance?

14 A. Equations 1 and 2 of Lumia lay out the
15 scientific basis. Coefficient of retroreflection in
16 units of candelas per footcandle per square foot can be
17 expressed as -- it would be $R' = \frac{I}{E A}$
18 where $E A$ is the normal illumination, A is the area of
19 the surface, and I is the reflective intensity.

20 He goes on to say, "By suitable
21 manipulation of these parameters, the retroreflectance
22 can essentially be regarded as the absolute brightness
23 of the retroreflective target for a given amount of
24 incident illumination on the target. Arithmetically,
25 this can be expressed as: $R' = \frac{L}{E_n}$ where

1 L is the luminance of the reflected light. Figure 2
2 shows the commonly accepted geometry and definitions as
3 described by ASTM for evaluating retroreflective
4 materials."

5 I like equation No. 2 particularly because
6 now he's relating retroreflectance to luminance and to
7 the incident light.

8 Q. Does Lumia actually use the equation No. 2
9 that's on Page 16 of the Lumia article in the
10 calculations performed by the system described in Lumia?

11 MR. HIGH: Objection, form.

12 A. So Lumia -- further down on that same page,
13 "The reflective luminance may be measured with a
14 luminance meter, which is similar to an illuminance
15 meter except the field of view of the detector is
16 limited to a sufficiently small angle. The use of a
17 video camera effectively divides the field of view
18 defined by the system magnification into smaller fields
19 of view, thereby creating individual luminance meters at
20 each sensing element site."

21 So he is teaching the use of a video
22 camera, when properly calibrated, as individual
23 luminance meters.

24 Q. Now, claim 15 of the '255 patent mentions
25 determining a luminance value, correct?

1 A. Determining a luminance value, that is correct.

2 Q. And what in Lumia are you reading that
3 determining a luminance value limitation as being
4 disclosed or suggested by Lumia?

5 A. I am reading that sentence I just read about
6 the use of a video camera creating individual luminance
7 meters and the equation 2 which talks about how these
8 luminance values are related to retroreflectivity.

9 Q. Anything else?

10 A. From equation 2, it is clear from elementary
11 algebra, if you know two of the quantities, R prime L
12 and E, you can calculate the third.

13 So it is straightforward algebra to move
14 from one to another.

15 Q. So the ultimate goal in Lumia is to calculate
16 that R prime coefficient of retroreflection, right?

17 MR. HIGH: Objection, form.

18 A. In the embodiment shown in the experimental
19 results, that is what he is doing.

20 Q. (BY MR. SAUNDERS) And in that equation 2, what
21 is the En part of that equation?

22 A. The En is defined, under equation 1, "the normal
23 illumination incident on the retroreflector."

24 Q. Does Lumia disclose measuring that?

25 A. Lumia, in his implementation section, has a

1 section 5.3 -- this would be Page 23 in the native
2 numbering -- has a very detailed discussion of the
3 amount of illumination needed for this particular
4 embodiment of the system and calculates, for the
5 experimental conditions that he's using, how much
6 illumination he's getting from his flash mechanism.

7 So he knows quite accurately what the E
8 value is.

9 Q. And maybe I'm just missing it, but I don't see
10 that -- that E sub n in that section 5.3.

11 Is there somewhere that you're referring to
12 in that section as corresponding to that E sub n that's
13 in equation 2 of Lumia?

14 A. So what he's calculating is 28,500
15 candela-seconds. He's calculating that over the -- the
16 integration time of the camera to, in effect, calculate
17 the illumination.

18 Q. Let's go back to equation 2 on Page -- Page 16.
19 So on Page 16 it says that "the coefficient of
20 retroreflection, or R prime," is "in units of candelas
21 per footcandle per square foot"; is that right?

22 A. You're reading that at the top of the page?

23 Q. Yeah.

24 A. Yes.

25 Q. What are the units for L, luminance of the

1 reflected light, in equation 2 of Lumia?

2 A. "E equals I over d squared where I is the
3 intensity and d is the distance from the source to the
4 detector."

5 Q. So would that be candelas over some distance
6 squared, like candelas over square foot?

7 A. Could you repeat the question?

8 Q. Yes. So I asked about the units for L in
9 equation 2 of Lumia and I think you pointed me to
10 language on that Page 16 about E equals I over d squared
11 and it wasn't clear to me what units is required by what
12 you read for E equals I over d squared.

13 So I guess my follow-up question is: What
14 are the units you understand for that E in that
15 sentence, E equals I over d squared?

16 A. So if we look at equation 1, the coefficient of
17 retroreflection, it's candelas per footcandle per square
18 foot.

19 The A is the square foot. The I over E
20 will give us the candelas per footcandle.

21 Q. And then what units would L be in equation 2
22 then?

23 A. If you want me to work that out, I could work
24 that out.

25 Q. Yeah, I think -- I do want to know because I

1 think I want to understand what -- how you believe Lumia
2 to disclose determining a luminance value.

3 And so I think it's important to understand
4 the various units for all these numbers in these
5 equations you've pointed me to.

6 So what's your understanding of the units
7 for L in equation 2?

8 MR. HIGH: Objection, form.

9 A. That would take more algebra than I care to do
10 without paper and pencil.

11 Q. (BY MR. SAUNDERS) Okay. So I believe in an
12 earlier answer I -- or earlier question I asked you
13 about where in Lumia is there disclosure of calculating
14 that E sub n that appears in item 2.

15 So is there a part of Lumia that discloses
16 calculating a number that has that same units as E sub n
17 of Figure 2?

18 A. Again, underneath Figure 2 he's talking about
19 individual luminance meters from each pixel. So he's
20 talking about how each pixel is calculating that
21 luminance when suitably calibrated.

22 Q. Are you -- you're reading this -- referring
23 to -- sorry. Withdraw.

24 You're referring to the sentence "The use
25 of a video camera effectively divides the FOV defined by

1 the system magnification into smaller FOVs, thereby
2 creating individual luminance meters at each sensing
3 element site"? Is that what --

4 A. That is correct.

5 Q. -- you're referring to?

6 A. That is correct.

7 Q. What does Lumia mean by "effectively"?

8 MR. HIGH: Objection, form.

9 A. I don't understand the question.

10 Q. (BY MR. SAUNDERS) Well, is -- in your
11 experience, do people in the field typically refer to
12 pixels of a video camera as being individual luminance
13 meters?

14 A. Each pixel is measuring a brightness or a
15 luminance.

16 Q. Well, let's look at the bottom of that same
17 page. Do you see the last full sentence on that page
18 says, "The histogram of the extracted sign area is shown
19 in Figure 3(b), plotted as" a "relative number of image
20 points versus reflected light intensity (camera gray
21 levels)."

22 Do you see that?

23 A. I see that.

24 Q. So in that sentence it says that the output
25 of -- I guess let's just go back for a second. I'll ask

1 some questions to drill in.

2 What is your understanding of what is
3 depicted in Figure 3(a) of Lumia?

4 A. Figure 3(a) is an image of a sign that has been
5 illuminated by Lumia's system.

6 Q. And is that an image that's been captured by
7 Lumia's camera?

8 A. It has been captured by Lumia's camera.

9 Q. And what is Figure 3(b) of Lumia?

10 A. As the legend says, it is a histogram of
11 Figure 3(a). That is, it is a count of the number of
12 pixels of each recorded brightness level from the image
13 of 3(a).

14 Q. So on the bottom scale of Lumia, it goes -- it
15 says "Gray Levels, 0 through 255."

16 Do you see that?

17 A. I see that.

18 Q. So is Lumia converting the gray scale image
19 on -- in Figure 3(a) into a number that goes from zero
20 to 255?

21 A. Each --

22 MR. HIGH: Objection, form.

23 A. Each pixel in 3(a) has a recorded brightness
24 from 0 to 255. These brightnesses have not been
25 calibrated as luminances. They are simply the gray

1 scale values from the camera.

2 The histogram records how many of the
3 pixels in image 3(a) have brightness zero, how many have
4 brightness 1, how many have brightness 2, et cetera, up
5 through how many have brightness 255.

6 Q. And so those are light intensity values; is
7 that correct?

8 A. Those are the sensed intensity values from the
9 camera. That is correct.

10 Q. And you agree at that point of the data that's
11 shown in Figure 3(b), Lumia has not yet determined a
12 luminance value, correct?

13 A. They are related to the luminance value. This
14 has not been calibrated for luminance.

15 Q. And so after Lumia creates the histogram that's
16 in 3(b), how does Lumia use that histogram?

17 MR. HIGH: Objection, form.

18 A. Can you ask that again?

19 Q. (BY MR. SAUNDERS) How does Lumia use the
20 histogram data of Figure 3(b)?

21 MR. HIGH: Same objection.

22 A. In the image processing data, the -- Lumia
23 would like to calculate the average retrorreflectance of
24 sign legend and back graph.

25 Reading from my declaration, the

1 "retroreflectance calculation results in the following
2 equation: $R \text{ equals } L \text{ times } d \text{ squared over } I$," which
3 comes from Lumia.

4 So to convert the histogram peaks in
5 Figure 3(b) into retroreflectance, the system needs to
6 be calibrated.

7 It's calibrated according to several
8 metrics. It's calibrated according to the distance from
9 which these signs are measured in Lumia, and his
10 experimental setup uses a couple different distances.

11 It's calibrated according to the intensity
12 of the flash, and Lumia describes in great detail the
13 intensity of the flash.

14 And then Lumia discusses the issues
15 involving angles.

16 What in particular would you like me to
17 discuss?

18 Q. Well, I guess I'll start with -- you mentioned
19 calibration involving a couple of different distances.
20 What were you referring to?

21 A. Lumia refers to a 200-foot highway mode and I
22 believe it is a 100-foot urban mode for sampling the
23 signs.

24 Q. Is that the local mode that --

25 A. Is that -- is that -- where do you see the word

1 "local mode"?

2 Q. Page 20.

3 A. Thank you. The highway mode and the local
4 mode.

5 Q. So Lumia has two different modes with two
6 different distances; is that right?

7 A. By choosing discrete distances, the teaching
8 still holds for any distance that is required. The
9 calibration becomes more accurate if there are fewer
10 discrete distances over which the system is operating.

11 So the experimental system is set up to
12 take as many variables as possible out of the equation,
13 while the general teaching in the equations hold more
14 generally.

15 Q. Lumia's calibration is described in that first
16 paragraph under "Experimental Results" on Page 24; is
17 that correct?

18 A. Lumia goes into great detail in section 5.1,
19 5.2 on all the things which could affect the quality of
20 the sensing, 5.3, 5.4, 5.5, what his experimental
21 apparatus needs to do in terms of the intensity of the
22 light, the duration of the light, the accuracy of the
23 range finder.

24 In his experimental results, this is a
25 preliminary paper. He shows his calibration for one

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1 color for one distance, and he shows remarkably
2 consistent results.

3 Since Lumia has said at the very beginning
4 in his intro that he intends this to be for multiple
5 colors, it would be obvious to a person of ordinary
6 skill in the art to say: This is what the calibration
7 looks like for a white sheet. Let's run the equivalent
8 calibration for a red sheet. Let's run the equivalent
9 calibration for a green sheet, for a brown sheet, for
10 any color of reflector or sign that one cares to be
11 examining.

12 Q. In Lumia itself it doesn't discuss calibrating
13 other than with a white sheet, right?

14 MR. HIGH: Objection, form.

15 A. The experimental results in Lumia are a small
16 part of the paper. Experimental results are a couple of
17 paragraphs where he demonstrates the proof of concept by
18 calibrating with a white sheet.

19 That -- the teachings of Lumia are much
20 broader, and it would be obvious to a person of ordinary
21 skill in the art to calibrate at different ranges and
22 with different colors.

23 Lumia also discloses, for instance, the
24 effects of sunlight in the process and indicates that
25 you probably want to operate this with the sun fairly

1 straight overhead.

2 Q. And the third sentence under that "Experimental
3 Results" heading on Page 24, do you see it says,
4 "Calibration of the system was accomplished by acquiring
5 an image of a calibrated white sheeting material and
6 computing a scale factor to convert the 8-bit digital
7 gray levels of the calibration target ... to R prime
8 values"?

9 Do you see that sentence?

10 A. I see that.

11 Q. Okay. What does it mean by "scale factor"?

12 A. Since he has a fixed distance and a fixed
13 illumination, then a given brightness level will give
14 him a given retroreflection.

15 If you want to invert that and calculate
16 luminance, all you have to do is go back to equation 2,
17 take the known illumination, E, which he has calculated
18 for his flash, and flip the equation and you would get
19 the luminance.

20 So for his experimental results purposes,
21 he wants to know retroreflectivity to know the quality
22 of the object he's looking at; but his teaching is
23 broader than that and would be straightforward to
24 calculate the L instead of the R.

25 Q. In that sentence when it says "8-bit digital

1 gray levels," that's referring to the zero through 255
2 numbers that appear in Figure 3(b) of Lumia; is that
3 correct?

4 A. That would be correct.

5 Q. And so I read this as we take one of those
6 peaks in Figure 3(b) of Lumia, say, if we want to
7 calculate the retroreflectance value of the sign
8 background. We take the gray level of that peak and we
9 multiply it by a multiplier, which is the scale factor,
10 and if the scale factor was correctly calibrated, that
11 means that we're going to get a correct retroreflectance
12 value.

13 Is that an accurate description of what
14 Lumia is describing here?

15 A. Yes. One could do that to get the correct
16 retroreflectance; and then from there, one could easily
17 extract the luminance because one knows the distance,
18 one knows the illumination.

19 In the case of Figure 3(b), the sign
20 background would be red. The sign legend would be
21 white.

22 Since the calibration and the experimental
23 results section on Page 24 is for white, now the
24 retroreflectance or the luminance of the sign legend
25 would be correct.

1 If you wanted a correct luminance or
2 retroreflectance for the sign background, you would
3 simply repeat the experimental results section with a
4 red target rather than with a white target.

5 Q. You'd need a different scale factor for a
6 different color target, right?

7 A. You would want a different scale factor for
8 each color of target.

9 Q. And so Lumia can figure out the scale factor
10 because it has a calibration it performs on material
11 with a known retroreflectance and is then able to kind
12 of divide its 8-bit result from the camera by that known
13 retroreflectance to get a scale factor; is that right?

14 A. I'm sorry. I was distracted by bumping my
15 mouse incorrectly. Can -- I almost left the meeting.
16 Could you repeat that question?

17 Q. Yeah, I was trying to understand what is your
18 understanding of what Lumia is disclosing about how the
19 scale factor is determined.

20 My read of this is that Lumia has a
21 calibration process using a known material with known
22 retroreflectance and then it's able to basically use
23 division from the gray levels of its camera at a
24 specific distance and the known retroreflectance to get
25 the appropriate scale factor. Is that correct or am I

1 incorrect?

2 MR. HIGH: Objection, form.

3 A. Lumia has a calibrated white sheeting material.
4 Since Lumia knows the distance between his setup to that
5 white sheeting material, he knows the intensity of his
6 flash from his light exposure. He knows all of the
7 parameters required to calculate equations 1 and
8 equations 2.

9 The scale factor puts all of those together
10 to come up with a single number because it is a fixed
11 distance and a fixed illumination which turns gray
12 levels into retroreflectivity.

13 It's easy through algebra and through
14 knowing the intensity of the light source to calculate
15 the luminance.

16 Q. (BY MR. SAUNDERS) Well, what is your
17 understanding as to what equation Lumia uses in the
18 calibration process to compute the scale factor?

19 MR. HIGH: Objection, form, asked and
20 answered.

21 A. Ask that again. I don't understand the
22 question.

23 Q. (BY MR. SAUNDERS) Yeah. So we've been reading
24 from this sentence that mentions computing a scale
25 factor as part of calibration of the system.

1 Is there an equation that Lumia uses to
2 compute the scale factor?

3 MR. HIGH: Same objections.

4 A. Lumia does not disclose the details of how he
5 does that.

6 Q. (BY MR. SAUNDERS) So one way that is
7 consistent with the disclosures of Lumia is that you
8 take the known retroreflectance value of the calibrated
9 white sheeting material and you divide that by the value
10 you get from the camera to obtain the scale factor; is
11 that right?

12 MR. HIGH: Objection, form, scope.

13 A. Lumia does not disclose how he does that.

14 Q. (BY MR. SAUNDERS) Now, when I'm reading this
15 sentence that Lumia computes "a scale factor to convert
16 the 8-bit digital gray levels of calibration target
17 image to R prime values," that sentence is describing
18 converting light intensity values to retroreflectance
19 values; is that correct?

20 A. In the experimental results he is showing how
21 to convert a gray level value to a retroreflectance and,
22 through the equations 1 and 2, is a straightforward to
23 also calculate luminance.

24 In fact, you can't measure retroreflectance
25 without measuring luminance. He just has multiple scale

1 factors all pushed into one scale factor.

2 He could use his scale factor to calculate
3 luminance, another scale factor based on the -- the
4 illumination.

5 Now you have two scale factors, one to
6 calculate a luminance, one -- a luminance, one to
7 calculate the light exposure and push those together to
8 calculate retroreflectance. He merely combines those
9 two scale factors into one.

10 Q. I want to go back to Page 17 in the Lumia and
11 that Figure 3 and Figure 3(b). Let me know when you're
12 there.

13 A. I am there.

14 Q. And so in that description underneath that
15 figure, it mentions pixels; is that right?

16 A. Background with the largest pixel count? Is
17 that where you're looking?

18 Q. Yeah.

19 A. Yes.

20 Q. So the histogram results in 3(b) depend on the
21 number of pixels in the camera of Lumia, right?

22 A. The total size over the histogram should equal
23 the number of pixels.

24 Q. Does Lumia say what resolution of camera it
25 uses?

1 A. Again, let's separate out the teaching of Lumia
2 which talks about this technology in general versus a
3 particular implementation.

4 Here we go. At the top of Page 18, this
5 particular camera is 491 by 384 pixels.

6 There are lots of implementation details.
7 He uses a 1990 Dodge Ram van. The teaching is not
8 specific to a 1990 Dodge Ram van nor is it specific to a
9 491 by 384 pixel sensor.

10 Q. Would you agree with me that in general as the
11 resolution of the camera goes down, it's going to be
12 more difficult to identify peaks in the histogram?

13 MR. HIGH: Objection, form.

14 A. The fewer the pixels, the shorter the peaks.

15 Q. (BY MR. SAUNDERS) The technique that Lumia is
16 describing about identifying peaks in the histogram
17 wouldn't work if you had 10 pixels, right?

18 MR. HIGH: Objection, calls for
19 speculation.

20 A. I would have to see the scene being analyzed to
21 know whether 10 pixels would be sufficient.

22 Q. (BY MR. SAUNDERS) It would depend on the
23 particular sign and the other circumstances?

24 A. 10 pixels may be sufficient if 9 of them are
25 looking at background and 1 of them is much brighter.

1 Q. Let's go to your declaration and, in
2 particular, your analysis of claim 15 starts on Page 69,
3 paragraph 113.

4 A. I am there.

5 Q. You're there. Okay. So in paragraph 113, you
6 say, "Gallagher and Lumia render obvious the additional
7 limitations of claim 15."

8 Do you see that?

9 A. I see that.

10 Q. And you say that -- do you see that in the text
11 of claim 15 that it depends from claim 12?

12 A. I see that.

13 Q. And you analyze claim 12 over Gallagher alone
14 earlier in your declaration starting on Page 52; is that
15 correct?

16 A. Page 52, I use Gallagher for 12P. Page 53, I
17 use Gallagher for 12A. Page 56, I use Gallagher for
18 12B. Page 59, I use Gallagher for 12C, D, and E.

19 Q. And in 12B you identify Gallagher's light
20 sensor module 6a with array of light sensors 6 as
21 corresponding to the plurality of light intensity --
22 sorry. Withdraw.

23 In limitation 12B, you identify Gallagher's
24 light sensor module 6a with array of light sensor 6 as
25 corresponding to the at least one intensity sensor

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1 limitation of claim limitation 12B, right?

2 A. Show me where you're reading that.

3 Q. For example, paragraph 87 on Page 56.

4 A. Okay. So 12B says, "determining a plurality of
5 light intensity values with at least one intensity
6 sensor directed to cover a field of view which includes
7 at least a portion of the area illuminated by the light
8 source."

9 "Gallagher's apparatus includes or at least
10 suggests 'at least one intensity sensor directed to
11 cover a field of view which includes at least a portion
12 of the area illuminated by the light source.'"

13 Q. So in 12B, what are you identifying in
14 Gallagher's corresponding to the "at least one intensity
15 sensor"?

16 A. Well, Gallagher discloses -- in one embodiment,
17 Gallagher discloses an array of photodiodes; but in
18 paragraph 39 of Gallagher, "A variety of light sensors
19 are envisaged as being suitable in the apparatus 1."

20 So Gallagher preferred embodiment is an
21 array of photodiodes; but Gallagher, in his patent,
22 contemplates a much wider variety of light sensors.

23 Q. Do you cite to paragraph 39 in your analysis of
24 limitation 12B?

25 A. I don't believe I need to in my analysis of 12B

1 because the other citations adequately cover that,
2 Gallagher 9 throughout with light sensors; Gallagher 35
3 to 37, a light source, the positioning of the unit
4 adjustable for testing markers around bends on an
5 undulating roads, wide variety of light sources, et
6 cetera.

7 Q. The first sentence of paragraph 87 of your
8 declaration says, "Gallagher's apparatus includes or at
9 least suggests 'at least one intensity sensor directed
10 to cover a field of view which includes at least a
11 portion of the area illuminated by the light source'
12 because it includes a," quote, "'light sensor module
13 6a,'" quote, "(intensity sensor) with an array of,"
14 quote, "'light sensors 6,'" quote, "one or more of which
15 detects 'reflected light' from 'a reflective surface of
16 a marker 2.'" 2."

17 Do you see that?

18 A. Yes.

19 Q. Does that sentence accurately set forth your
20 opinions regarding why Gallagher satisfies the "at least
21 one intensity sensor" portion of limitation 12B?

22 MR. HIGH: Objection, form.

23 A. That sentence covers 12B, and the Gallagher
24 patent has even more sections which even further cover
25 12B.

1 Q. (BY MR. SAUNDERS) So going down to claim 15
2 which depends from claim 12, in your theory for claim 15
3 are you still relying on Gallagher's -- the same
4 disclosures in Gallagher that you cite in 12B in
5 paragraphs 86 through 89 as satisfying limitation 12B
6 when you get to your theory for claim 15?

7 A. For instance, in paragraph 117, "A POSITA would
8 have had a reasonable expectation of success because
9 both Gallagher and Lumia relate to apparatuses that
10 measure reflective characteristics of retroreflective
11 surfaces," et cetera, et cetera, et cetera.

12 Further down the paragraph, further
13 "giving a POSITA the expectation that a light sensor
14 could be selected and calibrated to associate the light
15 intensity value to a corresponding luminance value.
16 Gallagher, 37, 39."

17 So there's where we directly pull in the
18 wide variety of light sources and the wide variety of
19 light sensors.

20 Q. Directing you to the last sentence of paragraph
21 117, do you see that it says, "A POSITA would have had
22 to apply only conventional techniques to similarly
23 provide Gallagher's light sensor array with a
24 characterization profile based on calibration factors
25 that relate each measured light intensity value to a

1 luminance value."

2 Do you see that?

3 A. I see that.

4 Q. So you're explaining that a POSITA could have
5 used Lumia's teachings to relate the light intensity
6 values measured by Gallagher's light sensor array to
7 luminance values; is that correct?

8 A. In the larger context of paragraph 117, we are
9 talking about different sensors that Gallagher could
10 use; and the light sensor array could be the array of
11 photodiodes or it could be a different sensor as
12 indicated in Gallagher 039.

13 Q. Was there somewhere in your declaration that
14 says: My theory for claim 15 is that I'm going to
15 combine Gallagher and Lumia such that the combined
16 system uses a camera?

17 A. The photodiodes used by Gallagher are similar
18 sensing light intensity, similar to the photodiodes used
19 by Gallagher in his preferred embodiment, are detecting
20 light intensity using slightly different physical
21 principles than a video camera; but they are still
22 detecting light intensity.

23 They could also be calibrated based on the
24 kinds of calibration that Lumia does for different
25 colors for known light -- different known light

1 intensities.

2 So they could be similarly calibrated to
3 create a retroreflectance value or a luminance value, if
4 desired, using the teachings in Lumia.

5 Q. Paragraphs 114 through 117 of your report set
6 forth your reasons why you believe a POSITA would be
7 motivated to combine Gallagher and Lumia in the manner
8 recited in claim 15, correct?

9 A. Paragraph 114 is describing Lumia, determining
10 a luminance value.

11 Paragraph 115 is again describing Lumia.

12 Paragraph 116 is where we start to combine
13 Lumia with Gallagher.

14 Q. Earlier in your declaration going up to claim
15 13 on Page 65, you have another discussion of a
16 combination of Gallagher and Lumia.

17 Do you see that?

18 MR. HIGH: Objection, relevance.

19 A. Is -- is claim 13 under discussion today?

20 Q. (BY MR. SAUNDERS) I hope it's not. I just
21 want to confirm my understanding of your report.

22 So if you could go up to Page 65, do you
23 see that there's a claim 13 up there?

24 A. I thought that was outside of the scope of
25 today's hearing.

1 Q. I hope so, too. I just want to confirm with
2 you. So --

3 MR. HIGH: Objection, relevance.

4 Q. (BY MR. SAUNDERS) You see that you have a
5 theory for Gallagher and Lumia for claim 13 above
6 earlier in your declaration, correct?

7 A. I will not go there. Claim 13 is not under
8 discussion.

9 Q. Well, I -- are you -- so are you refusing to
10 answer the question of: You have a theory of Gallagher
11 and Lumia for claim 13 on Page of 65?

12 THE WITNESS: Counsel, should I answer the
13 question?

14 MR. HIGH: You can answer that.

15 But -- but, Michael, claim 13 is out of the
16 case. I think his opinions are entirely irrelevant at
17 this point for claim 13.

18 MR. SAUNDERS: I -- you just need to let me
19 get to where I'm going and you're going to -- it's not
20 going to be an issue. So I just --

21 MR. HIGH: Okay. All right.

22 MR. SAUNDERS: I hope that's what he says.
23 So that's what I'm trying to get.

24 A. Okay. I will answer the question, then. Where
25 are you looking?

1 Q. (BY MR. SAUNDERS) Page 65. You have Gallagher
2 and Lumia for claim 13, right?

3 A. Claim 13, "The automated method of claim 12,
4 wherein activating a light source comprises
5 synchronizing activation of a plurality of light sources
6 to optimize light intensity reflected from the road
7 marker."

8 Q. And I'll just go ahead and skip ahead to my
9 ultimate question here.

10 Your theories for combining Gallagher and
11 Lumia for claim 15, you're not relying on any of the
12 discussion you have above about combining Gallagher and
13 Lumia for claim 13, right?

14 A. Claim 13 talks about synchronizing light
15 sources. I don't believe that's relevant to claim 15.

16 Q. Okay. How I read your report, you have one
17 theory for combining Gallagher and Lumia for 13 and then
18 you have an independent theory for combining Gallagher
19 and Lumia for claim 15. Is that fair?

20 A. Remember that there are multiple ways of
21 combining Gallagher and Lumia.

22 One can combine them by using Lumia's
23 sensor in Gallagher's system. One can combine them by
24 using Lumia's calibration method in Gallagher's system.
25 One can combine them by using Lumia's processing in

1 1 Gallagher's system.

2 2 There's multiple combinations that are
3 3 possible.

4 4 Q. And in claim --

5 5 A. In 13 -- in 13, one could combine them by using
6 6 Lumia's illumination in Gallagher's system.

7 7 Q. Okay. And claim -- your theory for claim 15 in
8 8 your declaration is different than your theory for
9 9 claim 13, right?

10 10 A. Claim 13 has to do with illumination. That is
11 11 not contemplated in claim 15.

12 12 Q. All right. So we've been going for about an
13 13 hour. Why don't we go ahead and go off the record for a
14 14 break?

15 15 A. How much longer do you anticipate that we have
16 16 to go?

17 17 Q. My guess is probably about another hour or so.

18 18 MR. HIGH: Okay.

19 19 THE VIDEOGRAPHER: Okay. We're going off
20 20 the record.

21 21 A. So an hour --

22 22 THE VIDEOGRAPHER: We're going off the
23 23 11:10 23 record. The time now is a.m.

24 24 (Recess from 11:10 a.m. to 11:21 a.m.)

25 25 THE VIDEOGRAPHER: We are back on the

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1 11:21 1 record. The time now is a.m.

2 2 Q. (BY MR. SAUNDERS) Welcome back, Dr. Thorpe.

3 3 Can you go back again to Page 24 of Lumia and that

4 4 Experimental Results section?

5 5 A. In Lumia, Page 24. I am there.

6 6 Q. And I'm going to direct you again to that third

7 7 sentence under "Experimental Results" that begins with

8 8 "Calibration of the system."

9 9 Do you see that?

10 10 A. "Calibration of the system was accomplished by

11 11 acquiring an image of a calibrated white sheeting

12 12 material," et cetera.

13 13 Q. You would agree with me that sentence discloses

14 14 a way of converting light intensity values to

15 15 retroreflectivity values without having to determine

16 16 luminance values, correct?

17 17 MR. HIGH: Objection, form.

18 18 A. That system is directly converting 8-bit

19 19 digital gray levels to retroreflectance values which

20 20 could easily, by equations 1 and 2, be converted to

21 21 luminance values.

22 22 Q. (BY MR. SAUNDERS) Okay. Now I want to turn to

23 23 your declaration and particularly paragraph 116.

24 24 A. I have it.

25 25 Q. And you identify a motivation to combine

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1 Gallagher and Lumia because you note that "several road
2 authorities specified minimum retroreflectivity values
3 for road markings along a roadway"; is that right?

4 A. "Because Gallagher recognizes that 'road
5 authorities worldwide invariably advocate different
6 standards for road markings'" -- is that the sentence
7 you're looking at?

8 Q. Yes.

9 A. Yes.

10 Q. Now, you agree with me retroreflectivity values
11 are different than luminance values, right?

12 MR. HIGH: Objection, form.

13 A. If one knows the -- according to Lumia's
14 equations 1 and 2, retroreflectance values are directly
15 related to luminance values if one knows the
16 illumination.

17 Q. (BY MR. SAUNDERS) But retroreflectivity and
18 luminance use different units, right?

19 A. They are using different units as related by
20 Lumia equations 1 or 2.

21 Q. And I guess what I'm missing here is: If the
22 road authorities specify minimum retroreflectivity
23 values and Lumia teaches that you can calculate
24 retroreflectivity without having to determine luminance,
25 what is the motivation to determine luminance?

1 A. Let's remember how we are calculating
2 retroreflectivity. We are sensing some gray levels
3 which could be converted into luminance and then divided
4 by E to give retroreflectivity.

5 Given -- this is seventh grade algebra.
6 Given those equations, it is straightforward to
7 calculate either luminance or retroreflectivity.

8 If the road authorities want
9 retroreflectivity, it's easy to calculate
10 retroreflectivity.

11 If the system has a need of luminance,
12 given that you have a known illumination, that falls
13 straight out of a very basic equation.

14 Q. Do you identify somewhere in your declaration,
15 for your theories for claim 15, a need to determine
16 luminance?

17 A. Since claim 15 says determining a luminance,
18 Lumia teaches how the luminance can be determined.

19 Q. I guess, put another way: Do you identify a
20 reason why a POSITA would have wanted to determine
21 luminance as opposed to determining retroreflectivity?

22 A. Paragraph 116 says, "A POSITA would have found
23 it obvious to implement Lumia's determining a luminance
24 value."

25 Q. Okay. So this --

1 A. I was responding to 15 determining a luminance
2 value, then saying it's obvious to do so.

3 Q. Okay. Let's talk about the language in claim
4 15, "a characterization profile of the at least one
5 light intensity sensor."

6 Do you see that?

7 A. I see that.

8 Q. What is your understanding of what that phrase
9 means?

10 A. Claim 15 is not specific as to what a
11 characterization profile is. There are a wide variety
12 of things that could be a characterization profile.

13 For instance, what Lumia does in
14 calibrating with a white sheet, if Lumia also calibrated
15 with a green sheet and a brown sheet and an orange
16 sheet, that would be different characterization profiles
17 for different colors of retroreflective materials.

18 Q. Have you heard of the term "sensor
19 characterization" before?

20 A. Sensor characterization is a very broad term.
21 Are you talking about the spectral response? Are you
22 talking about the location? Are you talking about the
23 magnification? Are you talking about the filters? Are
24 you talking about the lens? Are you talking about the
25 pointing of the sensor?

1 Sensor characterization and calibration is
2 an old topic and has lots of different approaches.

3 Q. I guess at the high level what does the term
4 "sensor characterization" mean to you?

5 A. It means understanding, when you get a reading
6 from the sensor, what and where that corresponds to.

7 Q. And is sensor characterization related to
8 calibration?

9 A. They are all part of the same package.

10 Q. So what is the relationship between calibration
11 and sensor characterization?

12 A. These are terms which are not generally -- are
13 defined by the individuals using them. I don't believe
14 there is a standard sensor calibration definition
15 because it means so many different things.

16 Q. Well, what understanding of -- I guess, first
17 of all, did you understand the term "characterization
18 profile of the at least one light intensity sensor" to
19 relate to the concept of sensor characterization?

20 MR. HIGH: Objection, form, scope.

21 A. I don't know that the patent uses the phrase
22 "sensor characterization."

23 Q. (BY MR. SAUNDERS) Well, I guess when you
24 applied claim 15 to the prior art, did you have a
25 particular understanding of what claim 15 meant by a

1 "characterization profile of the at least one light
2 intensity sensor"?

3 MR. HIGH: Objection, form.

4 A. I can give you examples of what sensor
5 characterization means, and the examples include what
6 Lumia is doing and looking at his sheet under his
7 experimental results.

8 And the examples also include what
9 Gallagher discusses. Gallagher discusses different
10 colors, different light sources, and discloses a method
11 for calibrating his sensors -- discloses a couple
12 methods for calibrating his sensors, which I would also
13 put under the general term of building a
14 characterization profile for his sensors.

15 Q. (BY MR. SAUNDERS) Well, when you are analyzing
16 the language of claim 15 and trying to apply that to the
17 prior art, did -- was your meaning or -- sorry -- was
18 your understanding of the phrase "a characterization
19 profile of the at least one light intensity sensor"
20 informed by something specific in the '255 patent
21 specification?

22 MR. HIGH: Objection, form.

23 A. Can you point me where in particular in '255 I
24 should be looking?

25 Q. (BY MR. SAUNDERS) Well, right now I'm just

1 asking, you know: What was your process for doing this?

2 So was there something that you remember in
3 the '255 patent that you saw as informing your
4 understanding of what this language about a
5 characterization profile in claim 15 meant?

6 A. Let me go look at the '255 patent. So column 4
7 is talking about a characterization profile of the light
8 source.

9 Q. And is that what informed your understanding of
10 the meaning of the phrase "a characterization profile of
11 the at least one light intensity sensor"?

12 MR. HIGH: Objection, form.

13 A. Column 12 talks about light source angle
14 characterization profile.

15 Q. (BY MR. SAUNDERS) So those portions of the
16 '255 patent are part of what informed your understanding
17 of this term, "a characterization profile of the at
18 least one light intensity sensor"?

19 A. No. My recollection from the '255 patent --
20 and you can correct me if I'm wrong -- is that
21 characterization profile of the sensor is not used in
22 those terms in the body of the patent.

23 The places or characterization profile that
24 are used have to do with the illumination and do not
25 have to do with the sensor itself.

1 Q. So did you have --

2 A. Feel free to correct me if I'm wrong.

3 Q. Did you have some understanding of an ordinary
4 meaning of the term "characterization profile" that you
5 applied in your analysis of claim 15?

6 A. Characterization --

7 MR. HIGH: Object, form.

8 A. Characterization profile can mean a variety of
9 things. I selected some examples which I thought were
10 relevant.

11 Q. (BY MR. SAUNDERS) You selected some examples
12 from Lumia, right?

13 A. I believe I -- let me double-check. I cite
14 Gallagher as a motivation for why one would like to be
15 calibrated for different colors of sensors, and I cite
16 predominantly Lumia in how one calibrates a sensor.
17 Gallagher also references calibration.

18 Q. And so did you have some understanding of the
19 meaning of the term "characterization profile" in mind
20 that you used when you decided that those portions of
21 Gallagher and Lumia were relevant to claim 15?

22 A. An example of the characterization profile
23 would be the sensitivity of the camera, given the light
24 source, to particular colors.

25 Lumia, in his experimental method, does

1 that for white. In his introduction he also indicates
2 it would be of interest to do this for other colors of
3 retroreflective materials.

4 So that would be one example of many of
5 this undefined term, "characterization profile."

6 Q. How do you believe that they are examples of a
7 characterization profile if you don't have a particular
8 definition of "characterization profile" in mind?

9 MR. HIGH: Objection, form.

10 A. Because it is not clearly defined, there are a
11 broad number of things which are ways of characterizing
12 the sensor.

13 Lumia does a example of Lumia
14 characterization profile based on colors.

15 Gallagher discusses the need to do such a
16 thing in both his section on calibrations and in his
17 sections where he talks about a variety of light and a
18 variety of photo detectors.

19 Q. (BY MR. SAUNDERS) Have you reviewed the
20 preliminary response filed by Patent Owner in this IPR?

21 MR. HIGH: Objection, scope.

22 THE WITNESS: Does that mean I should not
23 answer?

24 MR. HIGH: You can answer truthfully.

25 A. I have looked at it.

1 Q. (BY MR. SAUNDERS) And do you recall that
2 Patent Owner set forth a proposed ordinary meaning of
3 "characterization profile" in its preliminary response?

4 MR. HIGH: Objection, scope.

5 A. I don't recall the details.

6 Q. (BY MR. SAUNDERS) Would you agree that a
7 sensor characterization is the process of describing the
8 properties and performance characteristics of a sensor
9 across various conditions?

10 MR. HIGH: Objection, scope.

11 A. Could you repeat that? The process of?

12 Q. (BY MR. SAUNDERS) Describing the properties
13 and performance characteriz -- let me try one more time.

14 The process of describing the properties
15 and performance characteristics of a sensor across
16 various conditions.

17 MR. HIGH: Objection, scope.

18 A. That is an extremely broad definition. What
19 conditions are you characterizing it under?

20 Q. (BY MR. SAUNDERS) Well, is that --

21 A. This is important in different applications.
22 If you're building a robot to clean up a nuclear
23 disaster, now the conditions are: How well does your
24 sensor hold up under radiation, et cetera, et cetera, et
25 cetera?

1 So that is a very broad definition.

2 Q. Was there something wrong about that
3 definition?

4 MR. HIGH: Objection, scope.

5 A. Within that broad definition, my discussion of
6 Lumia holds as an example.

7 Q. (BY MR. SAUNDERS) And Patent Owner set forth a
8 meaning of characterization profile as the compilation
9 of that description of sensor characterization into a
10 set of characteristics presented in a usable format.

11 Is there anything you see wrong in that
12 explanation of the meaning of characterization profile?

13 MR. HIGH: Objection, form, scope.

14 A. Read that again. Produced those
15 characteristics in a usable format?

16 Q. (BY MR. SAUNDERS) Yeah. The compilation of
17 that description into a set of characteristics presented
18 in a usable format.

19 MR. HIGH: Same objection.

20 A. That is such a broad description. Of course
21 the data has to be in a usable format, but you are still
22 not being specific enough to know what the
23 characterization profile means.

24 Q. (BY MR. SAUNDERS) What additional specificity
25 do you think is required?

1 MR. HIGH: Objection, scope.

2 A. What is it that you are characterizing?

3 Q. (BY MR. SAUNDERS) Well, let's start with a
4 camera.

5 What additional specificity would you need
6 if the -- if you're talking about a characterization
7 profile of a camera?

8 MR. HIGH: Objection, scope.

9 A. Is this the general question of camera
10 calibration?

11 Q. (BY MR. SAUNDERS) Well, I'm trying to
12 understand your understanding of characterization
13 profile.

14 And as part of that process, I'm kind of
15 providing you one of the proposed meanings that Patent
16 Owner has previously set forth in this case and trying
17 to understand to what extent you dispute Patent Owner's
18 explanation.

19 And so I kind of asked you: Well, is there
20 something wrong with what Patent Owner has set forth?

21 And I think you asked for some more details
22 and particularly what type of sensor, and so I tried to
23 identify camera sensor.

24 So if we're talking about camera sensors,
25 is there something wrong with the explanation of a

1 characterization profile as the compilation of the
2 description of sensor characterization into a set of
3 characteristics presented in a usable format?

4 MR. HIGH: Objection, outside the scope of
5 the declaration.

6 A. My expert declaration is responding to the
7 patent, and using the sources that I cited is not
8 responding to the further documents dealing with the
9 patent board.

10 Q. (BY MR. SAUNDERS) No, I understand that. I'm
11 just trying to understand what your interpretation of
12 characteration -- characterization profile is and that
13 you've applied in your declaration.

14 A. Oh. And I said that one example of that is
15 what Lumia is doing to calculate his scale factor for
16 one particular color and how he could use that to
17 calculate the scale factors for other particular colors.

18 Q. (BY MR. SAUNDERS) So, in your mind, a
19 characterization profile can be for a calibration
20 process for just one sign of one color at one distance?

21 MR. HIGH: Objection, mischaracterizes.

22 A. The example that I gave was for Lumia with
23 multiple colors.

24 While the experimental method section only
25 demonstrates one distance, that's for demonstrating the

1 repeatability and the accuracy of the process.

2 It would be straightforward to a person of
3 ordinary skill in the art to repeat that at different
4 distances with different colors under different
5 circumstances to build up a broader characterization
6 profile.

7 So the question is: How much detail does
8 this characterization profile have to have? Lumia
9 certainly teaches ways of building a characterization
10 profile of those factors to as much detail as would be
11 necessary.

12 Now, if the definition of "characterization
13 profile" is anything having to do with a camera, that is
14 not obvious to me from reading claim 15.

15 Q. So, in your mind, a characterization profile
16 has to be more than just one scale factor based on one
17 calibration of one sign at one distance; is that right?

18 MR. HIGH: Objection, mischaracterizes
19 prior testimony.

20 A. What I said is that Lumia teaches how to
21 calculate multiple scale factors under multiple
22 conditions.

23 I still have not opined as to the
24 definition of a characterization profile. I'm offering
25 examples of how a particular sensor can be

1 characterized.

2 Q. So you didn't have any particular definition of
3 characterization profile in mind when you rendered your
4 declaration?

5 A. I found no definition in the patent or in the
6 claim of the characterization profile of the sensor
7 which gave me enough detail.

8 So I am using examples of things which
9 could be characterization profiles to illustrate that
10 Lumia's does calculate those kinds -- does teach how to
11 calculate those kinds of factors.

12 Q. So in Lumia when it's doing calibration with
13 one sign at one distance, that results in one scale
14 factor; is that right?

15 A. That's correct. And he's doing that repeatedly
16 so he can see the accuracy and repeatability under those
17 conditions.

18 Q. And if he's going to do -- sorry. Withdraw.

19 If he's going to assess different colored
20 signs that would result in different scale factors; is
21 that right?

22 A. I would assume that that's the way to do it is
23 to -- instead of calibrating with a white sheet,
24 calibrate with other calibrated sheets.

25 Q. And if he's going to calibrate for different

1 distances, that would result in different scale factors;
2 is that right?

3 A. Again, the Lumia system for good engineering
4 purposes says: Let's take some of those variances out
5 and only calibrate at two distances so that there's
6 fewer variables to be concerned with and fewer chances
7 for error.

8 However, the teaching of Lumia certainly
9 extends to you could calibrate this at any distance that
10 you want.

11 Q. Is there something in Lumia that would tell you
12 how to use multiple different scale factors
13 simultaneously in an automated system?

14 MR. HIGH: Objection, form.

15 A. For instance, in the figure with the stop sign,
16 it is clear that the stop sign itself is red and the
17 legend on the stop sign is white.

18 It would be obvious to a person of ordinary
19 skill in the art to apply different calibration factors
20 for those two different -- two different cases.

21 Q. (BY MR. SAUNDERS) Okay. Well, I guess let's
22 get a little more specific.

23 In Lumia's system, it requires an operator
24 to manually aim a camera at a road sign, correct?

25 A. Again, let's separate out Lumia's teaching from

1 Lumia's proposed implementation.

2 The proposed implementation has all of
3 these limitations like a 1990 Dodge, like a person
4 aiming the camera.

5 That's separate from the general teaching
6 of detecting things. Even with a person in lieu of the
7 camera, Lumia does additional image processing to remove
8 the zero gray level black.

9 So I don't view that as a significant
10 limitation of the teaching of Lumia.

11 Q. Lumia doesn't tell you how to have a working
12 system for determining retroreflectivity values without
13 having an operator point a camera manually at a road
14 sign, right?

15 MR. HIGH: Objection, form.

16 A. So, for instance, in paragraph 5.6 -- this is
17 on Page 24 of Lumia -- discussing in one embodiment of
18 this system, that even with the operator pointing,
19 because he's looking -- he or she is looking at objects
20 of different size, there are still opportunities for
21 further processing to focus the attention on only the
22 object of interest.

23 So I believe Lumia contemplates other
24 possibilities here, but that's separate from the
25 teaching of Lumia of how to measure luminance and

1 retroreflectivity.

2 Q. In your proposed combined system using the
3 teachings of Gallagher and Lumia, does an operator have
4 to aim the sensor manually at the road marker?

5 MR. HIGH: Objection, form.

6 A. So, for example, in my paragraph 116, this is
7 using Lumia's processing with Gallagher's apparatus.

8 Gallagher's apparatus requires a human to
9 drive the vehicle -- this is well before the days of
10 automated Teslas -- but does not require anyone to aim a
11 sensor. It is nevertheless using Lumia's teaching to
12 improve Gallagher's system.

13 Q. (BY MR. SAUNDERS) In Gallagher's system, the
14 light sensor array is constantly sweeping ahead of the
15 vehicle a certain distance, right?

16 A. The usual implementation of Gallagher is push
17 brooming at a given distance. That distance can be
18 varied depending on the conditions of the road.

19 Q. And the photodiodes in Gallagher have a -- they
20 aren't just pinpoint sensors. They sense an entire area
21 of the road and whether there's light coming from that
22 area of the road, right?

23 MR. HIGH: Objection, form.

24 A. Remember that Gallagher discusses a variety of
25 light sensors as being suitable in the apparatus.

1 In a preferred embodiment, these are
2 photodiodes, each of which carry -- covers some area of
3 the road.

4 Q. (BY MR. SAUNDERS) Well, I guess let's ask it
5 this way: In your proposed combination of Gallagher and
6 Lumia, where are the sensors pointed?

7 A. So specifically in the combination proposed in
8 116, this is still using the Gallagher apparatus with
9 the sensors pointing down.

10 Q. And Lumia triggers its camera using a laser
11 range finder when the sign is within a particular
12 specified distance, correct?

13 A. Again, in the experimental embodiment of Lumia,
14 as opposed to the general teachings, he is taking as
15 much variation as possible out of the system by picking
16 one or two distances and doing consistent measurements
17 at those distances.

18 Q. The distance in Lumia is important because the
19 scale factor has been calibrated for a particular
20 distance, right?

21 MR. HIGH: Objection, form.

22 A. The distances chosen in Lumia are chosen in
23 order that the entrance angles and the observation
24 angles are within narrow bounds.

25 And, therefore, he calibrates the system at

1 the distances at which he wants to operate the system.

2 Q. (BY MR. SAUNDERS) If Lumia's range finder
3 wasn't working and it captured that image at a different
4 distance than it was expecting, then it could get the
5 wrong value for the retroreflectivity because that scale
6 factor had been calibrated for a particular distance,
7 right?

8 MR. HIGH: Objection, form.

9 A. That seems to be correct.

10 Q. (BY MR. SAUNDERS) Now, Gallagher doesn't have
11 a laser range finder, right?

12 A. Gallagher has set up his system to be looking
13 forward at a fairly short distance so that the geometry
14 between the light source, the photo detectors, and the
15 road gives him a fixed distance.

16 Will that fixed distance change if the road
17 is going over a curve or under a dip? Slightly. Not as
18 much as if you were trying to look out 100 feet because
19 he's trying to look out a much shorter distance.

20 Given the standards of roads, it will not
21 change greatly. So Gallagher is calibrating at a small
22 range of distances over which the calibration factors
23 still hold to within the accuracy that Gallagher needs.

24 Q. Now, you mentioned the Gallagher -- Gallagher
25 does calibration itself, right?

1 A. That's correct.

2 Q. And Gallagher also uses calibration as a
3 multiplier, correct?

4 A. Paragraph 59, "The calibration factor for a
5 range of markers can be obtained by conducting static
6 tests in a laboratory and additionally with checks on
7 the road. One type of static test is to mount markers
8 on a conveyor belt at even distances apart and to
9 arrange the apparatus I to measure the reflectivity of
10 the markers. Multiple static tests at different
11 tracking distances are also conducted to calculate
12 accurate calibration factors for each individual sensor
13 in the array."

14 Q. Okay. I think I was referring to paragraph 58
15 there. Do you see it re -- it says --

16 A. Oh.

17 Q. -- "Process step C involves calibrating the
18 data by multiplying the data with a predetermined
19 calibration factor"?

20 Do you see that?

21 A. Yes, that's correct.

22 Q. So Gallagher takes the smooth output from the
23 analog-to-digital converters and multiplies that by a
24 predetermined calibration factor, correct?

25 A. That's what's going on in those paragraphs.

1 Q. And is that how -- let me withdraw.

2 And then as a result of that in the later
3 steps, Gallagher in step H is able to determine the
4 reflectance level of the road marker in a value of
5 millicandela per Lux; is that correct?

6 A. I see that in paragraph 67.

7 Q. And the purpose of Gallagher doing that is to
8 determine whether the road marker has -- is present and
9 has the adequate levels of retroreflectivity, correct?

10 MR. HIGH: Objection, form.

11 A. Paragraph 68? It involves "activating the
12 tagging means ... if it is determined as measuring a
13 reflectivity less than the predetermined minimum
14 acceptant -- able reflectance level."

15 Q. (BY MR. SAUNDERS) That minimum level of those
16 levels are published by standards authorities that we
17 talked about earlier today, right?

18 A. That is correct, and it will vary from
19 authority to authority.

20 Q. So even without Lumia, Gallagher's already able
21 to calculate the retroreflectivity of road markers,
22 right?

23 MR. HIGH: Objection, form.

24 A. Since Gallagher talks about different light
25 sensors, different light sources, and different colors

1 of markers, as far as that goes, road signs and post
2 reflective painted lines, et cetera, the system would
3 need to be calibrated for the conditions under which it
4 is operating.

5 Q. (BY MR. SAUNDERS) Well, I guess what I'm
6 missing is: If Gallagher already discloses a system for
7 assessing whether markers meet the retroreflectivity
8 standards, how is Lumia improving Gallagher in your
9 proposed combination?

10 A. What I love about the Lumia reference is that
11 it lays out all of the equations, and so it is obvious
12 exactly what the calibration was doing and how all of
13 the parts fit together.

14 It is also obvious how to interpolate
15 between two different calibrations.

16 Gallagher is calibrating for one
17 scenario -- calibrating for another scenario.

18 For instance, with the teachings of Lumia,
19 if you had calibrated for 100 feet and calibrated for
20 200 feet and for some reason you wanted to look at
21 things at 150 feet, you can use the teachings of Lumia
22 to understand how to interpolate the calibration.

23 Gallagher would benefit by using the
24 teachings of Lumia to adjust the calibration for
25 slightly different situations by using the teachings of

1 Lumia rather than having to do a recalibration from
2 scratch.

3 That is one example of how these two can
4 work together. There are other examples where perhaps
5 Lumia provides higher precision than Gallagher provides.

6 Q. Both Lumia and Gallagher have a calibration
7 factor that it uses as the multiplier where that
8 calibration factor has to be set differently to address
9 different distances, different sensors that are used, et
10 cetera, right?

11 A. And different materials.

12 Q. Well, what is the additional teaching about
13 calibration and Lumia that one of skill in the art would
14 find useful and want to combine with Gallagher to better
15 determine retroreflectivity in road markers?

16 MR. HIGH: Objection, asked and answered.

17 A. Lumia's experimental method talks about
18 shooting the same thing ten times and then comparing the
19 results. So that is a much more detailed answer than
20 what Gallagher gives.

21 Lumia, with his equations, talks -- can --
22 those equations can be used to tweak the calibration
23 constant for a slightly different circumstance.

24 Gallagher talks about calibrating for each
25 individual circumstance. So I believe the combination

1 of those two together is more powerful than Gallagher
2 alone.

3 Q. (BY MR. SAUNDERS) So in your proposed
4 combination, how would Lumia's teachings be used to
5 tweak the calibration factor?

6 MR. HIGH: Objection, asked and answered.

7 A. Well, let's see what I say. "A POSITA would
8 have found it obvious to implement Lumia's determining a
9 luminance value utilizing the plurality of light
10 intensity values and a characterization profile of the
11 at least one light intensity sensor to allow Gallagher's
12 apparatus to calculate the retroreflectivity of road
13 markers. A POSITA would have been motivated to do so
14 because, as was well known at the time, several road
15 authorities specified minimum retroreflectivity values
16 for road marking" on "a roadway. Because Gallagher"
17 represents -- the "'road authorities worldwide
18 invariably advocate different standards for road
19 markings' and expressed a desire to analyze the data 'in
20 a way and to an extent that meets the criteria of each
21 country,' a POSITA would have been motivated to
22 implement Lumia's determining a luminance value to allow
23 its apparatus to identify and tag any markers 'that do
24 not meet the predetermined minimum acceptable
25 reflectance level' for countries that require a minimum

1 retroreflectivity level for road markers."

2 Does that answer?

3 Q. (BY MR. SAUNDERS) I mean, it -- I guess I'm
4 still missing the point. You just read some language
5 about things that Gallagher already says it does.

6 And I was trying to figure out what about
7 Lumia is -- is -- that a POSITA would find useful as
8 being added to that.

9 I think you mentioned something about
10 tweaking calibration factors. Is that something that's
11 in your declaration?

12 MR. HIGH: Objection, mischaracterizes his
13 prior testimony, form.

14 A. Would you like me to sift through my
15 declaration or would you like me to add additional
16 insights?

17 Q. (BY MR. SAUNDERS) Well, I guess the way I'll
18 characterize it is in a prior answer you mentioned Lumia
19 and tweaking caliber -- calibration factors.

20 Is that something that you have referenced
21 in some way in your declaration or is that something
22 that is beyond what you've discussed in your
23 declaration?

24 A. I think it is obvious to a person of ordinary
25 skill in the art that Lumia's teaching in his equations

1 1 and 2 shows how the calibration factors will vary with
2 distance.

3 It would be obvious to a person of ordinary
4 skill in the art that a minor change in distance could
5 be accomplished without recalibration simply by using
6 those equations. A larger change in distance would
7 probably merit a recalibration.

8 So, for instance, to a person of ordinary
9 skill in the art, if Gallagher's system is calibrated at
10 an angle looking 20 feet ahead and for some reason this
11 desired to look 25 feet ahead, Gallagher would
12 contemplate a recalibration of the whole system.

13 Lumia would provide the POSITA with the
14 intellectual tools to change the calibration factors
15 appropriately.

16 That is one small example of why the
17 combination is more powerful than Gallagher alone.

18 Q. And is that explanation that you just provided
19 referenced somewhere in your declaration or somehow
20 connected to what you put in your declaration?

21 MR. HIGH: Objection, form.

22 A. My declaration in several places refers to a
23 POSITA. My explanation I gave you just now is how I
24 believe a POSITA would use that information.

25 I did not spell it out in the declaration

1 because I believe a person of ordinary skill in the art
2 would know how to do that.

3 Q. (BY MR. SAUNDERS) You would agree with me that
4 cameras have -- different cameras can have different
5 lenses, right?

6 A. The same camera can have different lenses.

7 Q. And camera lenses can have properties like
8 focal length?

9 A. That is one of the characteristics of a camera
10 lens.

11 Q. And aperture?

12 A. That is another characteristic of camera
13 lenses.

14 Q. And cameras can use different technology like
15 CCD or CMOS?

16 A. Camera technology keeps evolving.

17 Q. Are the properties of a camera and a lens some
18 of the aspects that affect calibration in Lumia?

19 A. So Lumia discloses the field of view of
20 individual pixels and discloses the details of a
21 particular camera.

22 If you use a different camera with
23 different characteristics, whether it be sensor
24 technology or lens technology, that would change the
25 calibration factors.

1 Q. And there are different factors that would
2 affect the calibration of a photodiode, right?

3 A. That would depend on the technology used in the
4 photodiode.

5 Q. Well, for example, a -- photodiodes of
6 Gallagher.

7 A. Photodiodes -- and, again, you would have to
8 look at the lens put in front of them, the size of the
9 photodiode, the electronics behind the photodiode.

10 Q. But they're not the same factors that are going
11 to influence the calibration of a photodiode as would
12 influence the calibration of a camera, right?

13 A. Well, they are the same factors and field of
14 view in sensitivity. The numerical values of the
15 factors may be different, but it's the same conceptual
16 consideration.

17 MR. SAUNDERS: I will pass the witness.

18 MR. HIGH: Okay. Can we take a break --
19 10-minute break?

20 MR. SAUNDERS: Sure.

21 THE VIDEOGRAPHER: Okay. We're going off
22 12:17 22 the record. The time now is p.m.
23 12:23 23 (Recess from 12:17 p.m. to
p.m.)

24
24 THE VIDEOGRAPHER: Okay. We are back on

25
12:23 25 the record. The time now is p.m.

1 MR. HIGH: I have no questions. So that
2 concludes the deposition.

3 THE VIDEOGRAPHER: Okay. And before we go
4 off the record, Mr. High, would you like a video copy?

5 MR. HIGH: No video.

6 THE VIDEOGRAPHER: Mr. Saunders, would you
7 like a video copy?

8 MR. SAUNDERS: Not at this time.

9 THE VIDEOGRAPHER: Ms. Ross, do you need
10 orders on the record or off?

11 THE REPORTER: I can do it off the record.

12 THE VIDEOGRAPHER: Okay. In that case,
13 everybody is concluded, then we are off the record at
14 12:23 p.m. and this concludes today's testimony given by
15 Dr. Charles E. Thorpe, PhD.

16 The total number of media used was three
17 and will be retained by Veritext Legal Solutions.

18 (The deposition was concluded at 12:23 p.m.)

19 (Signature waived.)
20
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REPORTER'S CERTIFICATE

I, SHARON ROSS, Certified Shorthand Reporter, do hereby certify:

That on Friday, May 30, 2025, at 10:06 a.m. Eastern Time, this deposition was taken down by me in machine shorthand and was thereafter reduced to typewriting under my supervision; that the foregoing represents, to the best of my ability, a true and correct transcript of the proceedings had in the foregoing matter.

I further certify that I am not an attorney for any of the parties hereto, nor in any way concerned with the cause.

Dated this 4th day of June, 2025.



SHARON ROSS, HI CSR NO. 432,
TX CSR NO. 1961, CRR, RMR, CRC
Realtime Systems Administrator

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[background - camera]

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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VERITEXT LEGAL SOLUTIONS

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