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 3        UNITED STATES PATENT AND TRADEMARK OFFICE

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 5        BEFORE THE PATENT TRIAL AND APPEAL BOARD

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 7        HTC CORPORATION, HTC AMERICA, INC.
                   and APPLE INC.,
 8                   Petitioners

 9                        v.

10                   INVT SPE LLC,
                   Patent Owner.
11
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12
        Case Nos. IPR2018-0155 and IPR2018-01581
13           U.S. Patent No. 7,848,439

14    -------------------------------------------------

15

16

17                  DEPOSITION OF

18                 ZHI DING, PH.D.

19           Tuesday, December 3, 2019

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23

24

25    REPORTED BY:  Brandi N. Bigalke, RPR, RSA
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1            The following is the deposition of ZHI

2    DING, PH.D., taken before Brandi N. Bigalke, RPR,

3    RSA pursuant to Notice of Taking Deposition, at

4    Best Western Plus Palm Court Hotel, 234 D Street,

5    Davis, California.

6

7                A P P E A R A N C E S

8

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     and APPLE INC.:
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 2                          I N D E X

 3   EXAMINATION                                     PAGE

 4   Mr. Morton......................................4

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 6

 7                      EXHIBIT INDEX

 8   PREVIOUSLY-MARKED EXHIBITS           REFERRED PAGE

 9   HTC EXHIBIT 1001................................4

10   U.S. Patent 7,848,439

11   HTC EXHIBIT 1003...............................45

12   U.S. Patent 6,904,283

13   HTC EXHIBIT 1004..............................107

14   U.S. Patent 7,221,680

15   HTC EXHIBIT 1005..............................141

16   U.S. Patent 6,721,569

17   HTC EXHIBIT 1006...............................24

18   U.S. Patent 5,596,604

19   HTC EXHIBIT 1007..............................109

20   Declaration of Zhi Ding, Ph.D. in Support of

21   Petition for Inter Partes Review

22   HTC EXHIBIT 1016...............................24

23   Declaration of Zhi Ding, Ph.D. in Support of

24   Petitioners' Consolidated Reply to Patent Owner's

25   Consolidated Response
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1 P R O C E E D I N G S
2 Whereupon, the deposition of ZHI DING, PH.D.
3 was commenced at 8:34 a.m. as follows:
4 - - -
5 ZHI DING, PH.D.
6 Called as a witness and having been first duly
7 sworn, testifies as follows:
8 EXAMINATION
9 BY MR. MORTON:
10 Q. Good morning, Dr. Ding. I assume
11 you've had your deposition taken before?
12 **A. Yes. Good morning. Yes, I have**
13 had depositions taken before.
14 Q. Okay. And you've had time to
15 prepare for this deposition with counsel?
16 **A. Some time, yes.**
17 Q. And is there any reason you can
18 think of why you cannot hear my questions, and
19 give full, true and honest answers here today?
20 **A. No.**
21 Q. Okay. Let's dive right in and talk
22 about the '439 patents. I have it there in front
23 of you. It's Exhibit 1001 to this IPR
24 proceeding.
25 Do you see that?           *Page 4*

1 **A. Yes.**
2 Q. Okay. With reference to Column 2
3 of that patent, if you want to have that open for
4 your reference.
5 So Column 2 is some of the -- under
6 the section called The Background of the Art in
7 the '439 patent.
8 Do you see that?
9 **A. Yes.**
10 Q. Okay. And it talks about adaptive
11 modulation and coding based on subcarriers.
12 **A. Which line are we referring to?**
13 Q. If you look at Column 2, lines 4
14 through 8, it's introducing that concept.
15 **A. Okay. I see Column 2, right.**
16 Q. And Column 2 talks about -- you
17 understand what adaptive modulation and coding
18 is, right?
19 **A. I understand that as a general**
20 concept, yes.
21 Q. Okay. So just for the record then,
22 what is adaptive modulation and coding?
23 **A. It's a mechanism where depending on**
24 the conditions necessary, the modulation and
25 coding that is used to transmit data can be  *Page 5*

1 adjusted in accordance to the conditions.
2 Q. Right.
3 And what happens in general is you
4 have a pilot signal or something like that, user
5 equipment or wireless device, handheld device
6 can measure, right?
7 MR. FRANKLIN: Objection; vague.
8 THE WITNESS: Could you break down
9 the question a bit better?
10 BY MR. MORTON:
11 Q. Well, you're the expert. This is
12 adaptive modulation and coding. I thought this
13 was basic stuff.
14 So you describe to me how adaptive
15 modulation and coding works.
16 **A. To make the adjustment of**
17 modulation and coding, the transmitter needs to
18 be aware of the necessity to make adjustment on
19 the modulation and coding. And what conditions
20 necessitates that needs to be available to the
21 transmitter.
22 Q. Okay. And how do the conditions as
23 you call them, how are those made available to
24 the transmitter?
25 **A. There is several ways that can --**  *Page 6*

1 **that can be made aware to the transmitter.**
2 Q. Okay. What are the ways?
3 **A. For example, the transmitter may**
4 simply be looking at the channel that the
5 transmitter is also receiving data on from the
6 mobile station, and based on the principal of
7 reciprocity, the transmitter can estimate the
8 conditions of the forward link channel, and in
9 accordance to that condition of the channel make
10 adjustments to the adaptive -- to the modulation
11 and coding scheme that the transmitter is about
12 to use.
13 Q. Okay.
14 **A. That's one.**
15 Q. What's another way?
16 **A. Sorry?**
17 Q. What's another way?
18 **A. Another possibility is that the**
19 transmitter simply does not have sufficient power
20 to transmit at -- you're running out of power or
21 battery, so you have to dial down the modulation
22 complexity simply because higher modulation
23 requires more power.
24 Q. Okay.
25 **A. Yeah.**  *Page 7*

1 Q. And another way?

2 **A. Other ways includes that the**

3 transmitter may perceive that there's a strong

4 likelihood of having interference in -- for the

5 channel that the transmission will take place.

6 So again, in accordance you are likely to add

7 additional redundancy to protect your --

8 redundancy in the error -- forward error

9 correction code to protect the data you're

10 transmitting.

11 Q. Okay. Is that all the ways?

12 **A. No.**

13 Q. What's another one?

14 **A. What's another one. Well,**

15 conditions generally includes the transmitter

16 itself whether it have enough powers to do

17 something, or the way to perceive the channel

18 condition change, whether the forwarding channel

19 has changed.

20 So I've given you a list of ways

21 that the transmitter can perceive that change.

22 Q. Is there a reason that you're

23 avoiding the situation of the user equipment

24 making a measurement on the downlink on a pilot

25 signal and then reporting something back up to

1 the transmitter?

2 MR. FRANKLIN: Objection;

3 argumentative.

4 THE WITNESS: No.

5 BY MR. MORTON:

6 Q. Okay. Well, let's talk about that

7 since that's what's in Column 2 that I pointed

8 to.

9 Do you see where it says, "AMC in

10 OFDM is divided into two, AMC based on

11 subcarriers and AMC based on subbands."

12 Do you see that?

13 **A. Okay. Yes.**

14 Q. Okay. So any of the things you

15 describe, was any of that AMC based on

16 subcarriers?

17 **A. Yeah. It can be done based on**

18 subcarriers.

19 Q. Okay. What's AMC based on

20 subcarriers?

21 **A. That's the granularity with which**

22 you are making adjustments of modulation.

23 Therefore, the adjustment of different modulation

24 is done on a per sip -- subcarrier basis.

25 (Clarification by the court

1 reporter.)

2 THE WITNESS: On a per subcarrier

3 basis. And same answer for AMC based on subband

4 basis. Per subband basis.

5 BY MR. MORTON:

6 Q. So the '439 patent acknowledges

7 that AMC based on subcarriers was known and that

8 AMC based on subbands was known prior to the

9 invention, right?

10 **A. Yes.**

11 Q. Okay. And when we're talking

12 about -- what's the difference between a

13 subcarrier and a subband?

14 **A. Okay. So in this context, in the**

15 context of '439, subbands contains one or more

16 subcarriers.

17 Q. Okay. And those are -- the

18 subcarriers would be neighboring on the frequency

19 domain, is that right, to make up a subband?

20 **A. Generally, no, but you certainly**

21 can make it contiguous. You can have contiguous

22 subcarriers forming a subband, but it's also not

23 necessary in general.

24 Q. Okay. You actually put in your

25 declaration and defined subbands as neighboring

1 subcarriers on a frequency domain, right?

2 **A. I may have.**

3 Which side?

4 Q. What's that?

5 **A. Where is that in the declaration?**

6 Q. It would be in the claim

7 construction portion of your opening declaration

8 says that, and it may repeat it in your secondary

9 declaration.

10 **A. I'm sorry, what was the question?**

11 Q. I'm just asking you to confirm that

12 you actually defined subbands -- you said

13 subbands don't have to have subcarriers

14 neighboring on the frequency access?

15 **A. Right.**

16 Q. I'm asking you isn't it true that

17 you actually defined subbands as having

18 subcarriers neighboring on the frequency?

19 **A. I'm just asking you to refresh my**

20 memory. I don't remember where I wrote that, and

21 I certainly would own up to it if it is written

22 that -- if I said that subbands necessarily have

23 to have subcarriers in a contiguous relationship.

24 Q. It would be in your opening

25 declaration which you have there.

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