

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
IPR2023-00151
PATENT 7,110,779

APPLE INC.,

Petitioner,

-vs-

SPEIR TECHNOLOGIES LTD.,

Patent Owner.

_____ /

DEPOSITION OF
DR. ZHI DING

Friday, July 21, 2023
9:02 a.m. - 2:26 p.m.

Remote Location
Via Zoom Videoconference
All Parties Remote

Stenographically reported by:
Erica Field, RPR, CA-CSR, GA-CSR, WA-CSR,
NM-CCR, IL-CSR, NJ-CCR, FL-FPR, NY Notary,
FL Notary
Job No. 7588

1 REALTIME STENOGRAPHIC DEPOSITION of DR.

2 ZHI DING, taken in the above-entitled

3 matter before ERICA FIELD, RPR, California

4 Certified Shorthand Reporter (License No.

5 14515), New Jersey Certified Court Reporter

6 (License No. 30XI00244800), New Mexico

7 Certified Court Reporter (License No. 575),

8 Washington Certified Shorthand Reporter

9 (License No. 22020479), Illinois Certified

10 Shorthand Reporter (License No. 084004952),

11 Georgia Certified Court Reporter (License

12 No. 5338-8044-2296-7296), Florida

13 Professional Reporter (Licence No. 1109),

14 New York Notary, Florida Notary taken via

15 remote videoconference on Friday,

16 July 21, 2023, commencing at 9:02 a.m.

APPEARANCES:

On behalf of the Petitioner:

FISH & RICHARDSON

3200 RBC Plaza

60 South Sixth Street

Minneapolis, Minnesota 55402

(612) 335-5070

BY: JOHN-PAUL FRYKMAN, ESQUIRE

KENNETH DARBY, ESQUIRE

fryckman@fr.com

kdarby@fr.com

On behalf of the Patent Owner:

BC LAW GROUP

200 Madison Avenue

24th Floor

New York, New York 10016

(212) 951-0100

BY: JOHN PETRSORIC, ESQUIRE

ROBERT AUCHTER, ESQUIRE

jpetrSORIC@bc-lawgroup.com

rauchter@bc-lawgroup.com

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NO EXHIBITS MARKED

1 Thereupon,
2 the proceedings began at 9:02 a.m.:

3 THE STENOGRAPHER: The attorneys
4 participating in this deposition
5 acknowledge that I'm not physically
6 present in the deposition room and
7 that I will be reporting this
8 deposition remotely. The parties and
9 their counsel consent to this
10 arrangement and waive any objections
11 to this manner of reporting.

12 MR. PETRSORIC: This is
13 John Petrsoric from BC Law Group, and
14 you have my agreement.

15 MR. FRYCKMAN: This is
16 John-Paul Fryckman for petitioner, and
17 you have my agreement as well.

18 Whereupon,

19 ZHI DING, Ph.D.,
20 having been first duly sworn or affirmed, was
21 examined and testified as follows:

22 THE WITNESS: I do.

23 DIRECT EXAMINATION

24 BY MR. PETRSORIC:

25 Q. Good morning, Dr. Ding.

1 A. Good morning, Counsel.

2 Q. Quick -- some quick housekeeping.

3 How many times have you been
4 deposited before approximately?

5 A. Approximately 15 times.

6 Q. Okay. So you're fairly familiar
7 with the ground rules then; is that fair to
8 say?

9 A. I'm fairly familiar with general
10 rules of depositions and also remote
11 deposition as well.

12 Q. Any reason you can't testify
13 truthfully today?

14 A. No. None whatsoever.

15 Q. And if you need to take a break,
16 please let me know. All I will ask is that
17 you allow me to finish a line of questioning,
18 and I will try to get through it as quickly
19 as possible, if that's okay.

20 A. Certainly.

21 Q. And I know we all have a habit of
22 answering too quickly or speaking too
23 quickly, so I think to keep the record neat,
24 I will try to finish my questions and let you
25 finish your answers before the next one of us

1 speaks. Is that okay?

2 A. Oh, yeah. Of course.

3 Sorry. Did you mean to say I was
4 answering too quickly?

5 Q. No, no. Either you might answer
6 too quickly, or I might jump into the next
7 question too quickly. I just wanted to bring
8 that to both of our attention so we have a
9 cleaner transcript.

10 A. Okay.

11 Q. And you're here today to testify
12 with respect to two separate IPR proceedings.

13 Is that your understanding?

14 A. That is my understanding.

15 Q. And one of those IPR proceedings
16 is -- or inter partes review proceedings is
17 IPR 2022-01512.

18 Is that your understanding?

19 A. Yes, I believe so.

20 Q. And the other proceeding is the
21 IPR 2023-00151.

22 Is that your understanding?

23 A. Yes, that is my understanding.

24 Q. You submitted declarations in both
25 of these proceedings, correct?

1 A. I did submit declarations in both
2 proceedings.

3 Q. How did you prepare for your
4 deposition today?

5 A. I prepared by deposition for today
6 by reviewing my own declarations, and I also
7 reviewed the prior arts, and I had some
8 meetings with counsel in preparation for
9 today's deposition.

10 Q. And how long approximately did you
11 meet with counsel for?

12 A. Let me try to calibrate my time
13 here.

14 Yeah, approximately seven --
15 between seven and eight hours.

16 Q. And besides meeting with counsel
17 and reviewing your declaration and some of
18 the prior art references, did you do anything
19 else to prepare for the deposition?

20 A. No.

21 Q. Do you have in front of you the
22 declaration you submitted in the inter partes
23 review proceeding IPR 2022-01512?

24 A. I have both declarations here with
25 me. It -- my apologies, Counsel. It might

1 be easier if we just refer to the patent
2 number as opposed to the long numeral you
3 were reading off.

4 Q. Understandably good suggestion.

5 So the '152 proceeding is with
6 respect to the patent that ends in '777, the
7 triple seven patent.

8 And then the other proceeding,
9 which I referred to by 2023-00151, refers to
10 the '779 Patent?

11 A. That's correct.

12 Q. And both of your declarations were
13 submitted as Exhibit 1003 in the proceeding
14 on the '777 Patent and the proceeding on the
15 '779 Patent, correct?

16 A. That's correct.

17 Q. And both of your declarations
18 refer to some prior art -- some common prior
19 art references; is that correct?

20 A. Yes.

21 Q. And one of those prior art
22 references is US Patent Number 6,453,168?

23 A. That is right.

24 Q. And I believe you referred to this
25 reference in your declarations as McCrady,

1 correct?

2 A. That is correct. McCrady.

3 Q. Is it okay if we use that
4 reference throughout the remainder of the
5 deposition?

6 A. We'll be glad to do that, yes,
7 sir.

8 Q. Similarly -- and that was
9 Exhibit 1005 in both -- to both declarations;
10 is that correct?

11 A. Yes.

12 Q. And then the next reference was US
13 Patent Number 7,511,604 to Raphaeli, et al.;
14 is that correct?

15 A. Yes, that is true.

16 Q. And that patent, if we refer to it
17 as Raphaeli, is that acceptable?

18 A. Of course. I will be happy to do
19 that.

20 Q. And that particular patent was
21 Exhibit 1006 in -- for both declarations,
22 correct?

23 A. That is correct.

24 Q. Then Exhibit 1007, for both
25 declarations, was a patent to Kuwahara; is

1 that correct?

2 A. Yes. Yes, sir.

3 Q. And is it okay if we refer to
4 Exhibit 1007 as Kuwahara?

5 A. Of course. Kuwahara it is.

6 Q. Finally, US Patent
7 Number 7,058,414 to Rofheart, et al. was
8 referred to as Exhibit 1009 in both
9 declarations; is that correct?

10 A. Let me check the number real
11 quick. This is the one I'm a little foggy on
12 in terms of memory. Yes. Yes, it is.

13 Q. Okay. And is it okay if we refer
14 to this patent as Rofheart?

15 A. Of course.

16 Q. Do you have a recollection of
17 approximately how long you spent preparing
18 the declaration you submitted in the
19 proceeding for the '777 Patent?

20 A. Frankly, I don't have
21 recollections as to how long I spent
22 preparing the declaration for '777 in
23 particular. But just based on the volume,
24 you can tell it is not short. It was -- it
25 was hours of work, but I don't recall

1 precisely how many hours I spent in
2 preparation for this entire declaration
3 including reviewing the prior art and
4 charting the differences and writing basis
5 for the declaration.

6 So I'm sorry, I just don't recall
7 how many hours. I imagine it was very long
8 hours -- many, many long hours.

9 Q. Did you write the initial draft of
10 the declaration yourself?

11 A. I wrote the draft. This is my
12 report. I wrote the declaration with
13 counsel's help.

14 Q. And when you say "with counsel's
15 help," what do you mean by that?

16 A. Well, I'm not a lawyer; therefore,
17 I need help legal definitions and, you know,
18 the principles that I've alluded to in my
19 declaration, as I listed under Section 5,
20 legal standards -- legal standards for claim
21 construction, legal standards for obviousness
22 and so forth.

23 I relied on counsel's advice,
24 counsel for the petitioner, of course.

25 Q. So besides those portions that you

1 just mentioned, did you draft the remaining
2 portions of the declaration yourself?

3 A. For the declaration, that is my
4 declaration, and this is my report. It is
5 not the counsel's report or anyone else's
6 report.

7 Q. That wasn't exactly my question.
8 I'm just more curious, did you
9 draft those portions of the declaration
10 yourself?

11 A. I beg your pardon. I don't know
12 what you mean by "those portions."

13 Q. You mentioned that counsel
14 assisted you with Section 5 of the
15 declaration, and I'm -- I would like to know
16 with the remaining portions of the
17 declaration whether you drafted those
18 portions yourself or whether a counsel
19 assisted you in drafting any of those other
20 portions?

21 MR. FRYCKMAN: Objection. Form.

22 A. The report -- I wrote the report,
23 and the technical grounds analysis are
24 entirely my own. Counsel from time to time,
25 if I recall, assisted in clarifying the

1 language that we -- I often get advice from
2 counsel about what words and languages are --
3 maybe has a legal meaning, and since I'm not
4 a trained attorney, I try to stay away from
5 using loaded words.

6 So those are the -- that's my
7 recollection as to how I drafted the report
8 and then submitted that.

9 BY MR. PETRSORIC:

10 Q. Have you compared your declaration
11 in the proceeding for the '777 Patent to the
12 petition at all?

13 A. Have I compared? No. I don't
14 remember comparing anything about the
15 petitioning -- petitions. Yeah. No, I don't
16 recall that at all.

17 Q. On to technical matters.

18 I would ask you to pull up the
19 Exhibit 1005, McCrady.

20 A. Yes.

21 Q. And I would to first ask you,
22 generally, what is it that's -- what type of
23 system is it that McCrady is describing?

24 A. Okay. Right now, at this point,
25 I'm going to go to my report, but before I

1 dig into it, there is -- there are two quick
2 typos I would like to fix for the record.

3 The -- if I may go straight to
4 the -- to the -- this is regarding the '777
5 declaration. So I would like -- I would like
6 to go to -- let's see which section it was I
7 had issues. There's some -- there's more
8 typos.

9 Okay. Paragraph 241 on Page 145,
10 there's an equation that was taken out from
11 the Rofheart prior art. That's equation 10.
12 And in the equation, there is -- the line it
13 start was D equals to. And by the transcript
14 you can see that it says, D equals to
15 c x Trt/2.

16 What really had happened was this
17 was an error when I -- when the text was
18 copied out of the prior art, that X was
19 actually a multiplication sign, and
20 unfortunately the small mistake was made. So
21 I would like to correct that that X in
22 equation 10 should have been not a Roman
23 letter X. It should be a multiplication sign
24 across.

25 So that's -- and then the same

1 thing happened on the very next page. In
2 Paragraph 243, you will see the same equation
3 that should also be similarly corrected and
4 for exactly the same reasons.

5 The fonts also played a trick. In
6 Paragraph 244, the very last line, the
7 equation was D average equals to c -- the X
8 should still be a multiplication sign, and
9 TRT-average/2.

10 So that's the first two pages --
11 three locations where I would like to make a
12 correction on.

13 And then, similarly, if we flip
14 forward to Paragraph 268 on Page 152 of the
15 declaration, the same typo persisted.
16 There's a D average equals to c. That should
17 be a multiplication, TRT-average/2, not a
18 Roman letter X.

19 That's -- later on, when we get to
20 the other declaration, similar request will
21 be made by me to correct the typo. That's
22 what I have right now.

23 I apologize for interrupting your
24 questioning, Counsel.

25 Q. That's okay. So you -- so while

1 we're at it, do you want to identify those
2 particular paragraphs in the declaration for
3 the '779 Patent, or are you comfortable
4 stating it's the same correction that you're
5 making in likely multiple locations?

6 A. Yeah, it's likely multiple
7 locations. I can begin by listing the page
8 and paragraph number for the other
9 declaration if we -- if you prefer that we
10 just take care of them once for all.

11 Q. I -- it's your correction, so I
12 will let you have the floor in terms of the
13 details you would like to describe.

14 A. All right, Mr. Chairman. Go to
15 the '779 declaration. And I will start by
16 pointing to the same typographic -- same
17 typographic copy error.

18 In Paragraph 300 on Page 179, and
19 also in Paragraph 302 on Page 180, and
20 there's also Paragraph 303, also on Page 180,
21 the final line. And I also see another one
22 at least.

23 This is not meant to be
24 exhaustive, but I can find another one that's
25 in Paragraph 332 on Page 187. And I will

1 stop here.

2 In case there are others,
3 similar -- this is the similar error, and it
4 should be obvious to anyone reading it that
5 there was a transcription error copying the
6 multiplication sign into a Word text.

7 Q. I probably wouldn't have noticed
8 it if you didn't raise it.

9 A. All right.

10 Q. With that said, are there any
11 other errors that you know of in either
12 declaration?

13 A. Not at the moment. Not that I
14 know of. Thank you for the opportunity to
15 make a correction.

16 Q. If you during the deposition come
17 across any errors or things you believe
18 require a correction, will you please let me
19 know?

20 A. Certainly. Certainly, I would.

21 Q. Getting back to McCrady --

22 A. Okay. Go ahead. Sorry.

23 Q. Can you -- I will just re-ask it.

24 Generally, what type of system is
25 it that McCrady is describing?

1 A. Right. So as I wrote in my
2 report, McCrady is entitled Method and
3 Apparatus for Determining the Position of a
4 Mobile Communication Device Using Low
5 Accuracy Clocks.

6 This particular patent, as I
7 understand, really describes that a position
8 location system (10) would include a target
9 or a master mobile communication device or
10 radio (12) in communication with four
11 reference communication devices and that
12 these devices can be any portable electronic
13 devices equipped with wireless transmission
14 and reception capabilities.

15 McCrady's patent is discussing
16 method and apparatus for determining the
17 position of a mobile communication device in
18 this context.

19 Q. And the -- were you just referring
20 to Paragraph 51 of your declaration in the
21 '777 matter?

22 A. Yes, I'm referring to my
23 declaration in Paragraph 50 and 51.

24 Q. And Paragraph 51 refers to McCrady
25 at Column 6, Lines 44 through 56 initially?

1 A. Yes.

2 Q. And then if you -- turning to
3 McCradly, the next paragraph in McCradly
4 beginning at Column 6, Line 57 recites that,
5 Each of the reference radios (14, 16, 18, and
6 20) can be any radio located at a known
7 position that is capable of communicating
8 with the master radio (12) in the manner
9 described herein to convey position and
10 range-related information.

11 Do you see that?

12 A. I heard you, but I missed the
13 first part. Did you say, Counsel, that
14 you're reading off McCradly directly or
15 reading off my declaration's quotes of
16 McCrady?

17 Q. That was directly read from
18 McCrady.

19 A. Okay. I need to open that just so
20 that we are on the same page literally.

21 Referring to Figure 1, the
22 position location system (10) includes a
23 target of master mobile communication device
24 or radio (12) communicating with four
25 reference communication devices (14, 16, 18,

1 and 20).

2 Is that what we are reading or the
3 next paragraph?

4 Q. I was reading from the next
5 paragraph.

6 A. I see. Starting from Line 57?

7 Q. Yes.

8 A. Okay. Yes, I see that paragraph.

9 Q. The following sentence from there
10 says that, One or more of the reference
11 radios can be beacon-like radio fixedly
12 mounted in a known location such as on a
13 tower or building; is that correct?

14 A. It -- that's what -- yeah, that's
15 what McCrady stated in this paragraph.

16 Q. And then in that next sentence, it
17 states that, One or more of the reference
18 radios can also be a mobile radio capable of
19 determining its position from other sources
20 such as from reception of global positioning
21 system, GPS signals, or from being presently
22 located at a surveyed position whose
23 coordinates are known and stored -- known and
24 entered into the radio.

25 And then in parentheses, the

1 reference radios are not themselves GPS
2 satellites.

3 Do you see that?

4 A. Yes, I do.

5 Q. So is it your understanding that
6 McCrady is describing a system where the
7 reference radios will have some known
8 position for ranging purposes?

9 MR. FRYCKMAN: Objection. Form.

10 A. My understanding reading this
11 version of McCrady is that as an example, one
12 or more of the reference radios can be mobile
13 radios capable of determining its own
14 position from other sources.

15 I do not view that as the entirety
16 of McCrady's invention. In fact, it is not.

17 BY MR. PETRSORIC:

18 Q. And what you are saying is that
19 the reference radios will have a known
20 position associated with them?

21 A. No. That's -- what we are reading
22 literally is that one or more of the
23 reference radios -- one or more can also be a
24 mobile radio capable of determining its
25 position from other sources. I emphasize the

1 word "capable."

2 Q. And when you say "capable," does
3 McCrady require that the -- as part of the
4 ranging mechanisms described therein that the
5 reference radios have a known position at the
6 time of -- the ranging is accomplished?

7 A. I do not believe that was my
8 opinion either in my declaration or just
9 reading from McCrady.

10 Q. Do you have an opinion from
11 reading McCrady that is to the contrary?

12 MR. FRYCKMAN: Objection. Form.

13 A. I beg your pardon. I don't quite
14 understand the question yet. When you said
15 "contrary," how do you mean?

16 BY MR. PETRSORIC:

17 Q. Does McCrady describe a ranging
18 mechanism where the reference -- the position
19 of the reference radios is not known?

20 A. Yeah, I do not -- I do not recall
21 that. If you need me to look, I can check.
22 At least for what we have just read, these
23 were examples given by McCrady that in the
24 event that the position is unknown and it's
25 showing that there's a particular Figure 1,

1 that the position location can be obtained by
2 the master mobile communication device, a
3 radio 12, in communication with these
4 reference radios.

5 Q. Do you know if McCrady describes
6 a -- strike that.

7 Do you know if McCrady describes a
8 system where the position of the reference
9 radios is not known?

10 A. Do I know whether McCrady gave
11 examples when the positions of the reference
12 radios are unknown?

13 I don't recall that. I don't
14 recall writing about that subject. My
15 understanding of McCrady is that McCrady
16 does -- McCrady's patent is about position
17 location, not about ranging.

18 I recall your earlier question
19 was -- appears to mix the two, position
20 location versus ranging. I would just like
21 to state that McCrady is about -- is more --
22 is about more than ranging. It is about the
23 position location system. And the '777
24 Patent insofar as -- most of the claims are
25 about ranging.

1 So one would argue there's a
2 difference between the two. One -- a person
3 of ordinary skill would argue there's a
4 difference between the two.

5 Q. Thank you for the clarification.

6 So the -- is it fair to say that
7 McCrady as part of accomplishing a position
8 location -- strike that.

9 Is it fair to say that McCrady as
10 part of determining a position location uses
11 a ranging mechanism?

12 A. McCrady described the steps of
13 locating a mobile radio station through
14 exchange of messages, and that message, in
15 fact -- that message exchange allows the -- I
16 can go right into the specific part -- is
17 Paragraph 54, McCrady determines -- 54 of my
18 declaration.

19 McCrady determines a propagation
20 delay that is a round-trip propagation time
21 associated with the transmission of each
22 ranging message transmitted at time of
23 transmission and the respective reply signal
24 therefore received at the time of arrival
25 using the known device latency.

1 Here I quote from McCrady, by
2 precisely knowing the time of transmission of
3 the outbound ranging message, the far and
4 turnaround time at the reference radio
5 supplied to the master radio in the reply
6 ranging message, the time of arrival of the
7 replied ranging message, and the internal
8 transmission/reception processing delays, the
9 master radio can precisely determine the
10 two-way radio signal propagation time between
11 itself and each reference radio.

12 More specifically, the two-way or
13 round-trip propagation time, TRT, is the time
14 of arrival of the reply message minus the
15 time of transmission (TT) of the outbound
16 message minus the duration of the turnaround
17 time and internal processing delays within
18 the master radio.

19 I will stop here.

20 So suffice to say that McCrady
21 here discussed the use of a ranging message
22 and the reply message in response to the
23 ranging message to determine the device
24 position.

25 Q. Going back to the first sentence

1 you just read -- and before I do that, what
2 you just read from McCrady was beginning at
3 Column 8, Line 65 and going through about
4 Column 9, Line 9; is that correct?

5 A. It does start from Column 8,
6 Line 65 and proceed to Column 9, and the
7 entire paragraph ends at Column 9 of Line 22.
8 I think it's 22 or maybe 23. It's hard to
9 tell. Sorry.

10 Q. That's always a problem with the
11 patents, isn't it?

12 A. Yes, indeed.

13 Q. Going back to the first sentence
14 beginning at Column 8, Line 65, it says, by
15 precisely knowing the time of transmission of
16 the outbound ranging message.

17 Is McCrady saying that the time of
18 transmission of the outbound ranging message
19 would be precisely known?

20 A. McCrady does denote TT, the
21 acronym TT, as the time of transmission. And
22 this particular paragraph in McCrady does
23 state that the ranging -- the ranging steps
24 here relies on the knowledge of the time of
25 the transmission of the outbound ranging

1 message.

2 Q. And is McCrady saying in the first
3 sentence that this acronym TT, the time of
4 transmission, is something that is precisely
5 known?

6 A. It says that by precisely knowing
7 the time of transmission of outbound ranging
8 message, you would know the actual value of
9 the TT, thereby allow it to be subtracted as
10 you see from Column 9, on the next page, in
11 equation 2 of McCrady.

12 Without knowing the time of
13 transmission, it would be impossible to
14 subtract it out of the TRT in equation 1 of
15 McCrady in Column 9.

16 Q. And in addition to the time of
17 transmission, TT, McCrady in this section
18 also refers to the far end turnaround time at
19 the reference radio, and then parentheses,
20 supply to the master radio in the reply
21 ranging message; is that correct?

22 A. This paragraph does indeed talk
23 about the duration of the turnaround time
24 denoted as Greek letter delta TTA and the
25 internal processing delay within the master

1 radio delta TID.

2 Q. And I think I was more
3 specifically referring to the delta TTA. And
4 that's what we are -- McCrady is referring to
5 as the far end turnaround time at the
6 reference radio; is that correct?

7 A. Yes, I see that.

8 Q. And is it your understanding from
9 this paragraph that McCrady is also saying
10 that's another time value that's precisely
11 known?

12 A. This -- I think the word
13 "precisely" is used to discuss -- to describe
14 the time of transmission because you're the
15 one -- by "you," I mean, the mobile -- the
16 master state radio knows when the signal was
17 transmitted, and the paragraph here from
18 McCrady does not indicate to what precision
19 the delta TTA is known other than indicating
20 that its knowledge is used to estimate the
21 TRT, in this case, the two way or the
22 round-trip propagation time that takes the
23 radio signal from the transmitter to the
24 receiver and back from the receiver to the
25 transmitter, that two-way propagation time.

1 So that equation 1 shows how that
2 value of two-way or round-trip propagation
3 time is obtained or estimated.

4 Q. Does, to your knowledge, McCrady
5 describe the level of precision that delta
6 TTA is -- strike that.

7 Does, to your knowledge, McCrady
8 describing what the level of precision is for
9 that delta TTA?

10 A. Not to my recollection. There was
11 a precise discussion about the precision in
12 McCrady. Now, a person of ordinary skill in
13 the art would have understood that because
14 McCrady disclosed a mechanism or method for
15 which that information can be obtained from
16 the remote station, therefore, that
17 information ought to be quite accurate in
18 order for the master station to estimate the
19 two-way or round-trip propagation time in
20 equation 1.

21 Q. When you say "quite accurate,"
22 have you put any degree of precision on that?

23 MR. FRYCKMAN: Object to the
24 form.

25 A. I -- I'm not sure whether I have

1 done that or not. Could you clarify?

2 BY MR. PETRSORIC:

3 Q. You just said that the
4 information -- I believe you were referring
5 to delta TTA -- ought to be quite accurate.
6 Is that correct?

7 A. Yes. The more accurate, the more
8 precise you can estimate the round-trip
9 propagation time TRT.

10 Q. In reading McCrady, did you find
11 any further information that would indicate
12 the degree of precision that McCrady is
13 contemplating or requiring?

14 A. I see. As a person of ordinary
15 skill in the art reading this, not just an
16 expert, reading this, one who would
17 understand -- a person of ordinary skill
18 would have understood, you know, that
19 accuracy of the TTA and therefore the
20 accuracy of the round-trip propagation TRT
21 depends on the level of precision one would
22 like to have for the ranging step.

23 And in applications -- in some
24 applications, that precision may be very
25 high, and for that reason, it would have been

1 aspirational for a person of skill in the art
2 to understand, okay, for this application, if
3 I were to practice McCrady, I would need to
4 have a more precise transmission -- sorry,
5 delta TTA.

6 And there could be cases where
7 the -- like your Uber driver wanting to know
8 roughly where you are. As long as they can
9 see you, then that resolution they not be
10 necessary, so you could get away with a lower
11 resolution of TRT. Therefore, you wouldn't
12 have to have extremely precise delta TTA.
13 That is all a matter of application and
14 implementation.

15 So it is scenario-driven, and a
16 person of ordinary skill in the art would not
17 need to read the precise definition of the --
18 the level of precision required for delta
19 TTA. They could have easily computed it and
20 use it to address the specific problems they
21 were trying to solve in position location or
22 in ranging.

23 Q. And in general, McCrady -- with
24 respect to the precision of ranging, do you
25 know what McCrady describes in terms of that

1 level of precision?

2 A. I'm sorry. Could you ask
3 differently? I didn't quite understand.

4 Q. What level of precision of ranging
5 does McCrady describe with respect to your
6 understanding -- strike that. Let me ask it
7 a little bit more clearly.

8 What is your understanding of the
9 level of precision of ranging that McCrady
10 describes?

11 A. Yeah, as I explained in -- earlier
12 that of the -- to a person of ordinary skill
13 in the art, the understanding would have
14 been, reading McCrady, that it is application
15 or device-specific. It really depends on
16 what application you are concerned with.

17 If you're dealing with, let's say,
18 a celestial level of positioning, then maybe,
19 you know, miles or hundreds of miles, that
20 kind of accuracy would have been sufficient.

21 But if you're dealing with
22 something -- let's say, I lost my cat. I'm
23 looking for my cat, then you need to have
24 something much more precise or else I will be
25 running around the whole city.

1 So a person of ordinary skill in
2 the art would have understood that reading
3 McCradly, it is -- it has enough information.
4 It has very good information to apply the
5 McCradly's -- McCradly's disclosure in their
6 assistant -- in the application they aspire
7 to use, the McCradly's technique and system.

8 Q. Having just put an AirTag on a
9 puppy, I understand what you're referring to
10 there.

11 Let me just ask just quickly, do
12 you know if -- if there are any specific
13 range resolutions that McCradly refers to?

14 MR. FRYCKMAN: Objection. Form.

15 A. There are informations that
16 McCradly discussed regarding to the level of
17 resolution on the clocks. So that is
18 directly related in the example given by
19 McCradly to show that your -- the resolution
20 of delta TTA would be -- were likely going to
21 be related to the clock resolution.

22 And after all, McCradly's patent is
23 about positioning of a mobile communication
24 device using, you know, even rather
25 low-accuracy clocks, you could get a good

1 precision.

2 But in terms of a clock
3 resolution, I would like to point you to
4 Column 9 starting at Line 62. Here I read
5 from McCrady: That is, conventional systems
6 that maintain synchronization of the local
7 clocks need highly accurate clocks, e.g.,
8 0.03 ppm.

9 So that tells you the accuracy of
10 the clocks that are typically used or could
11 be used for a ranging application.

12 And here I continue -- McCrady
13 continues by saying: And periodic
14 synchronization processing to prevent the
15 clocks from drifting relative to each other
16 over time. In contrast, the clocks of the
17 present invention can be accurate, for
18 example, to approximately 1 ppm.

19 So there are discussions in
20 McCrady in reference to the clock accuracy,
21 the level of accuracy one is to expect from
22 the round-trip propagation time estimation.
23 BY MR. PETRSORIC:

24 Q. And just for the point of clarity,
25 when speaking of the accuracy of the clocks,

1 are we discussing the frequency of the
2 clocks?

3 MR. FRYCKMAN: Objection. Form.

4 A. I'm not certain that I mentioned
5 the frequency nor do I see it in what I just
6 read.

7 BY MR. PETRSORIC:

8 Q. Okay. Do you have an opinion as
9 to what the accuracy of the clocks that
10 McCrady is referring to means?

11 A. A person of ordinary skill in the
12 art reading McCrady's discussion about the
13 clock accuracy would have understood that the
14 clock accuracy would be in the orders of one
15 parts per million.

16 So that one can consider this --
17 consider that to indicate how precisely you
18 can count on your clock to record the time,
19 the one parts per million.

20 Q. And can you tell me, if you know,
21 what aspects of the clocks would affect the
22 accuracy?

23 A. Well, a clock -- a clock accuracy
24 is -- describes a situation when -- sorry --
25 describes how confident you are that the

1 clock timing would not drift over time.
2 Because in the manufacturing process, the
3 clocks are -- can, in fact, drift over time
4 because of the environment, the humidity,
5 temperature, and so forth.

6 In discussing clock
7 synchronization here in McCrady is discussing
8 how accurate you can rely on your clock. If
9 your clock says that right now is
10 1:00 p.m. -- I hope -- I guess it's close
11 enough -- then one part per million would
12 just mean that you're accurate up to
13 1 million of the -- to the hour.

14 So if you care about -- you only
15 care about the accuracy to the hour, then
16 that's just -- that's the clock accuracy is
17 describing. You can count on that you're
18 only ten to the minus six plus-minus away
19 from 1:00.

20 Q. Are there any other aspects of a
21 clock that might drift over time?

22 A. I'm sorry. Could you rephrase --
23 did you mean my -- whether McCrady talks
24 about it or in my declaration I talk about a
25 clock that you're asking about?

1 Q. Just your understanding generally
2 from a -- for a person of ordinary skill in
3 the art?

4 A. I'm sorry. And please -- can you
5 ask that question again? As a person of
6 ordinary skill would have known -- what else?

7 Q. Are there any other aspects of a
8 clock that might drift over time?

9 A. In addition to temperature and
10 humidity?

11 Q. No, not things that cause it, but
12 what a clock might be referring to.

13 MR. FRYCKMAN: Objection. Form.

14 A. I'm sorry. I don't understand the
15 question. I believe I gave you examples to
16 what a clock drift is about, and I'll just
17 stick with that answer. I thought it was
18 pretty clear.

19 BY MR. PETRSORIC:

20 Q. Let me approach maybe from a
21 slightly different point of view.

22 In digital systems -- digital
23 systems that -- will typically use a clock to
24 increment counters and the like; is that
25 correct?

1 A. I did not opine on digital system
2 using clock and so forth. I would like to
3 agree with you, but sorry, I haven't thought
4 about that.

5 Q. Okay. In general, though, is
6 there -- never mind. We'll move on.

7 MR. PETRSORIC: We have been
8 going about an hour. Would you like
9 to take a break? This might be a good
10 time.

11 THE WITNESS: Yeah. It's
12 probably a good tea time.

13 (A brief recess was held from
14 10:00 a.m. to 10:12 a.m.)

15 BY MR. PETRSORIC:

16 Q. Dr. Ding, a few minutes ago we
17 were talking about the equation at Column 9.
18 I believe it's about Line 13 of McCrady, and
19 that is that TRT equals TOA minus TT minus
20 delta TA minus delta TID; is that correct?

21 A. Yes, I see that equation.

22 Q. And you mentioned, I believe, TOE
23 is the time of arrival of the reply
24 message -- ranging message; is that correct?

25 A. No, I -- unless I misheard you. I

1 didn't say it was a time of arrival of the
2 ranging message. It's -- TOA is the time of
3 arrival of the reply message.

4 Q. I thought that's what I asked,
5 but --

6 A. Okay. Maybe I misheard you. I
7 apologize.

8 Q. That's okay.
9 So just to confirm, TOA is the
10 time of arrival of the reply ranging message?

11 A. It's time of arrival of the reply
12 to the ranging message.

13 Q. Okay. And TT is the time of
14 transmission of the ranging message?

15 A. Right. That is -- TT is the time
16 of transmission of the outbound ranging
17 message.

18 Q. The delta TTA is the turn-around
19 time at a reference radio, correct?

20 A. Delta TTA is the turn-around time
21 from the reference radio, yes.

22 Q. And is it fair to say that the
23 components of delta TTA are described in
24 McCrady at Column 10 beginning at Line 64 and
25 going through Column 11 at Line 23?

1 A. Sorry, Counsel. I'm not sure if
2 I'm missing something. But we are talking
3 about delta TTA, and I would agree that
4 McCrady has lengthy discussions in and around
5 Column 9 and Column 10. But I'm lost with
6 regard to how to answer you question.

7 Are you asking me whether those
8 sections that you mentioned in Column 10 and
9 11 discusses delta TTA?

10 Q. Do those -- yes. Do those
11 sections discuss what delta TTA would be --
12 the components that delta TTA would be
13 comprised of?

14 A. I see that you're referring to the
15 parts where McCrady is discussing the
16 calibration process to determine internal
17 delays.

18 Q. Yes. Let me -- yes, that's
19 correct.

20 Are the internal delays of the
21 reference radio that are described at
22 Column 10 from Line 64 through Column 11,
23 Line 14, do these factor into the delta TTA?

24 A. The internal delays of the
25 reference radio does -- the internal delays

1 of the reference radio do affect the delta
2 TTA.

3 Q. And then at Column 11 from Line 15
4 through Line 23, there's a discussion of the
5 radio antenna delay TA.

6 Do you see that?

7 A. I see these -- I see the paragraph
8 starting Line 15 of Column 11 begin by
9 discussing the value for the master and the
10 reference radio antenna delay TA. See
11 Figure 4.

12 Yes, I see it.

13 Q. Okay. And is the -- for the
14 reference radio antenna delay, TA, does that
15 also factor into the -- affecting the delta
16 TTA?

17 A. Yes, the -- I was just trying to
18 confirm that I didn't miss the section.

19 So starting from Column 11,
20 McCrady stated that, Thus the internal
21 processing delay of the master radio with
22 delta TID seen in equation 1 is determined
23 from the master radio transmitter and
24 receiver delays TMT and TMR determined from
25 the calibration process and the estimated

1 antenna delay TA.

2 And that's for the master radio.

3 So let me continue to read.

4 Similarly, the estimate of the
5 duration the turn-around time TT includes the
6 reference radio transmitter and receiver
7 delays TRT and TRR determined from the
8 calibration process and the estimated antenna
9 delay TA.

10 The total elapsed time measured by
11 the master radio between the transmission of
12 the outbound ranging message and reception of
13 reply ranging message includes time
14 attributable to the propagation of the
15 message signal and time attributable to
16 processing delays within the radios.

17 Q. Thank you.

18 So, in effect, the TMT, TMR, TA
19 for the master radio, TRT, TRR, and TA for
20 the reference radio could be substituted into
21 that equation 1 at Column 9, Line 13?

22 MR. FRYCKMAN: Object to the
23 form.

24 A. I don't believe McCrady talks
25 about substitution. The correct word is

1 "determined from." That's what McCrady was
2 discussing here.

3 Q. So -- but from a mathematical
4 perspective, if it's -- if delta TID is
5 determined by adding TMR, TMT, and TA for the
6 master radio antenna, that is how you arrive
7 at delta TID?

8 A. I believe, Counsel, you're
9 describing a -- so there's a premise to your
10 question, that is, whether the TRT and TRR
11 and the antenna delay TA are all there is in
12 terms of the internal processing time, which
13 may or may not be all there is.

14 So if we are working under the
15 assumption in an example where that's all
16 there is, then you could potentially
17 substitute, but there could be occasions
18 where there's additional processing delaying
19 that has not been accounted for, and in that
20 case, you would look into what else would
21 have affected delta TTA.

22 Q. I understand that.

23 And -- but do you know if McCrady
24 describes any other delays that have not been
25 accounted for?

1 MR. FRYCKMAN: Objection. Form.

2 A. McCrady discusses variations. For
3 example, the very next paragraph starts on
4 Line 40 of McCrady started by saying, The
5 internal delay calibration performed in the
6 radios of the present invention is one of
7 keys in getting repeatable accuracy with low
8 resolution clocks. In essence, by sending
9 calibration signals through the same
10 processing used to subsequently transmit the
11 actual ranging signal, the difficult to
12 categorize processing delay variations can be
13 calibrated out to yield a more accurate
14 measurement.

15 Here, as one can see, there are
16 potentially variations in the delay, and
17 McCrady has mentioned that possibility and
18 proposed a solution to, in fact, mitigate.

19 BY MR. PETRSORIC:

20 Q. If -- referring back to Column 10
21 at line -- beginning at Line 44, for the
22 master radio, McCrady describes a calibration
23 process where multiple trials are performed
24 in average to reduce the variance of the
25 internal delays estimated, which the internal

1 delays it refers to there are TMT and TMR; is
2 that correct?

3 A. I believe you're reading from
4 Line 48, Multiple trials, for example, ten,
5 are performed and averaged to reduce the
6 variance of the delay estimate. The delay
7 TMT is a master radio transmitter delay.

8 Is that correct? I think that's
9 what you're reading from, and I confirmed
10 that's what McCrady discusses here.

11 Q. Okay. Thank you.

12 I just wanted to confirm, for
13 example, delta TID, as described by McCrady
14 is -- consists of TMT, TMR, and TA for the
15 master radio antenna. Is that correct?

16 MR. FRYCKMAN: Objection. Form.

17 A. The McCrady stated that the TID
18 is -- contains the internal delays TMT and
19 TMR.

20 BY MR. PETRSORIC:

21 Q. And McCrady doesn't describe any
22 additional values or delays that go into the
23 delta TID, does it?

24 A. I do not recall explaining
25 McCrady's discussion on potentially other

1 delays. But as we mentioned -- discussed
2 earlier, the variations -- variations exist
3 in any given systems, so a person of ordinary
4 skill in the art would have understood that
5 if there were other delays, then you would
6 account for that.

7 And that's only correct for a
8 practitioner -- a person of ordinary skill in
9 the art reading the discussions on McCrady to
10 understand that what you do need to find is
11 the factual internal processing delay data
12 TID.

13 It's not limited to just the
14 calibration delay or the antenna delay.
15 Essentially whatever delay that you can
16 estimate in the system you would like to
17 practice, the techniques and methods
18 explained by McCrady would have -- should
19 have been accounted for.

20 Q. But just to be clear, without
21 describing any other variations, McCrady
22 discloses the TMT, TMR, and the TA master
23 antenna delay and no further variations
24 beyond that?

25 A. As specific examples, I answered

1 that I don't recall that. But I always -- as
2 a person of ordinary skill in the art, you
3 always go and look at the totality of the
4 patent and read, in this case, what McCrady
5 explained as the general principals of this
6 invention.

7 McCrady in Column 17 -- at the
8 very end of Column 17, paragraph starting
9 from Line 59 stated that, Having described
10 preferred embodiment of new and improved
11 method and apparatus for determining the
12 position of a mobile communication device
13 using low-accuracy clocks, it is believed
14 that other modifications, variations, and
15 changes will be suggested by those skilled in
16 the art to view -- in view of the teachings
17 set forth herein. It's therefore to be
18 understood that all such variations,
19 modifications, and changes are believed to
20 fall within the scope of the present
21 invention as defined by the appended claims.

22 So in summary, a person of
23 ordinary skill in the art would have
24 understood that any other variations, be it
25 the system-level variation, the practical

1 environment, what the additional process in
2 delays may be necessary can be accounted for,
3 and McCrady anticipated it, these variations
4 and modifications as a part of the -- as the
5 scope of this present invention.

6 Q. Okay. So what I understand you're
7 saying is that the -- within what -- McCrady
8 explicitly describes, there's TMT, TMR, and
9 TA of the master radio, but it would have
10 been the understanding of one of ordinary
11 skill in the art that there could be
12 potentially other delays that could factor in
13 as well?

14 A. Yeah. My answer was I do not
15 recall any other delays that was entered.
16 But not necessarily mean there isn't. This
17 is -- really was more than a year ago, and it
18 was a -- this was involves a declaration
19 altogether over 350 pages.

20 So I don't recall that at the
21 moment, but I also would like to explain that
22 as a matter of principle, McCrady discussed
23 their potential variations and modifications
24 by those of ordinary skill in the art in view
25 of what their practical application of

1 McCradly's invention would apply to.

2 So it would have been obvious at
3 least to suggest other delays in them. But
4 McCradly was only giving, after all, examples
5 about the internal delay, not exhaustive list
6 of all delays that may arise in the process
7 of practicing his invention.

8 Q. I understand. Thank you.

9 Moving on to the bottom of
10 Column 11, beginning at Line 59, there's a
11 paragraph that goes through Column 12 at
12 Line 7.

13 Do you see that?

14 A. Yes.

15 Q. And the first sentence of this
16 paragraph reads, Another aspect to accurately
17 determining the range between the master
18 radio and the reference radios is the precise
19 estimate of the time of arrival of the
20 outbound ranging message at the reference
21 radio and the time of arrival of the reply
22 ranging message at the master radio.

23 Do you see that?

24 A. Yes. I see what you're referring
25 to.

1 Q. And the next sentence reads, In
2 accordance with another aspect of the present
3 invention, the timing of the leading edge of
4 a synchronization sequence of the ranging
5 message is accurately determined by assessing
6 and avoiding multipath interference which can
7 degrade the accuracy of the time of arrival
8 estimate.

9 Do you see that?

10 A. I see it.

11 Q. What would be the purpose of
12 assessing and avoiding multipath
13 interference?

14 A. As McCrady stated, it's to avoid
15 their impact that might degrade the accuracy
16 of the time arrival estimate.

17 Q. Is that because as a result of
18 multipath interference, the timing of the
19 arrival of a signal at a radio could be
20 shifted from the time that it should take
21 based purely on propagation delay?

22 A. I'm sorry. Did you say clock?

23 Q. No. I said that -- would
24 multipath interference affect the timing of
25 the arrival of a signal on a radio such that

1 the time of arrival would be different if
2 there was no multipath interference?

3 A. All right. In here, as an
4 example, multipath could degrade the accuracy
5 of the time of arrival estimate. Physics are
6 physics. So time of arrival is the time of
7 arrival.

8 So it's not that multipath would
9 make it difficult. It's only that they can
10 be -- in the case of a multipath channel, you
11 could get several copies, like echoes of the
12 message. Therefore, it poses challenges to
13 the receiver in determining which one of the
14 multipath arrivals is the -- either the
15 dominant or the true time of arrival.

16 So that poses the challenge of the
17 estimate that McCrady here attempts to
18 address.

19 Q. Is it your understanding that
20 McCrady is noting that this should be
21 addressed at both radios?

22 A. I did not -- I did not see that
23 part being discussed here by McCrady.

24 Q. In this particular paragraph, does
25 McCrady limit the multipath interference

1 assessment to a particular radio?

2 MR. FRYCKMAN: Objection. Form.

3 A. It doesn't specifically -- McCrady
4 does not specifically limit this discussion
5 on multipath to one or the other. In fact,
6 it states that another aspect is -- aspect to
7 accurately determining the range between
8 master radio and the reference radio is the
9 precise estimate of the time of arrival of
10 the outbound ranging message and the
11 reference radio and the time of arrival of
12 the reply ranging message of the master
13 radio.

14 BY MR. PETRSORIC:

15 Q. Do you understand that opening of
16 the paragraph, when taken in the context of
17 the following sentence, that McCrady is
18 indicating that the assessment and avoidance
19 of multipath interference can be used at both
20 radios to assist in the precise estimation of
21 time of arrival of a particular message?

22 A. I have not formed an opinion on
23 that one way or the other. It may -- it
24 certainly -- McCrady -- this paragraph
25 provides an understanding to a person of

1 ordinary -- or ordinary skill in the art that
2 you can consider both -- both impacts -- the
3 impact -- the multipath impact on the
4 outbound ranging message and the impact on
5 the time of arrival of the reply ranging
6 message.

7 Q. And is it your understanding then
8 that McCrady describes a process to assess
9 the effects of multipath interference?

10 A. So McCrady started stating that
11 this discussion that you're referring to
12 starting from paragraph -- Line 59 of
13 Column 11 going to Column 12, but we'll start
14 from Column 12.

15 McCrady explained that, in
16 particular, in the context of the discussion
17 regarding multipath, a two-stage signal
18 acquisition scheme is employed using the
19 communication acquisition sequence and the
20 TOA synchronization sequence of the RTS-T and
21 the TOA message.

22 Detection of the communication
23 acquisition sequence is used to trigger
24 acquisition of the TOA synchronization
25 sequence in which the time of arrival is

1 precisely estimated.

2 Q. Where were you just reading from?

3 A. I beg your pardon. I was reading
4 from Column 12 starting from Line 1 to
5 Line 7. That's where McCrady explained
6 better -- more precise estimation -- precise
7 estimation of the time of arrival.

8 Q. Okay. And it mentions a two-stage
9 signal acquisition scheme, correct?

10 A. It does mention a two-stage signal
11 acquisition scheme is employed.

12 Q. And is it fair to say the first
13 stage is the -- was with respect to the
14 communication acquisition sequence?

15 A. The two-stage signal acquisition
16 scheme is employed using, number 1, A, the
17 communication acquisition sequence and, B,
18 the TOA synchronization sequence of the RTS-A
19 and TOA messages.

20 Q. The -- this two-stage acquisition
21 process, is not something you discussed in
22 your declaration, is it?

23 A. Not in my recollection. I do not
24 recall discussing this particular aspect of
25 McCrady's path in detail.

1 Q. Moving on to Column 13, at Line 15
2 it refers to the TOA estimation algorithm in
3 accordance with an exemplary embodiment of
4 the present invention as shown in Figure 7.

5 Do you see that?

6 A. Yes, I see that.

7 Q. And is it your understanding that
8 the TOA estimation algorithm that's
9 referenced here is with respect to assessing
10 and avoiding the effects of multipath
11 interference?

12 A. It's my understanding in the
13 discussion provided by McCrady that the
14 resulting TOA measurement and the estimate as
15 discussed here and in Figure 7 are part of
16 the two-step -- the two-step process that we
17 discussed earlier -- the two-stage process we
18 discussed earlier.

19 Q. The following sentence says, Note
20 that TOA processing occurs in both the
21 reference radio upon reception of the
22 outbound RTS-T ranging message and in the
23 master radio upon reception of the reply TOA
24 ranging message.

25 Do you see that?

1 A. Yes, I see that sentence.

2 Q. So am I correct that McCrady is
3 describing that both radios would implement
4 the two-stage acquisition process or could
5 implement the two-stage acquisition process?

6 A. All I can see from this paragraph
7 is that McCrady describes at least a TOA
8 estimation algorithm in accordance with this
9 exemplary embodiment of Figure 7 occurs in
10 both the reference radio and the master
11 radio. So it can be used in both radios.

12 Q. Moving down Column 13 to Line 48,
13 there's a paragraph that begins, The TOA
14 processor can be configured to provide one or
15 more levels of TOA accuracy.

16 Do you see that?

17 A. I am sorry. I'm still looking for
18 it. This is Line 48?

19 Q. 48.

20 A. I see it.

21 Q. And then the next sentence, it --
22 I believe it indicates that the TOA processor
23 as shown in the embodiment of Figure 7 is
24 capable of providing two selectable levels of
25 accuracy, a one-meter accuracy and the

1 three-meter accuracy.

2 And then it also notes in
3 parentheses that the accuracy refers to the
4 resultant range estimate.

5 Do you see that?

6 A. I see it.

7 Q. So is it fair to say that McCrady
8 is describing a system that can achieve
9 accuracy of range within a one-meter
10 resolution and -- or can achieve accuracy of
11 range within a three-meter resolution?

12 A. My reading of McCrady as a person
13 of skill in the art is that Figure 7
14 provides -- can provide one or more levels of
15 TOA accuracy, and in paragraph -- starting
16 from Line 48, it describes in this example
17 that the TOA processor, in this example,
18 Figure 7, is capable of providing two
19 selective levels of accuracy.

20 So this example McCrady provides
21 can be one-meter or three-meter selectable.
22 It is my understanding that a person of
23 ordinary skill in the art would have read it
24 and understood that these are exemplary
25 embodiment. The whole ideas that McCrady's

1 trying to address is that you could consider
2 multi-levels of accuracy, and that is what
3 the essence of Figure 7 is trying to
4 illustrate.

5 Q. And is that level of accuracy
6 would be -- would be understood to a person
7 of ordinary skill in the art that it's the
8 embodiment of Figure 7 combined with the
9 remaining teachings of McCrady with respect
10 to --

11 MR. FRYCKMAN: Objection.

12 BY MR. PETRSORIC:

13 Q. -- the precision of timing
14 determinations?

15 MR. FRYCKMAN: Objection. Form.

16 A. That is -- it's not clear what
17 you're asking, Counsel.

18 So Figure 7 and the teaching
19 explained in and around those paragraphs are
20 doing what?

21 BY MR. PETRSORIC:

22 Q. Let me see if I can ask this.
23 Would a person of ordinary skill
24 in the art understand that by implementing
25 the embodiment shown in Figure 7, along with

1 the other aspects that McCrady describes,
2 could achieve range resolution within one
3 meter in one instance and three meters in
4 another instance?

5 A. Oh, I see.

6 Right. In the -- a person of
7 ordinary skill in the art, in my opinion,
8 would read Figure 7 and the discussion that
9 understood that this example provides
10 implementation that can achieve a selectable
11 accuracy, be it one-meter or three-meter
12 accuracy of ranging.

13 And if one looks at Figure 7, you
14 could -- a person of ordinary skill in the
15 art would have seen that they are -- you
16 know, this is clearly just a example because
17 they are numbers such as three chips, larger
18 and smaller than three chips and smaller than
19 three chips.

20 There's also DMT where N is 128
21 and -- sorry, DMF. There is N is 128, and
22 there's DMF which N is 4096. So a person of
23 skill in the art reading that would have
24 understood that this provides the framework
25 of TOA processing that can achieve

1 multi-levels of accuracy with one meter and
2 three meter as an example.

3 Q. Going to Column 14, and the first
4 paragraph beginning at Line 1, McCrady
5 indicates that when the multipath
6 interference is judged by the pulse width
7 evaluator 96 to be insubstantial, the TOA
8 estimate is obtained via a curve-fitting
9 algorithm using the leading-edge samples plus
10 two samples after the peak.

11 Do you see that?

12 A. Yes.

13 Q. It also says, Post peak samples
14 can be used because the multipath will not
15 corrupt them in this case.

16 And the paragraph concludes, A
17 high accuracy TOA measurement, in
18 parentheses, e.g., one meter accuracy, is
19 attained in this case, regardless of the
20 selective accuracy mode.

21 Do you see that?

22 A. I see it, yep.

23 Q. Can you explain to me what -- if
24 you know, what these -- what this paragraph
25 is describing in general terms?

1 A. I don't need to explain in general
2 terms because McCrady already explained that,
3 When the multipath interference is judged by
4 the pulse width evaluator 96 to be
5 insubstantial, then the TOA estimate can be
6 obtained via a curve-fitting algorithm using
7 the leading edge samples plus two samples
8 after the peak.

9 And then you read the rest. The
10 point is that in this case, when the
11 multipath interference is judged to be
12 insubstantial, a high accuracy TOA
13 measurement is attained in this case
14 regardless of which accuracy mode you select.

15 It basically just says in plain
16 language that you get a high accuracy TOA
17 measurement regardless of what accuracy you
18 select because the multipath interference is
19 judged by the pulse width evaluator 96 to be
20 insignificant or insubstantial.

21 Q. Do you know how the pulse width
22 evaluator 96 determines whether multipath
23 interference is insubstantial?

24 A. Do I understand how it is done?

25 Q. Yes.

1 A. I do.

2 Q. Can you explain that to me?

3 A. Yes. So the McCrady talked about
4 this particular -- this particular evaluator
5 96 in the discussion would begin from
6 Column 13. So a person of ordinary skill in
7 the art reading about the evaluator would
8 have read this portion.

9 It states that the -- starting
10 from Column 13, Line 26 that, Matched
11 filtering is performed on the 4096 chip TOA
12 synchronization sequence using a digital
13 matched filter with N equal to 4096.

14 After performing a magnitude
15 function block 94, the filtered TOA
16 synchronization sequence is applied to a
17 pulse width evaluator 96, which determines
18 the severity of the multipath interference
19 between the master radio and the reference
20 radio at the frequency of the ranging
21 message.

22 Essentially, a replica of the TOA
23 synchronization sequence's multipath-free
24 correlation function out of the matched
25 filter is stored in the pulse width evaluator

1 96 (i.e., the -- the multipath-free pulse
2 shape profile is known).

3 So with that, the pulse width
4 evaluator moved the pulse-shaped replica
5 through the profile of the output of the
6 matched filter 92 and performed a
7 least-mean-square error fit to achieve a
8 rough curve fitting between the replica pulse
9 shape and the matched filter output to
10 identify the timing of the direct path signal
11 and the subsequent multipath signal at the
12 time of the direct path signal and the
13 multipath signal.

14 The matched filter profile will be
15 similar to the replica profile.

16 In this manner -- McCrady
17 continued -- the pulse width evaluator 96 can
18 determine the separation in terms of chips
19 between the direct path signal and the
20 closest substantial multipath interference
21 signal.

22 So here's how McCrady explained
23 this pulse width evaluator would be able to
24 make that determination.

25 Q. The distance in the number of

1 chips between the direct path -- the expected
2 direct path signal and the closest
3 substantial multipath interference signal
4 would determine the time effect that the
5 multipath interference would have. Is that
6 accurate?

7 A. I hate to say this, but I don't
8 understand what -- what you'd like me to say
9 about your explanation about what is
10 accurate.

11 I think if a person of skill in
12 the art reading this section, it would have
13 been clear to them that you're using a least
14 square base curve fitting and based on a
15 replica of the TOA synchronization sequences
16 multipath-free correlation function.

17 And then that particular function
18 has been stored in the pulse width evaluator
19 96 through which you can determine the pulse
20 width by using the pulse width evaluator.

21 Q. Let me see if I can just ask this
22 question in simpler terms.

23 So the comparison of the replica
24 of the TOA synchronization sequence with the
25 least mean squared curve fitting of the

1 actual received sequence would determine the
2 number of chips that separate the two?

3 A. As a principle, I do not see any
4 discussion on chips nor do I find it
5 necessary. The comparison can be in certain
6 time units. It's not what -- this is not
7 what McCrady says, that you have to evaluate
8 this difference based on the number of chips.

9 Q. At Column 13, Lines 44 through 47,
10 McCrady states, In this manner, the pulse
11 width evaluator 96 can determine the
12 separation in terms of chips between the
13 direct path signal and the closest
14 substantial multipath interference signal.

15 Do you see that?

16 A. I do.

17 Q. What is McCrady describing then
18 there when he references in terms of chips?

19 A. Well, McCrady explaining in this
20 particular example, matched filtering is
21 performed on the 4096 chip TOA
22 synchronization sequence.

23 So in that context, if your TOA
24 synchronization sequence consists of certain
25 chips, then this example shows that the pulse

1 width evaluator can determine separation in
2 terms of chips.

3 But as a general principle, the
4 pulse width evaluator as taught in McCrady is
5 broader than that to a person of ordinary
6 skill in the art.

7 The whole idea is you need to have
8 a pulse -- you use a pulse width evaluator to
9 judge whether the multipath interference is
10 substantial enough. That goes back to
11 Column 14, Line 1.

12 And then you will discover that if
13 the multipath interference, whether you're
14 using chips or not is insubstantial, then you
15 will get a high accuracy TOA measurement
16 because the environment is very -- the
17 environment is very favorable.

18 The multipath is not severe when
19 you're trying to perform ranging.

20 Q. Okay. I understand what you're
21 saying with respect to how a POSITA would
22 view the description of McCrady with respect
23 to the pulse width evaluator.

24 Just trying to make sure that I
25 understand is that McCrady's specific use of

1 determining the separation in terms of chips
2 is one way to determine the separation in
3 time from the expected direct path signal and
4 the closest substantial multipath signal that
5 is derived from the curve fitting. Is that
6 accurate?

7 A. I'm sorry. But I think McCrady's
8 giving a quite accurate statement that I
9 could have in 30 seconds. So I feel that a
10 person of ordinary skill in the art reading
11 McCrady would have gotten a much more
12 accurate picture than what you want -- would
13 like me to confirm what your summary is.

14 Q. Okay. Just -- can you just
15 explain then how -- let me break this down
16 from the sentence at Column 13 from Line 44
17 through 47.

18 A. Yes.

19 Q. So the pulse width evaluator can
20 determine separation between the direct path
21 signal and the closest substantial multipath
22 interference signal, correct?

23 A. Yes.

24 Q. And McCrady, in that sense, is
25 indicating that the separation is indicated

1 in terms of chips; is that accurate?

2 A. That sentence is absolutely
3 accurate. It is, However, in the context of
4 performing a match filtering on a chip-based
5 TOA synchronization sequence.

6 So that wraps up the exemplary
7 discussion starting from Line 26 of the same
8 column. And what I was explaining is that
9 this is an example on chip-based
10 synchronization sequence and to a person of
11 skill in the art, it's really just describing
12 the use of a match filter, and if the match
13 filter is applied with respect to a
14 chip-based sequence, then you can -- as
15 McCrady says, that you can get a pulse width
16 evaluator that provides the separation in
17 terms of chips.

18 Q. Does the separation in terms of
19 chips relate to a separation in terms of
20 time?

21 A. Time can be measured in terms of
22 chips. In this example, it shows that.

23 Q. Just to confirm two more points.

24 The direct path signal is the --
25 let me make sure I get this right so we can

1 finish this point.

2 So the direct path signal is what
3 McCrady refers to as a replica of the TOA
4 synchronization sequence's multipath free
5 correlation function out of the matched
6 filter?

7 A. I'm sorry. Is your question --
8 are you asking me about what McCrady said or
9 in a particular line or --

10 Q. I'm asking in this particular
11 sentence at Column 13, Line 44 through 47 --

12 A. Right.

13 Q. -- whether the reference to a
14 direct path signal is a reference to the
15 replica TOA synchronization sequence
16 correlation function out of the match filter?

17 A. No. The filter output is used in
18 this manner by the pulse width evaluator to
19 determine the separation between the direct
20 path signal and the closest substantial
21 multipath interference signal.

22 So you would like to know -- what
23 you would really like to evaluate, according
24 to McCrady and the person of ordinary skill
25 in the art would have understood, is that

1 what is the separation in terms of the direct
2 path of the signal that you're receiving and
3 the closest substantial multipath. So the
4 one that just follows.

5 And McCrady here explained that
6 this curve fitting uses the match filter
7 output to estimate this information to find
8 the -- to evaluate the separation.

9 So I think your summary is
10 inaccurate. But what I just said is that you
11 have to use something you received to measure
12 the separation of these two signals, and
13 McCrady, in this example, provides a match
14 filter that generate another signal from the
15 match filter process to estimate the
16 separation.

17 Q. I finally understand it from that.
18 Thank you.

19 MR. PETRSORIC: We have been
20 going about another hour, and I think
21 this is a good time probably to take a
22 break and get away from multipath
23 interference to a certain extent, to a
24 specific extent.

25 (A brief recess was held from

1 11:12 a.m. to 11:25 a.m.)

2 BY MR. PETRSORIC:

3 Q. Dr. Ding, the -- we are just
4 discussing how the pulse width evaluator is
5 used to judge whether multipath interference
6 is substantial or insubstantial; is that
7 correct?

8 A. We were looking at the prior art
9 McCrady in which it discusses the multipath
10 issue, yes.

11 Q. And is it my understanding that
12 McCrady, if is in a high accuracy mode, which
13 McCrady describes as one meter accuracy, that
14 substantial multipath interference would
15 cause McCrady's ranging mechanism to --
16 strike that.

17 Is it my understanding that
18 McCrady -- if the pulse width evaluator
19 determines that multipath interference is
20 substantial and McCrady is operating in a
21 high-accuracy mode, that McCrady will take a
22 different action than if it was operating in
23 the low-accuracy mode?

24 A. I want to say your understanding
25 is inconsistent with McCrady. McCrady stated

1 that a high-accuracy TOA measurement is
2 attained in this case, i.e., when the
3 multipath interference is judged to be
4 insubstantial, regardless of this selected
5 accuracy mode.

6 McCrary simply stated that
7 whichever mode you're using, you can get a
8 high accuracy TOA measurement because
9 multipath interference is judged by the pulse
10 width evaluator to be insubstantial.

11 Q. In -- if the pulse width evaluator
12 judges the multipath interference to be
13 substantial, is it my understanding -- is it
14 your understanding that McCrary will take
15 different actions if it's operating in the
16 low-accuracy mode versus the high-accuracy
17 mode?

18 A. McCrary stated starting in
19 Column 14, Paragraph 5, On the other hand, if
20 the multipath interference is classified as
21 substantial and the high-accuracy mode has
22 been selected, then the TOA processor
23 implements a process employing frequency
24 diversity to identify an optimal transmission
25 frequency that minimizes multipath

1 interferences.

2 So McCrady explains that for -- if
3 the multipath interference is classified as
4 substantial and if the high-accuracy mode has
5 been selected, then the TOA processor would
6 implement a process by utilizing frequency
7 diversity.

8 So that's the difference between
9 the case earlier when the multipath is judged
10 to be insubstantial versus the case when the
11 multipath interference is classified as
12 substantial.

13 Q. If McCrady determines that the
14 multipath interference is classified as
15 substantial and if the how-accuracy mode has
16 been selected, does McCrady describe
17 utilizing frequency diversity?

18 MR. FRYCKMAN: Form.

19 A. So in the case of -- in the case
20 of McCrady, McCrady describes multiple
21 measurement through an averaging process that
22 you can improve the accuracy of the time of
23 arrival estimate.

24 McCrady's discussion to a person
25 of ordinary skill in the art gives an example

1 that if you want to have very high accuracy,
2 then this paragraph we just read is stated
3 that you should use diversity or multiple
4 pulses -- sorry, multiple outbound ranging
5 messages and multiple turnaround -- sorry,
6 multiple reply ranging messages to improve
7 the accuracy.

8 To the extent that -- whether or
9 not a -- if the -- if the mobile device in
10 case -- in the ranging process, whether it --
11 if it doesn't care about the accuracy,
12 whether or not you need to use -- whether or
13 not you would like to use frequency diversity
14 or not, I think that's a design choice by a
15 person of ordinary skill in the art.

16 It is -- McCrady does not say
17 don't use it. It only tells you that to the
18 extent that you care about the accuracy so
19 much, then we are offering an exemplary
20 solution with multiple message exchanges.

21 BY MR. PETRSORIC:

22 Q. So does McCrady describing using
23 the frequency -- strike that.

24 Does McCrady explicitly describe
25 using the frequency diversity process in the

1 low-accuracy mode?

2 A. Does McCrady describe in greater
3 detail? I don't recall. But McCrady said
4 that, as we explained earlier in my reply to
5 you, that McCrady stated in Column 17 that
6 these are having only the preferred
7 embodiment of the new and improved methods
8 and apparatus for determining the position of
9 a mobile communication device using
10 low-accuracy clocks.

11 And it's believed that other
12 modification, variations, and changes would
13 be suggested to those skilled in the art in
14 view of the teaching set forth herein.

15 It really -- there is nothing in
16 McCrady that says you shall not use frequency
17 diversity when the system is in the other --
18 for lack of a better word, low-accuracy mode.
19 Even -- when we say the relative low accuracy
20 doesn't mean no accuracy.

21 So as an engineer, one can always
22 improve, and there's nothing to lose when one
23 uses the frequency diversity to get a better
24 accuracy.

25 Q. So I understand what you're saying

1 is that a person of ordinary skill in the art
2 reading McCrady would understand that you
3 could implement the frequency diversity
4 process as part of the low-accuracy mode; is
5 that correct?

6 A. Yeah. My reply is that it's a
7 design choice, and the person of ordinary
8 skill in the art in reading McCrady would
9 have understood that the mechanisms are
10 there. It is as explained and taught by
11 McCrady, and it is their design choice as to
12 whether or not they would like to have this
13 extra frequency diversity to improve the
14 accuracy.

15 Q. Does McCrady expressly describe
16 using the frequency diversity process as part
17 of the low-accuracy mode?

18 A. That's not how a person of skill
19 in the art would have read it. I mean, you
20 would read it as saying what does McCrady
21 describes as a process of improved -- of
22 improving accuracy. McCrady essentially
23 said -- literally said that if you have
24 chosen in high-accuracy mode and -- I read
25 that part already.

1 So -- and if the multipath
2 interference is classified as substantial and
3 the high-accuracy mode has been selected,
4 McCradly suggested that the use of frequency
5 diversity or multiple exchanges of ranging
6 information can improve the accuracy.

7 So when I said it doesn't read
8 that way, it's not like if McCradly does not
9 say that other mode can use frequency
10 diversity, then a person of skill in the art
11 would never have thought about it because the
12 principle is the same whether you're in
13 high-accuracy mode or low-accuracy mode.

14 It's only a design choice by
15 engineers that all persons of skill in the
16 art to determine, you know, whether they
17 would like to implement the frequency
18 diversity option suggested by McCradly or not.

19 Q. Does McCradly describe that the
20 processing differs depending on whether a
21 high-accuracy mode or a low-accuracy mode has
22 been selected and the multipath interference
23 is classified as substantial?

24 A. I think I understand your question
25 to be does McCradly -- it's probably a

1 different way of asking the same question:

2 Does McCrady explain that they will do
3 something different between the two modes if
4 the multipath interference is substantial,
5 correct? Is that your question?

6 Q. That is my question.

7 A. That -- not to my recollection. I
8 do not recall seeing that McCrady says that
9 there -- there has to be different. Again,
10 by way of example, McCrady provide these
11 designed choices, and it is really up to the
12 person who reads it and then trying to
13 practice it to decide whether or not you
14 would prefer to have even high accuracy or,
15 you know, the current accuracy is sufficient
16 without the multiple frequency diversity
17 option.

18 I think I answered that in several
19 different -- to several different ways of you
20 asking the same question. And I am going to
21 stick to that. It's not going to change my
22 answer.

23 Q. The -- I understand your answer is
24 how a person of ordinary skill in the art
25 would view the design choices available based

1 on reading the disclosure of McCrady. Is
2 that correct?

3 A. And I also explained -- and I also
4 stated that I don't recall the precise
5 wording where you would say these words are
6 precisely showing, you know, McCrady telling
7 you to use frequency diversity in both modes.
8 I don't recall that.

9 It's -- I apologize. My memory
10 has been fading as I age. Though, it may be
11 there. But if you think you found it and
12 you're trying to test my memory, I apologize.
13 I failed.

14 But if you think it's not there,
15 you're also trying to test my memory, I also
16 failed. I don't recall. And I don't
17 remember explaining that in my declaration,
18 which have a better grasp of it.

19 Q. If you're referring to Column 14
20 of McCrady, beginning at Line 19 --

21 A. Yes.

22 Q. -- the first sentence reads, In
23 accordance with the exemplary embodiment
24 shown in Figure 7, if the pulse width
25 evaluator 96 determines that the separation

1 between the direct path signal and the
2 nearest multipath signal is less than a
3 predetermined number of chips -- chip widths
4 (e.g., three), the multipath interference is
5 classified as substantial. Correct?

6 A. Yes.

7 Q. So what that sentence is saying is
8 in the exemplary embodiment of Figure 7, the
9 chip width is used to determine whether the
10 multipath -- whether the received signal is
11 classified to have multipath interference as
12 substantial, correct?

13 A. Okay. That's what it says.

14 Q. Yes. And in the following
15 sentence, it says, In this case, the
16 processing differs depending on whether a
17 high accuracy (e.g., one meter) TOA mode or a
18 lower accuracy (e.g., three meter) TOA mode
19 has been selected.

20 Do you see that?

21 A. Yes, I see it.

22 Q. So do you understand that in this
23 sentence, which is referring to the exemplary
24 embodiment of Figure 7, if the multipath
25 interference is classified as substantial,

1 McCrady is indicating that the processing
2 will be different depending on whether the
3 high-accuracy mode or the lower-accuracy mode
4 has been selected?

5 A. I understood from the -- from
6 Figure 7, the schematics that -- provided by
7 McCrady and the discussions by McCrady, as
8 you just referred to moments ago, that they
9 are different -- they are -- they can be
10 different processes under -- that are
11 undertaken by the TOA processing that would
12 generate different time of arrival accuracy
13 in this example.

14 And there can also be examples in
15 cases for -- in cases such as when I'm --
16 even if I'm prefacing Figure 7 as a person of
17 ordinary skill in the art, I would have a
18 case where you really -- I only have one
19 mode. I mean, I just have -- I just want to
20 have higher accuracy, and I really don't want
21 to have low accuracy.

22 I mean, I don't know why you would
23 want to have low accuracy, but, you know, as
24 in here -- let's hypothetically say, you
25 always -- you want to have high accuracy.

1 Under this -- in this context then you would
2 just be processing -- you know, you would
3 just be processing the received signal --
4 received reply ranging signal by going
5 through the steps required for high-accuracy
6 mode.

7 Q. And McCrady, with respect to the
8 exemplary embodiment shown in Figure 7,
9 indicates that in the low-accuracy mode, you
10 can process without employing frequency
11 diversity; is that correct?

12 A. Is there a particular section
13 we're pointing to that McCrady says you
14 should not use it?

15 Q. No. That wasn't my question. Let
16 me look -- we were just in Column 14 at
17 Line 24.

18 A. Okay.

19 Q. And where it says, in this case,
20 referring to where the multipath interference
21 is classified as substantial, the processing
22 differs depending on whether a high-accuracy
23 or a low-accuracy TOA mode has been selected;
24 is that correct?

25 A. That's what it says.

1 Q. And so do you understand that from
2 this exemplary embodiment of Figure 7 of
3 McCradly, that the low-accuracy mode can be
4 implemented without frequency diversity? Not
5 that it has to be implemented but that it can
6 be implemented without frequency diversity?

7 MR. FRYCKMAN: Objection. Form.

8 A. I am not reading that. What I
9 understood here is that McCradly describes
10 these two algorithms. There's an algorithm
11 using leading-edge curve fit as opposed to
12 the other fitting for the high-accuracy mode.

13 BY MR. PETRSORIC:

14 Q. Okay. Let's talk about the
15 high-accuracy mode then.

16 What is your understanding of what
17 McCradly teaches with respect to the
18 high-accuracy mode process when the multipath
19 interference is classified as substantial?

20 A. Well, McCradly stated that if the
21 multipath interference is classified as
22 substantial, that's a first condition, and
23 the high-accuracy mode has been selected,
24 then the TOA processor would implement a
25 process employing frequency diversity -- it

1 implements a process employing frequency
2 diversity to identify the optimal
3 transmission frequency that minimizes
4 multipath interference.

5 So he identifies an optimal
6 frequency from the -- a bunch of received
7 reply ranging signals and choose the optimal
8 transmission frequency to minimize the
9 multipath interference.

10 Q. And am I correct that the
11 frequency diversity process of McCrady
12 includes a rapid succession of different
13 frequency signals or what McCrady refers to
14 as multiple pings being transmitted between
15 the two radios?

16 A. Okay. So back to this -- the
17 paragraph starting from Line 45, Column 14,
18 Taking the case where the master radio is
19 configured to declare the need for frequency
20 diversity -- so long as the master radio is
21 configured to declare there's a need for
22 frequency diversity, be it high resolution or
23 high accuracy or lower accuracy, but there's
24 a need for that. The master radio identifies
25 a set of M carrier frequencies that will be

1 used to transmit a sequence of M outbound
2 ranging messages and the M corresponding
3 reply ranging messages.

4 It will -- this will be received
5 from the reference radio. And if the
6 reference radio is configured to declare the
7 need for frequency diversity processing, it
8 can notify the master radio in the reply TOA
9 ranging message of the need to initiate this
10 process.

11 So either one of them could
12 initiate that process to transmit, as you
13 said -- these frequencies are referred to as
14 ping frequencies since a -- since rapid
15 successions of M different frequency signals
16 or multiple pings are transmitted between the
17 radios in search of optimal frequency.

18 I believe you're referring to --
19 your question was about whether they are --
20 there's a rapid succession of M different
21 frequency signal exchanges between the two
22 radios. And here's what McCrady explained.

23 Q. So I understand this to be that
24 regardless of whether the master radio or the
25 reference radio initiates the frequency

1 diversity processing, the master radio will
2 send out -- will transmit M outgoing ranging
3 messages to the reference radio at -- each at
4 a different frequency.

5 Is that an accurate understanding?

6 A. McCradly said that master radio can
7 identify the M carrier frequency used to
8 transmit outbound ranging or the reference
9 radio is configured to declare that need. It
10 can also notify the master radio in its reply
11 message of the need to initiate the process.

12 But the need to initiate to me
13 reads that the master radio, sensing the need
14 either from itself or from the remote radio
15 or reference radio -- the master radio is the
16 one that initiates the frequency diversity
17 process.

18 Q. When you say initiates -- the
19 master radio initiates the frequency
20 diversity process, the -- is it your
21 understanding that the master radio will then
22 send out -- send M outgoing ranging messages
23 to the reference radio at different
24 frequencies?

25 A. What -- McCradly said the master

1 radio identifies the set of M carrier
2 frequencies that will be used to transmit a
3 sequence of M outbound ranging messages.

4 It's not necessarily M distinct
5 carrier frequencies. That word is not in
6 McCrady. But regardless, even for a person
7 of skill in the art would have understood
8 that the frequency diversity, right, can --
9 the frequency diversity is a concept that
10 depends on your local resources.

11 If you have -- if you do not have
12 many carrier frequencies that are unique, you
13 could have, you know, used fewer just because
14 you don't have -- you're not allowed to use
15 it. You don't have that particular ability
16 to do so in some application examples.

17 McCrady here is giving -- laying
18 out that you essentially transmit M pings.

19 Q. Is that why McCrady referred to as
20 M pings or M carrier frequencies instead of
21 setting a fixed number of carrier frequencies
22 or pings?

23 A. I can't tell you why an inventor
24 would draft their patent in a certain way.
25 What I could only opine in my declaration and

1 also in my testimony is that as long as it's
2 clear to a person of skill in the art, I
3 think McCrady has done his job, and I believe
4 he has done a very marvelous job explaining
5 the process.

6 It is very clear, and it would
7 have been very clear to a POSITA.

8 Q. Moving on to Column 15 at Line 24,
9 it begins -- referring again to Figure 7 --
10 the TOA processor processes the communication
11 acquisition sequence and the TOA
12 synchronization sequences of each of the M
13 ranging messages in the same manner as the
14 initial ranging message.

15 Do you see that?

16 A. Yes.

17 Q. Do you understand this to be
18 disclosing that the TOA process that we
19 previously discussed is -- strike that.

20 Do you understand from reading the
21 next sentence that the -- strike that.

22 Does McCrady in the next sentence
23 teach a person of ordinary skill in the art
24 what it's describing in terms of the TOA
25 processor processing when it says, Upon

1 detection of the communication acquisition
2 sequence, the TOA synchronization sequence is
3 match filtered, and then in parentheses,
4 taken into consideration the carrier
5 frequency, the magnitude is determined, and
6 the resulting signal is evaluated by a pulse
7 width evaluator to determine the proximity of
8 the multipath interference to the direct path
9 signal. Then in parentheses, see blocks 104,
10 106, and 108.

11 MR. FRYCKMAN: Objection. Form.

12 A. Sorry. I didn't actually hear a
13 question.

14 BY MR. PETRSORIC:

15 Q. So am I correct in that the
16 disclosure of McCrady at column -- in the
17 sentence beginning at Column 15, Line 27 and
18 going through Line 34, that McCrady is
19 describing using the TOA processor to have
20 the pulse width evaluator determine
21 whether -- determine the proximity of
22 multipath interference to the direct path
23 signal?

24 A. In conjunction with Figure 7 and
25 the discussion here referring to Figure 7,

1 McCrady explained that for the -- for each of
2 the M ranging messages that you transmit and
3 the M received or reply ranging messages, you
4 would perform the same process of pulse width
5 evaluation.

6 And the pulse width evaluator
7 would determine, as you read it, that the
8 proximity of the multipath interference to
9 the direct path signal. And the result of
10 this evaluation from each of the M ranging
11 messages will be stored, and then once you
12 finish the M trials, one would look at the
13 outcome of the path width evaluator and
14 determine, based at least on the outcome, to
15 determine the best multipath
16 discrimination -- basically find the
17 frequency that has, in essence, the best
18 multipath determination.

19 So whichever one is the best
20 frequency would be determined by the master
21 radio by looking at the outcome of the pulse
22 width evaluation that has been performed in M
23 trials.

24 Q. And at that point, does McCrady
25 disclose that leading-edge curve fit 114 is

1 performed on the output of the corresponding
2 match filter to estimate the TOA for the
3 frequency having the best multipath?

4 A. Well, McCrady did say here in
5 Line 25 -- 27, Specifically, upon detection
6 of the communication acquisition sequence,
7 the TOA synchronization sequence is match
8 filtered taking into consideration the
9 carrier frequency and then the magnitude was
10 determined and resulting signal is evaluated
11 by the pulse width evaluator.

12 And clearly, from here, McCrady
13 discussed the use of a match filter for
14 potentially each one of the M ranging reply
15 signals.

16 Q. And the match filter is used as
17 part of the pulse width evaluator to
18 determine the amount or the -- whether or
19 not -- strike that.

20 Match filter is used as part of
21 the pulse width evaluator to determine the
22 amount of multipath interference with respect
23 to each of the M ranging messages?

24 A. Well, McCrady here explained that
25 the evaluation can use this match filter. I

1 think it's -- we just read that. It's stated
2 that the magnitude is determined out of the
3 match filter, and then resulting signal
4 coming out of the magnitude is evaluated by
5 the pulse width evaluator.

6 As we -- I think you and I talked
7 about this quite a bit earlier, is that you
8 are using the match filter as a mechanism to
9 detect the pulse width. And in turn that
10 allows you to figure out the -- what we call
11 separation in -- between the direct path
12 signal and the closest substantial multipath
13 interference signal.

14 And that process, as we can see,
15 explained by McCrady was that you repeat that
16 for the M ranging signals.

17 Q. And then at Column 15, Line 36,
18 McCrady states that, Upon completion of the M
19 trials, the frequency having the best
20 multipath discrimination is identified (block
21 112) and a leading-edge curve fit 114 is
22 performed on the output of the corresponding
23 match filter to estimate the TOA.

24 Do you see that?

25 A. Yes, I see --

1 Q. So the -- in this sentence,
2 McCrary is saying that the TOA is determined
3 for the carrier frequency with the best
4 multipath discrimination; is that correct?

5 A. Yeah. In this -- in this
6 exemplary embodiment associated with
7 Figure 7, McCrary stated the -- after pulse
8 width evaluation, you would determine the
9 frequency that has the best multipath
10 discrimination, and once that's identified, a
11 leading-edge curve fit is performed to
12 estimate the TOA of the corresponding match
13 filter output.

14 And that's only one example where
15 you would do the TOA by trying to figure out
16 which frequency is the best. It's not
17 necessary to a person of skill in the art to
18 only perform the TOA estimate after you have
19 done all that.

20 You could have done that during
21 the process of the pulse width evaluation as
22 well.

23 But that's, again, a design
24 choice. Would you rather wait until later to
25 get it done, or can you get ready beforehand?

1 If it does -- you know, if it's just a matter
2 of a few extra -- of a minor complication
3 that would accompany the pulse width
4 evaluation.

5 Q. Does McCrady describe another
6 example where you would do the TOA on each of
7 the frequencies?

8 A. Okay. So to your question,
9 McCrady was discussing the process of pulse
10 width evaluation, and the discussion we just
11 had says, Upon completion of the M trials,
12 that is to -- that is the result of the pulse
13 width evaluation, one would -- according to
14 McCrady, a leading-edge curve fit 114 is
15 performed on the output of the corresponding
16 master radio to estimate the TOA.

17 It is -- to a person of ordinary
18 skill in the art, one would have understood
19 that the same TOA estimate could have been
20 computed prior to finding the best frequency.
21 In a manner of speaking, what you would do in
22 the process is that either you wait until the
23 very end and then you find the best frequency
24 and compute the TOA, or you already have them
25 listed in the table as you go through the

1 evaluation and the TOA estimate, right?

2 So a person of ordinary skill
3 would appreciate that McCrady disclosed
4 already multiple message exchanges during the
5 frequency diversity process and then the --
6 because the master radios transmit a sequence
7 of M outgoing ranging messages on different
8 frequencies.

9 So the information is already
10 there for the master radio to process and
11 perform that estimate. So that is a -- that
12 renders the whole -- this whole process of
13 processing to estimate the TOA even before
14 selecting the best frequency obvious.

15 And sometimes, technically, the
16 time changes because it will shorten the time
17 that you'll have to come back and recompute
18 it again once you have selected the best
19 frequency.

20 And the other parts I would like
21 to also point out is with respect to Claim 1
22 in my report, we looked -- there's also the
23 prior art by Raphaeli, which clearly
24 indicated that multiple outbound ranging
25 messages would be transmitted and then

1 averages can be undertaken from the collected
2 data to perform a better estimation.

3 So a person of ordinary skill in
4 the art reading that would have to -- would
5 have understood the benefit of having a TOA
6 information computed along with the pulse
7 width evaluation prior -- in fact, just prior
8 to completing the whole M trials and find the
9 best frequency.

10 So that would be -- that would
11 combine -- that would make a strong
12 motivation to combine with Raphaeli because
13 Raphaeli, which proposes that in this
14 context, one could use multiple time of
15 arrival or multiple delay estimations by
16 averaging to achieve the advantage of
17 accuracy and precision.

18 Q. So McCrady does not describe
19 another example where you would estimate the
20 TOA on each of the frequencies?

21 MR. FRYCKMAN: Objection. Form.

22 A. McCrady provides an exemplary
23 embodiment in by way of Figure 7, and as a
24 person of ordinary skill in the art would
25 have understood that looking at Figure 7,

1 they can be -- they can be different
2 alternatives in terms of the diagram flow.
3 And that's really another design choice. And
4 then the -- a person of skill in the art
5 would have to weigh what's more important and
6 the pros and cons and the tradeoffs to modify
7 as McCrady suggested.

8 You can modify that, but that
9 still falls in the scope of this invention.

10 To put it differently, if a person
11 of skill in the art is reading this and then
12 realizing, of course, that this is only an
13 example, right, so it will be beneficial if I
14 have the TOA estimate computed before I even
15 find the best frequency, then they would have
16 done it, and then McCrady's scope or
17 invention would have covered that.

18 So I don't see any technical
19 differences, whether you find the best
20 frequency and then go back and recompute
21 something, which you have access to already,
22 based on the same information, or follow
23 strictly only the exemplary embodiment of
24 Figure 7 and view that as the only option
25 even though McCrady has explicitly said that,

1 you know, these are subject to modification
2 and improvement, but the scope and the
3 concept are the same.

4 BY MR. PETRSORIC:

5 Q. You mentioned that it may be
6 technically advantageous to compute the TOA
7 with each of the M carrier frequencies.

8 How would it be technically
9 advantageous?

10 A. Well, in an example where you
11 would like to perform this operation very
12 rapidly, you would have done the evaluation
13 of the pulse width along with the TOA and
14 essentially listen in a table. You have the
15 pulse width evaluation outcome and you have
16 the TOA in there, and then you just go
17 through the M trials. And once you decide
18 which one is the best, you look at the table.

19 You already have the TOA ready for
20 you. So that advantage for the example I'm
21 explaining is that you would not have to go
22 back and recompute the TOA after you have
23 done the M trials.

24 So you would have saved time in
25 the example I'm providing. And, again, a

1 person of skill in the art would have
2 recognized that this is purely a design
3 choice. There's no conceptual difference in
4 terms of the scope or principle.

5 MR. PETRSORIC: Okay. You can
6 set McCrady aside. I was going to
7 move to Raphaeli next.

8 Might it be time -- a good time
9 to take a quick break?

10 (A lunch recess was held from
11 12:21 p.m. to 12:52 p.m.)

12 BY MR. PETRSORIC:

13 Q. Welcome back, Dr. Ding.

14 If we could turn to Exhibit 1003
15 in the '777 proceeding, and I would also at
16 the same time ask you to -- if you have the
17 Exhibit 1003, your declaration in the '779
18 proceeding, that might be helpful as well
19 because I think they are --

20 A. I am sorry. That's the other
21 proceeding?

22 Q. Yeah. I've got questions related
23 to paragraphs that I believe are identical in
24 the two declarations, so I just want to make
25 sure --

1 A. Yeah. I'm trying to make sure too
2 that we are switching to a different
3 declaration, right?

4 Okay. They're both labeled 1003.
5 All right. I have it with me, '779.

6 Q. And if you turn to Page 48 of the
7 '777, which is Paragraph 73.

8 A. Okay.

9 Q. And then in the '779 declaration,
10 it's Paragraph 77 on Page 53.

11 A. Okay.

12 Q. In Paragraph 73 of the '777
13 declaration and Paragraph 77 of the '779
14 declaration, you state that, McCrady's
15 message exchange technique employs frequency
16 diversity to handle severe multipath
17 interference.

18 And we've been discussing the way
19 McCrady's process describes frequency
20 diversity to send out multiple ping messages,
21 correct?

22 A. Yes, in Paragraph 73 of '777, the
23 declaration, and Paragraph 77 of the '779
24 declaration, I did allude to the McCrady
25 message technique that employs frequency

1 diversity that handles severe multipath
2 interferences.

3 Q. Yes. And you recite Column 5 from
4 Lines 12 through 27 of McCrady as well as
5 Column 13 from Lines 45 to 67 of McCrady,
6 correct?

7 A. Yes, that's correct. I did recite
8 those questions.

9 Q. And then you state that the POSITA
10 would have seen the benefit of leveraging
11 McCrady's technique to facilitate Raphaeli's
12 teaching on average propagation delays.

13 Do you see that?

14 A. Yes.

15 Q. You then say, For example, setting
16 aside multipath interference, the POSITA
17 would have understood that diversifying the
18 sample of to-be-averaged propagation delays
19 from a frequency perspective would reduce the
20 impact of other types of interference such as
21 co-channel interference and general channel
22 noise.

23 Do you see that?

24 A. Yes.

25 Q. Can you explain to me how the

1 frequency diversification would reduce the
2 impact of co-channel interference and general
3 channel noise?

4 MR. FRYCKMAN: Objection. Form.

5 A. Is it okay, Counsel, if I just
6 focus on the '777 unless the other
7 declaration plays additional role of --

8 BY MR. PETRSORIC:

9 Q. That's fine. If something arises
10 with respect to needing to refer to the other
11 declaration, it's fine. Because I believe
12 the -- the declarations are identical in --
13 with respect to these paragraphs.

14 A. Okay. I will follow your
15 instruction, and I will answer the...

16 So what I explained was that, for
17 example, a POSITA would have understood --
18 this is my declaration -- the same section we
19 are looking at -- what should I do? Hang on
20 a second. I should go to the point that --
21 point out that it is at the end of
22 Paragraph 73 of the '777 declaration.

23 I explain that the benefit of
24 leveraging McCrady's technique to facilitate
25 Raphaeli's teaching of average propagation

1 delay.

2 For example, a POSITA would have
3 understood that diversifying the sample of
4 to-be-averaged propagation delays from a
5 frequency perspective would reduce impact of
6 other type of interferences such as
7 co-channel interference and general channel
8 interference.

9 As McCrady explained, one example
10 of repeating M trials of outbound ranging
11 message as well as the inbound, where they
12 could reply ranging message over M
13 experiment -- over M trials possibly over
14 multiple frequencies, right, can be used to
15 mitigate the accuracy and uncertainty
16 problem.

17 So what -- what will happen to a
18 person of ordinary skill in the art would
19 have understood that McCrady explained there
20 is a, potentially, difference. That's why
21 McCrady proposed to look at the best -- so
22 the result of the pulse width evaluation from
23 each of the M ranging messages and the output
24 of the master radio stored in buffer 110, and
25 then the frequency having the best multipath

1 discrimination is identified.

2 So McCrady already recognized
3 that, as well as a person of ordinary skill
4 in the art would have understood, that at
5 different frequency the multipath effect can
6 be different. That's the first part.

7 But we explained also even -- just
8 set aside a multipath portion, at different
9 frequency, the level of interference from
10 co-channel sources -- for example, you could
11 have a background radio that is of adjacent
12 frequency but it's spilling over, causing
13 some interference in the same channel, or you
14 could have other devices in the wireless
15 environment that happen to -- happen to come
16 into the same frequency band of this message
17 exchange that McCrady is trying to implement.

18 So these are co-channel
19 interferences, and they can also be noises.
20 The point that the person of skill in the art
21 would take away from the -- from McCrady's
22 discussion is that at different frequency,
23 the interference can be different. Be it
24 multipath, be it co-channel interference, or
25 noise.

1 And a person of ordinary skill in
2 the art would have known that, and that's a
3 well-known fact.

4 So here comes the issue that
5 you're -- if you rely on one particular
6 frequency to execute and implement the
7 round-trip delay estimation ranging, then you
8 are putting -- likely you're putting all your
9 eggs in one frequency, one basket, so to
10 speak, and at one time, just one shot.

11 Now, the interference could be
12 time-dependent and frequency-dependent. The
13 frequency -- the noise could be
14 frequency-dependent and time-dependent. Now,
15 if you did this one time, then there's a
16 likelihood that you may get unlucky that the
17 estimation of the round-trip delay as well as
18 the time of arrival of the reply ranging
19 message could be jeopardized or at least be
20 effected negatively.

21 Now, when you have multiple
22 pulses -- multiple reply range -- reply
23 ranging messages being used along with the
24 same multiple of outbound ranging messages to
25 allow you to estimate the time of arrival and

1 the round-trip time delay, then you have a
2 better chance of mitigating the unlucky
3 circumstances that the one -- the one
4 frequency you happen to select at that time
5 happens to have strong interferences
6 co-channelling and also just have a
7 spur-of-moment strong noise.

8 So that is the benefit of
9 leveraging the discussions of McCrady in
10 disclosing that you could use multiple
11 frequencies and you could send M ranging
12 signals and Raphaeli's -- Raphaeli's
13 discussion of averaging the multi-delay that
14 you can obtain from the multiple exchanges of
15 outbound and reply ranging message would be
16 beneficial to mitigate the effects of
17 interference co-channelling and the noise
18 that the system may experience.

19 Q. Would co-channel interference or
20 general channel noise affect the output of
21 the pulse width evaluator in terms of using
22 the match filter to determine the potential
23 time variation of the direct path signal
24 versus the actual signal?

25 A. Well, my answer to this

1 hypothetical situation is that the noise --
2 in the context of channel noise -- noises are
3 unpredictable and you cannot predict the
4 shape and when it happens and how it happens
5 and that's -- unfortunately, that's the
6 nature of noise.

7 So imagine a scenario where you
8 were receiving or you were transmitting the
9 outbound ranging message and encountered a
10 very strong noise just out of bad luck or in
11 the reply message you are trying to receive,
12 you also happen to collide with a strong
13 co-channel interference or noise, then,
14 certainly, the next step that you're trying
15 to estimate the time of arrival would have
16 been affected.

17 Q. But if the time of arrival would
18 have been affected, the output of the --
19 isn't it the case that the output of the
20 pulse width evaluator would also have been
21 affected?

22 MR. FRYCKMAN: Objection. Form.

23 A. The noise and co-channel
24 interferences are our sworn enemies in
25 communication, so engineers are always

1 mindful of their effect on the various aspect
2 of the wireless system.

3 So in my declaration, I explained
4 that this will be affecting the estimation of
5 in terms of time of arrival.

6 BY MR. PETRSORIC:

7 Q. My question is would the noise
8 also affect the output of the pulse width
9 evaluator?

10 A. Well, if you have a -- if you have
11 the channel noise that happens to be very
12 strong when you're receiving the entire reply
13 signal in such an example within this -- such
14 an example, the pulse width evaluator would
15 be subject to the noise effect, just like
16 almost all wireless system would have to be
17 mindful of the prospect of noise and
18 co-channel interference.

19 Q. With respect to the -- reducing
20 the impact of co-channel interference and
21 general channel noise, apart from this
22 paragraph in your declaration, did you
23 evaluate the impact at any other point in
24 your declaration?

25 MR. FRYCKMAN: Objection. Form.

1 A. I'm slightly confused by your
2 question, Counsel. You're asking me did I
3 discuss the effect of noise and co-channel
4 interference in other parts of my
5 declaration?

6 BY MR. PETRSORIC:

7 Q. Yes.

8 A. I would imagine they are -- it's
9 not just in this paragraph, but -- I believe
10 it's not just in this paragraph. I think I
11 talked about -- I cited discussions from --
12 sorry.

13 I cited discussions from an Apple
14 exhibit, 1023, by Gesbert, you know,
15 regarding the issues that can be solved or
16 can be mitigated by using multiple antennas.
17 And I go to Paragraph 95, and it says -- from
18 Gesbert, Column 1, Line 36 to 40.

19 For example, when channel
20 performance is degradated, the transmitted
21 data may experience excessive corruption
22 yielding unacceptable communication
23 parameters. For example, transmitted data
24 can exhibit excessive bit error rates or
25 packet error rates.

1 The degradation of the channel can
2 be due to a multitude of factors such as
3 general noise in the channel and
4 multipath fading, loss of line of sight,
5 excessive --

6 (Reporter clarification.)

7 A. I'm reading directly from Page 96,
8 Paragraph 161. I'm quoting Apple
9 Exhibit 1023 by Gesbert, G-E-S-B-E-R-T,
10 Column 1, Line 36 to 40.

11 Here I quote: For example, when
12 channel performance is degraded, the
13 transmitted data may experience excessive
14 corruption yielding unacceptable
15 communication parameters.

16 For instance, transmitted data can
17 exhibit excessive bit error rates or packet
18 error rates. The degradation of the channel
19 can be due to a multitude of factors such as
20 general noise in the channel, multipath
21 fading, loss of line-of-sight path, excessive
22 co-channel interference (CCI) and other
23 factors, end of quote.

24 BY MR. PETRSORIC:

25 Q. Besides this reference to

1 Exhibit 1023 to Gesbert, is there any other
2 discussion or explanation in your declaration
3 of how co-channel interference or general
4 channel noise would manifest in either the
5 TOA or the output of the -- the TOA
6 calculation or the output of the pulse width
7 evaluator in McCrady?

8 MR. FRYCKMAN: Objection. Form.

9 A. Is there any other place? I
10 believe there are. So memory tests are
11 tough, so let me try --

12 BY MR. PETRSORIC:

13 Q. That's why we have PDFs.

14 A. I wasn't aware that -- I mean, I'm
15 looking at a hard copy. Sorry.

16 Q. I understand. But if you have an
17 electronic copy, it's okay too.

18 A. I see. Okay. As long as I have
19 your concurrence, the next question I will go
20 to the electronic copy. But there were
21 depositions where attorneys would just want
22 me to stick to the paper copy.

23 My apologies. I should have
24 asked.

25 So my recollection is that

1 generally these discussions are in a number
2 of places. Often when discussing the
3 motivations to combine strong prior arts, so
4 improved precision -- okay. I think it's
5 here. Let me read through.

6 All right. So Paragraph 216 on
7 Page 123, I did -- I also explained that even
8 without Raphaeli's observation of improved
9 precision, a POSITA, in my opinion, would
10 have recognized that unknown/random errors
11 exist in the individual propagation delay
12 estimate described by Rofheart/Raphaeli due
13 to channel noise, interferences, measurement
14 errors, et cetera.

15 It would have been well known to a
16 POSITA that such errors can be a result of
17 channel noise and/or interferences which can
18 distort the received signals exchanged for
19 the wrenching estimate thereby causing errors
20 in estimating the time of arrival and
21 consequently the round-trip propagation delay
22 in McCrady.

23 Similarly, channel noises and/or
24 interference can distort the received pulses
25 and cause errors to the round-trip delay,

1 therefore, it would have been also obvious to
2 a POSITA that any measurement methods used
3 for TOA or round-trip delay measurement is
4 limited in accuracy leading to measurement
5 errors.

6 And I provided a background
7 reference to Birchler, Apple Exhibit 1021,
8 wherein Column 1, Line 33 through 39
9 virtually explain that propagation delays are
10 measured in practice using transmitted
11 signal, which signals are subject to the
12 effects of various error sources, example,
13 noise, multipath interference, distortion,
14 et cetera, period.

15 The resultant errors in the delay
16 measurement translated into errors in the
17 pseudo-ranges and consequently into errors in
18 the local estimate, close quote, and period.

19 So to answer your question, there
20 are other places where they explained the
21 effect and the issues involving channel noise
22 and co-channel interferences. And here
23 there's even additional discussion about
24 measurement errors that needs to be addressed
25 in practical systems.

1 Q. Does McCrady with its frequency
2 diversity process take into account the
3 errors that need to be addressed in practical
4 systems?

5 A. Does McCrady talk about errors in
6 practical systems?

7 Yeah, I believe -- I recall it
8 does. Let me find that for you. Let me try
9 to open the PDF shared with me.

10 Q. I don't know that those are
11 searchable PDFs.

12 A. You're right.

13 One place I recall here is in
14 Column 10 of McCrady and starting at Line 36,
15 that paragraph. So McCrady here is
16 discussing, they are timing errors. So
17 McCrady stated, as previously described --
18 sorry. Not quite that one.

19 Okay. So the -- Line 36 of
20 Column 10, According to the present
21 invention, to minimize processing delay
22 timing errors resulting from asynchronous
23 events that occur within the signal
24 processors of the radio -- so these are the
25 internal errors -- each radio performance and

1 internal delay calibration in close time
2 proximity to the transmission time of the
3 ranging messages in order to accurately
4 estimate the actual internal process time
5 delay that occur when processing the ranging
6 message. Referring to Figures 4 and 5, the
7 master radio initiates the TOA ranging
8 process by performing an internal delay
9 calibration using a loop back through pad 40
10 to determine internal delays in the master
11 radio for correction purposes.

12 Multiple trials, for example ten,
13 are performed and averaged to reduce the
14 variation of the delay estimate.

15 All right. So I stop here.

16 This one here is discussing that
17 various events could happen such as --
18 asynchronous events would occur in each radio
19 and that would lead to errors in the radio
20 with respect to the actual knowledge of the
21 actual time of transmission and time of
22 arrival. And these errors are to be
23 corrected and motivated by McCrady and, in
24 fact, explained that averaging is one
25 well-known solution to address this problem

1 to reduce the variance of the delay estimate.

2 Q. Does that averaging of the delay
3 estimates account for co-channel interference
4 or general channel noise?

5 A. Those are one possible such
6 effects as McCrady stated in the paragraph
7 above. Column 10, Lines 16, As will be
8 appreciated from the foregoing, the radios of
9 the present invention must be able to
10 accurately determine the time of transmission
11 and the time of arrival of the ranging
12 messages in order to accurately measure the
13 range between the radios and to accurately
14 estimate the position of the master radio.

15 The present invention includes a
16 number of techniques to accurately determine
17 the true time of arrival and the time of
18 transmission even in the presence of severe
19 multipath interferences -- that refers to
20 your question -- which conventionally tends
21 to degrade the accuracy of the time of
22 arrival estimate.

23 Q. The multipath interference is
24 taken into account with the frequency
25 diversity process, correct?

1 A. Sorry. Could you rephrase the
2 question? The multi --

3 Q. The -- McCrady describes that the
4 multipath interference problem would be taken
5 into account with the frequency diversity
6 process, correct?

7 A. McCrady, as we discussed earlier
8 in the example, explained that the
9 multipath -- multipath problem can be
10 addressed by using -- by using the frequency
11 diversity process in which the best frequency
12 that has the least multipath effect can be
13 selected.

14 Q. With respect to the internal delay
15 calculations, doesn't McCrady describe a
16 loop-back mechanism so that the radio is not
17 reliant on signals received from the antenna?

18 MR. FRYCKMAN: Objection. Form.

19 A. McCrady says the following:
20 Referring to Figures 4 and 5, the master
21 radio initiates the TOA ranging process by
22 performing an internal delay calibration
23 using a loop back through pad 40 to determine
24 internal delays in the master radio for
25 correction purposes.

1 It estimates TMT and TMR -- the
2 sum of TMT and TMR in this -- in this
3 calibration process and suggested that
4 multiple such trials can be performed to
5 reduce the variance of such delay estimate.

6 BY MR. PETRSORIC:

7 Q. Let's -- you can put McCrady
8 aside. We'll -- I'd like to talk about
9 Raphaeli.

10 With respect to the -- with
11 respect to Exhibit 1003, your declaration in
12 the '777 proceeding, I believe you addressed
13 Raphaeli at Paragraphs 56 through 60; is that
14 correct?

15 A. Paragraph 56 is where it starts,
16 that's correct, and -- yes. It ends at --
17 well, that particular discussion itself ends
18 at Paragraph 60 where I provided a discussion
19 about the -- what Raphaeli is about and give
20 a somewhat -- a short summary.

21 Q. And the -- I believe in the '779
22 Patent, you have the same paragraphs in your
23 declaration?

24 A. Yes. They are the same paragraph
25 numbers. I mean, in both '777 and '779, same

1 paragraph numbers.

2 Q. To your knowledge, are they
3 identical paragraphs?

4 A. I think they're substantially the
5 same, Counsel.

6 Q. The -- if you look at Paragraph 58
7 of the '777 declaration or Paragraph 58 of
8 the '779 declaration, you state that Raphaeli
9 discloses a wide band broadcast interrogation
10 signal 20 that features a sequence of pulses
11 22 separated by a fixed interval, correct?

12 A. Yes. Raphaeli, for example, but
13 not just exclusively, disclosed a wide band
14 broadcast integration signal 20 that features
15 a sequence of pulses 22 separated by a fixed
16 interval, which can be organized into
17 preamble, data and responded period portions.

18 Q. And then you cite Raphaeli at
19 Column 9, Lines 3 through 21 below that,
20 correct?

21 A. I did cite Column 9, Line 3 to 21
22 from Raphaeli, Apple Exhibit 1006.

23 Q. And the second-to-last sentence of
24 that citation begins, In the preferred
25 embodiment of the present invention, pulses

1 22 of wide band broadcast interrogation
2 signal 20 are optionally organized in three
3 intervals, a preamble portion 24, a data
4 portion 26 and a response period portion 28.

5 Do you see that?

6 A. I see that. I'm also going to
7 open up the exhibit itself.

8 Q. Okay. That's 1006.

9 A. 1006. Yes. Now I have it. Thank
10 you.

11 Q. You're waiting on a question from
12 me, correct?

13 A. Yes.

14 Q. Okay. In your declaration of the
15 '777 proceeding, on the top of Page 35 is an
16 annotated version of Figure 2 of Raphaeli,
17 right below Paragraph 58.

18 Do you see that?

19 A. I do.

20 Q. Am I correct that the -- Raphaeli
21 is describing separate pulses, this
22 collection of which would make up the
23 preamble data and response portions of the
24 wide band broadcast interrogation signal?

25 A. Well, as Figure 2 of Raphaeli

1 shows and -- along with my annotation that
2 Raphaeli is showing these pulses -- he called
3 them pulses. Later on, he said this can be
4 just a broader term.

5 But, yeah, it shows that the --
6 this whole succession of, quote/unquote,
7 pulses from 20 -- from -- they're all labeled
8 as 22, but there's a portion 24, which is the
9 preamble, and there's a portion 26 that is
10 the data portion and the response period
11 portion, which is 28, and these are all
12 labeled and described by Raphaeli as pulses
13 in this example.

14 Q. Which of these pulses is used to
15 determine the time between the propagation
16 delay between the two devices?

17 A. I'm still looking. I'm sorry.

18 Okay. So confirming this, the way
19 that Raphaeli discusses with respect to this
20 particular figure, Figure 2, it's with
21 respect to interrogation signal 20. That is
22 not a response signal. It's the signal that
23 is transmitted by the interrogator, i.e., the
24 first station.

25 So that alone doesn't allow you to

determine the interrogation -- sorry, the
round-trip delay time.

MR. FRYCKMAN: Counsel, it's
been about an hour. Is it a good time
for a break?

MR. PETRSORIC: Yeah, that
probably is good.

(A brief recess was held from
1:53 p.m. are to 2:11 p.m.)

BY MR. PETRSORIC:

Q. Dr. Ding, do you recall when you
first saw the '777 Patent?

A. As far as I recall was -- I forgot
when we started the proceeding, but I recall
reading that perhaps in earlier part of last
year.

Q. And would the same be true for the
'779 Patent?

A. Correct. Same. Yeah, it should
be the same.

Q. And were those patents provided to
you by counsel?

A. Actually, I'm not too sure about
that. In some of my expert experiences,
counsel would just give me a patent number,

1 and I will download it from the -- most of
2 the time, just USPT -- you know, Patent Trade
3 Office or, you know, some -- reserve some
4 other means, but I actually don't recall. I
5 believe it was.

6 Q. When did you first learn of
7 McCrady?

8 A. I can't say for sure, but it
9 should be shortly after.

10 Q. And was McCrady identified to you
11 by counsel?

12 A. Good question. I'm not sure about
13 that in particular. So I will just explain
14 that in my line of work, very often the --
15 sometimes counsel engage in a search firm,
16 and they'll help find the most relevant art,
17 and sometimes I'm not happy with them, so I
18 will do my own search as well.

19 I don't recall in this particular
20 instance, Counsel, but that's typically how I
21 work with attorneys in dealing with sensitive
22 issues such as patent. I just want to be
23 accurate and be sure.

24 Q. I understand that, and I
25 appreciate that.

1 I will ask the same question with
2 respect to Raphaeli.

3 Did you -- when did you first
4 learn of it?

5 A. I think it's the same situation.
6 That -- approximately around the same time as
7 the patents in dispute were disclosed to me.

8 Q. And do you know -- do you recall
9 if you found Raphaeli on your own, or was it
10 identified to you by counsel?

11 A. I can't recall that. I apologize.
12 I can't recall that for sure. You know,
13 McCrady and Raphaeli, it didn't really
14 register. So sometimes I'm very proud I
15 found something, go whew, you know. But
16 sometimes it's, like, oh, it was pretty easy.
17 So it wasn't -- it just didn't register. I
18 apologize.

19 Q. It's okay.

20 The -- is the same true with
21 respect to Kuwahara?

22 A. Same is true for Kuwahara.

23 Q. And is the same also true for
24 Rofheart?

25 A. Correct.

1 Q. So you -- each of the prior art
2 reference -- you didn't know of any of the
3 prior art references prior to last year?

4 A. I would say that I didn't know of
5 these specific references. I know of the
6 technique in terms of dealing with round-trip
7 return estimation and multi-antenna such as
8 the use of ESPRIT, but, you know, the
9 specific references we are dealing with,
10 like, you know, this patent or this
11 technology that were presented in the
12 specific form, I don't think I saw them prior
13 to 2022.

14 Usually, when I review these
15 patents, I realize, oh, yeah, these were
16 exactly the same technology that I had known
17 before in another context, but it wasn't like
18 a patent. And I personally love the typed
19 format of the patent.

20 Very often when academics write
21 patent, they -- we don't write many -- we
22 don't write some specifics because we figure
23 it was so obvious that we don't need to
24 repeat something, but patents are much better
25 form.

1 So I just want to explain that I
2 prefer working with patent and patent
3 application and even though the technology
4 may have been something I've seen before in
5 my line of research.

6 MR. PETRSORIC: Very good.

7 I've got no further questions.
8 I've conferred with Mr. Auchter. He
9 doesn't have any questions as well.
10 So with that, John-Paul, we'll turn it
11 over to you.

12 MR. FRYCKMAN: Let me just have
13 a short break, and then I will get
14 back in, say, ten minutes.

15 MR. PETRSORIC: That sounds
16 good.

17 (A brief recess was held from
18 2:17 p.m. to 2:26 p.m.)

19 MR. FRYCKMAN: We don't have any
20 questions for redirect, so we can wrap
21 up this deposition for today.

22 MR. PETRSORIC: Thank you,
23 Dr. Ding. Thank you, John-Paul.
24 Thank you, Erica.

25 (Thereupon, the proceedings

concluded at 2:26 p.m.)

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1 CERTIFICATE OF REPORTER

2
3 UNITED STATES PATENT AND TRADEMARK OFFICE)
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5

6 I, ERICA FIELD, RPR, Stenographic Court
7 Reporter, certify that I was authorized to
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18 financially interested in the action.

19
20 DATED this 2nd day of August, 2023.

21
22 _____
23 Erica Field
24
25

*** ERRATA SHEET ***

CASE: Apple Inc. v. Speir Technologies Ltd.

DATE: July 21, 2023

WITNESS: Dr. Zhi Ding

JOB NO.: 7588

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Dr. Zhi Ding

Subscribed and sworn to before me

this ____ day of _____, 20__.

Notary Public