

**UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

SAMSUNG ELECTRONICS CO. LTD.,

Petitioner,

v.

WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.,

Patent Owner.

**Case IPR 2025-00934, (U.S. Patent Number 11,159,210)
Ref. 39843-0195IP1**

VIDEOCONFERENCE DEPOSITION OF

DR. TODOR V. COOKLEV

MAY 13, 2026

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10:05 a.m. PST - 2:27 p.m. PST

REPORTED BY:

Tamara L. Houston

CA CSR No. 7244, RPR, CCRR No. 140

Job Number J14665586

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REMOTE VIDEOCONFERENCE DEPOSITION OF Dr. Todor V. Cooklev, taken on behalf of the Petitioner, commencing from 10:05 a.m. PST to 2:27 p.m., Wednesday, May 13, 2026, before Tamara L. Houston, CSR No. 7244, CCRR, RPR, CRG.

THE SULLIVAN GROUP OF COURT REPORTERS

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DR. TODOR V. COOKLEV

**SAMSUNG ELECTRONICS CO. LTD. vs. WILUS INSTITUTE OF
STANDARDS AND TECHNOLOGY INC.**

MAY 13, 2026

Tamara L. Houston, CSR No. 7244, CRR No. 140, RPR

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None marked.

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1 WEDNESDAY, MAY 13, 2026, 10:05 A.M. PST

2 --000--

3 COURT REPORTER: My name is Tamara Houston,
4 California Certified Shorthand Reporter Number 7244.

5 ---000---

6 Whereupon, DR. TODOR V. COOKLEV, having been
7 called as a witness was duly sworn
8 to tell the truth, the whole truth,
9 and nothing but the truth testified
10 as follows:

11 EXAMINATION BY MR. STEPHENS:

12 Q. Welcome, Dr. Cooklev. Now that we're on the
13 record, I'll reintroduce myself. I'm Nick Stephens.
14 I'm an attorney with Fish & Richardson. I'll be asking
15 the questions today on behalf of the Petitioner,
16 Samsung.

17 I'm also -- on the line we got Rishi Gupta,
18 who I am working with on this case who is a colleague of
19 mine at Fish.

20 Would counsel like to state their appearance?

21 MR. MILKEY: Yes. This is James Milkey on
22 behalf of patent owner, Wilus, and also representing the
23 defendant today -- sorry, representing the witness
24 today.

25

1 BY MR. STEPHENS:

2 Q. Okay. We're here today regarding
3 IPR2025-00934 involving the '210 patent.

4 Is that your understanding, Dr. Cooklev?

5 A. Yes, that's correct.

6 Q. And this deposition is being conducted by
7 video remotely but is being transcribed.

8 Do you understand?

9 A. I do.

10 Q. I know you've been through this before, but to
11 ensure a clean record, I'll -- I may not interrupt you
12 during your answers, and I'll ask that you do the same
13 while I'm asking a question so we can maintain a clean
14 record to the extent possible.

15 If you need a break at any time during the
16 deposition, please feel free to let me know. Happy to
17 take a pause. I don't know if you've had lunch yet. I
18 know you are likely Eastern Time, so you're a little bit
19 further ahead than some of us, but if you'd like a lunch
20 break, we can take one as well.

21 A. Thank you. Thank you. I think I won't need a
22 lunch break.

23 Q. Okay. Now, before we get started, I dropped
24 into the chat window a set of documents which are
25 electronic files of several exhibits, for the record, of

1 this IPR.

2 Did you receive those?

3 A. I did.

4 Q. And those documents included Exhibit 1001, the
5 '210 patent; Exhibit 1004, which is the IEEE 802.11ax,
6 draft 1.0 specification; Exhibit 1013, the Bharadwaj
7 reference; Exhibit 1015, the Sun reference; and
8 Exhibit 2018, which is the declaration that you
9 submitted in this proceeding, correct?

10 A. I believe that's correct, yes.

11 Q. Okay. And do you have any other documents or
12 materials in front of you?

13 A. I have -- I have some textbooks that is a
14 magazine, but they do not have anything to do with the
15 IPR.

16 Q. Would you please state your full name for the
17 record?

18 A. Todor Cooklev.

19 Q. And you understand that you're under oath?

20 A. I do.

21 Q. Is there any reason that you can't give
22 truthful and accurate testimony today?

23 A. I am not aware of any.

24 Q. Can you describe how you prepared for the
25 deposition today?

1 A. Yes. For the most part, I have been reviewing
2 the documents, the exhibits of the IPR. And, again, for
3 the most part, the same documents that you dropped in
4 the chat here. Also, I took a look at some of the other
5 exhibits.

6 This is what I did. I also had a discussion
7 with counsel for Wilus Institute of Standards and
8 Technology.

9 Q. Were any of the other documents that you
10 referenced outside of the materials listed in your
11 declaration?

12 A. Any other documents referenced?

13 Q. I'm sorry. That you referenced in preparation
14 for today's deposition.

15 A. No. I -- the documents that I reviewed -- I
16 think all of the documents that I reviewed are documents
17 that are a part of the records of the IPR.

18 I took a look at, for example, Exhibits 1035,
19 1036. I think those are -- if I recall correctly, those
20 are part of the records. Maybe I've taken a brief look,
21 if I may say, at some other -- some other exhibits, but
22 I do not -- I don't think I reviewed anything that's not
23 part of the records.

24 Q. How much time did you spend preparing for the
25 deposition?

1 A. I think maybe about four, five days and
2 considering that it wasn't -- they weren't full days.

3 Q. If you could quantify that in terms of a
4 number of hours, what would you estimate the number of
5 hours that it was that you spent preparing for the
6 deposition?

7 A. I'd say 20 hours, maybe a little bit more than
8 20, but in that frame range.

9 Q. Have you submitted declarations in any other
10 IPRs between Samsung and Wilus?

11 A. Yes.

12 Q. Do you recall about how many declarations you
13 submitted?

14 A. You know, my memory maybe is -- it's a little
15 difficult to rely on it.

16 So I would say around three, maybe.

17 Q. On three different patents?

18 MR. MILKEY: Object to form.

19 THE WITNESS: Well, I mean, if there are three
20 different IPRs, the subject matter would be different.
21 Or at least somewhat different.

22 BY MR. STEPHENS:

23 Q. And in this IPR, the patent that's been
24 challenged is the '210 patent, correct?

25 A. Yes, I think so.

1 Q. When did you first become aware of the '210
2 patent?

3 A. When I was asked to work on this IPR.

4 Q. Do you recall encountering -- I'm sorry,
5 Dr. Cooklev, it looked like you were going to add some
6 more.

7 A. Yes. I -- it's possible that I became aware
8 of it when I was asked to work -- the first time I was
9 asked to work on -- on these IPRs that you mentioned.
10 Not necessarily in connection with this one. There's a
11 chance that I became aware of it back then.

12 Q. You mentioned the first time that you were
13 asked to work on these IPRs.

14 A. Yes, sir.

15 Q. Is that in relation to the same IPRs or
16 another set of IPRs?

17 MR. MILKEY: Objection to form.

18 THE WITNESS: I'm not sure another set of
19 IPRs. It's generally in connection with the -- the IPRs
20 for the Wi-Fi patents of Wilus.

21 BY MR. STEPHENS:

22 Q. Do you recall ever encountering the '210
23 patent before Samsung filed its petition on the '210
24 patent?

25 A. I don't think I was aware of it.

1 Q. And are you aware that the '210 patent is
2 currently the subject of a district court litigation
3 between Samsung and Wilus?

4 MR. MILKEY: Objection to form. Outside the
5 scope of the declaration.

6 THE WITNESS: I have awareness of that, yes.

7 BY MR. STEPHENS:

8 Q. Have you had any involvement in the district
9 Court litigation?

10 A. I don't think so.

11 Q. Okay. So I mentioned earlier one of the
12 documents that I had shared was -- through the chat in
13 the Zoom window was Exhibit 2018, which is the
14 declaration that you had submitted in this IPR in the
15 '210 patent, correct?

16 A. I'm opening the document that you dropped in
17 the chat.

18 Yes, it looks like -- it looks that this is my
19 declaration.

20 Q. Can you describe the process by which you
21 prepared this declaration?

22 MR. MILKEY: Objection to form.

23 THE WITNESS: Well, I -- I think I started
24 with reviewing the petition, and -- and most
25 substantively, the declaration submitted by Dr. Hansen.

1 And together with that, reviewing the '210 patent, the
2 prior art before I -- or even together with that I had
3 some discussions with counsel. And I think the
4 process -- that's a general idea of the process.

5 BY MR. STEPHENS:

6 Q. Do you recall how much of the declaration you
7 personally wrote?

8 MR. MILKEY: Objection to form.

9 THE WITNESS: First, I don't -- I don't look
10 at this as did I write it personally, as you said.
11 It's -- the declaration contains my opinions. So I
12 don't necessarily look at it as to how it was written.

13 I -- I think I describe generally the process
14 of -- according to which I reviewed and read, as
15 carefully as I could, the declaration of Dr. Hansen, the
16 prior art, and started formulating my opinions or
17 started coming up with opinions. So I -- is it fair to
18 say that there are words in your declaration that were
19 not drafted by you?

20 MR. MILKEY: Objection to form.

21 THE WITNESS: I don't know that that's
22 accurate. If you say typed, maybe are not typed by me.
23 There are words not typed by me. Maybe there are.

24 Drafted -- to the extent drafted has a
25 different meaning, I wouldn't agree.

1 BY MR. STEPHENS:

2 Q. Are you aware of any errors, Dr. Cooklev, in
3 your declaration?

4 A. Errors. I don't know. I don't think after
5 submitting it, there were -- there were a couple of
6 places where I thought, well, maybe I was just thinking
7 if -- if -- that if those paragraphs were clear, I don't
8 think or -- at least I'm not aware of any errors.

9 Q. Even those paragraphs that in hindsight maybe
10 could have been clearer, you don't believe there were
11 any errors there; is that correct?

12 A. At least sitting here right now.

13 Q. I'll say as an attorney, I often look back at
14 work that's been submitted and think, maybe I could have
15 stated that in a different way, so I think I understand.

16 A. Well, thank you.

17 Q. Have you previously been retained outside the
18 IPRs between Samsung and Wilus? I'll start again.

19 How many times have you been retained as an
20 expert in litigation matters?

21 A. Overall?

22 Q. Yes.

23 A. Well, I don't remember. It's difficult even
24 to -- it's a little difficult to define litigation
25 matters. But maybe, if I were to guess, like 30, 40.

1 Maybe even a little bit more times.

2 Q. Have most of those been patent cases?

3 A. Yes.

4 Q. Have you done any work outside of patent
5 cases?

6 MR. MILKEY: Objection to form.

7 BY MR. STEPHENS:

8 Q. I'll clarify.

9 Have you been retained in any litigation
10 matters that were not patent cases?

11 A. Yes.

12 Q. And do you know the number -- about the number
13 of times you've been deposed?

14 A. The number of times, around 50, maybe a little
15 bit more.

16 Q. 50, 5-0?

17 A. Yes. 50 meaning 5-0.

18 Q. All right. I'd like to turn to your
19 declaration, Exhibit 2018.

20 A. Yes.

21 Q. And I'll start at Section 2, which is on
22 page 1, paragraph 3. Just let me know when you see
23 that.

24 A. Yes. Yes, I'm looking at paragraph 3.

25 Q. Okay. So you say that you're currently a

1 professor of electrical and computer engineering at
2 Purdue University in Fort Wayne, Indiana, correct?

3 A. Yes, that's what I state. Yes.

4 Q. How long have you been a professor at Purdue
5 in Fort Wayne?

6 A. Well, as a -- as a professor of electrical and
7 computer engineering, I think I've been since 2016.

8 Q. And were you employed by Purdue in Fort Wayne
9 before 2016?

10 A. Yes.

11 Q. What was your role before 2016?

12 A. I was associate professor.

13 Q. And how long were you an associate professor?

14 A. I mean, I was for several years.

15 Q. And you teach courses related to hardware and
16 software architectures of wireless systems and wireless
17 devices, correct?

18 A. Yes.

19 Q. Are these graduate level courses?
20 Undergraduate? Or both?

21 A. Both.

22 Q. Have any of the courses that you've taught
23 focused on the IEEE 802.11 wireless standard?

24 A. Yes.

25 Q. Can you describe the nature of those courses?

1 A. Yes. I have been teaching a course of
2 wireless communication networks which -- which
3 emphasizes 802.11.

4 (Reporter requested clarification.)

5 Q. And does the wireless communication network
6 course that emphasizes 802.11, is that an undergraduate
7 level course or a graduate level course?

8 A. That's a graduate level course.

9 Q. And do you look at the specifications for
10 802.11 in that course?

11 A. Yes.

12 Q. How long have you been teaching that course?

13 A. About 15 years.

14 Q. Okay. So in paragraph 4, you state that, "I
15 have received research funding from the National Science
16 Foundation, the Defense Advanced Research Projects
17 Agency, the U.S. Air Force Research Laboratory, the
18 Office of Naval Research and a number of private
19 companies including major technology companies."

20 Did I read that correctly?

21 A. Yes.

22 Q. Have you ever received research funding from
23 Samsung?

24 MR. MILKEY: Objection to form.

25 THE WITNESS: No, I haven't.

1 BY MR. STEPHENS:

2 Q. Have you ever received research funding from
3 Wilus?

4 A. No.

5 MR. MILKEY: Objection to form.

6 BY MR. STEPHENS:

7 Q. Outside of your work of the currently pending
8 IPRs between Samsung and Wilus, have you ever previously
9 worked on behalf of Samsung?

10 MR. MILKEY: Objection to form.

11 THE WITNESS: No, I haven't.

12 BY MR. STEPHENS:

13 Q. And outside of your work in the currently
14 pending IPRs between Samsung and Wilus, have you ever
15 previously worked on behalf of Wilus?

16 MR. MILKEY: Objection to form.

17 THE WITNESS: No, I haven't.

18 BY MR. STEPHENS:

19 Q. Outside of your work in the currently pending
20 IPRs between Samsung and Wilus, have you ever previously
21 worked adverse to Samsung?

22 MR. MILKEY: Objection to form.

23 THE WITNESS: Excuse me, have I previously
24 what?

25

1 BY MR. STEPHENS:

2 Q. Worked on a case that was adverse to Samsung.

3 A. I believe so, yes.

4 Q. And do you recall what those cases were?

5 A. And by "case," Counsel, do you mean just the
6 court case, IPR, or both?

7 Q. Any cases in which the case was adverse to
8 Samsung. So that would include IPRs, district court, or
9 potentially other matters.

10 A. I -- it's difficult to recall everything, but
11 I recall maybe one or two cases.

12 Q. What do you recall about those cases?

13 A. Well, I recall that Samsung was a party in
14 those cases, and I have some general recollection of
15 what -- of the technology, the subject matter of those
16 cases.

17 Q. Was it an IPR case?

18 A. Well, for example, in -- I -- I'm not sure
19 that it's one case, or maybe -- maybe more than one.
20 But I recall a case where there was -- in which there
21 was a district court case, and the district court case
22 involved multiple patents, maybe more than ten. And
23 there were more than ten IPRs.

24 Q. Did you submit any reports in those cases?

25 A. Yes, I did. I -- I was -- I submitted the

1 reports in all ten or more than ten IPRs, and also
2 submitted -- I don't really recall the details, but I
3 was also the expert working on the district court case.

4 Q. Outside of those cases, do you recall any
5 other cases in which you worked on behalf of a party
6 adverse to Samsung?

7 A. Yes.

8 Q. And can you identify what those cases were?

9 A. Those -- I recall one IPR other than -- other
10 than those. I said more than ten IPRs. As I said, I
11 recall one IPR.

12 Q. Do you recall the subject matter of the
13 patents at issue in those cases?

14 A. I do.

15 Q. Did they relate to 802.11?

16 A. Well, you said "those cases." I can maybe
17 just now try to recall some more details.

18 I was thinking about that other IPR, which I
19 said is separate from those more than ten IPRs. There
20 were 12 or 13. That additional IPR, I remember the
21 subject matter. It was not 802.11.

22 Q. And you said -- go ahead. I'm sorry, I didn't
23 mean to interrupt you.

24 A. I was just going to finish the subject matter
25 on that IPR was LTE cellular technology.

1 (Reporter requested clarification.)

2 BY MR. STEPHENS:

3 Q. And the first set of cases where you mentioned
4 there was a district court litigation and about ten
5 IPRs, do you recall if the subject matter of those
6 patents related to 802.11?

7 A. 802.11 was relevant, was a relevant
8 technology. And please, some of those IPRs, some of
9 those I said more than ten, and maybe it was relevant to
10 all. So it had some relevance.

11 BY MR. STEPHENS:

12 Q. Let's go forward to paragraph 7 in your
13 declaration.

14 A. I'm looking at it.

15 Q. Okay. You note here that you have experience
16 in private industry.

17 A. Yes.

18 Q. What experience do you have in private
19 industry?

20 A. Well, I -- I've worked for a couple of
21 companies, and I have also done technology consulting.
22 This is what I meant in connection with paragraph 7.

23 Q. So you've worked for a couple of companies.
24 Which companies did you work for?

25 A. I worked for a large company at the time

1 called 3Com, then I worked for a smaller company called
2 Aware.

3 Q. The large company was named 3Com; is that
4 correct?

5 A. Yes, the numeral 3 and then Com.

6 Q. What years did you work at 3Com?

7 A. From '97 to '99.

8 Q. Did your work at 3Com involve work related to
9 802.11?

10 A. A little bit. 802.11 was -- was -- I mean it
11 was -- those years -- at that time 802.11 did not -- was
12 not as successful. It was -- those years were prior to
13 the significant market success of 802.11.

14 But it was a technology in which -- in which
15 we at 3Com, we were interested in. And so that's why,
16 as I say, to some extent.

17 Q. Did you ever attend any 802.11 working group
18 meetings in connection with your work at 3Com?

19 A. No, nothing with 802.11 meetings. At that
20 time I was working more on Bluetooth, and I was -- so I
21 was attending meetings in connection with Bluetooth and
22 that work. Maybe I -- I did -- I did not describe this
23 part of my background I think in these paragraphs of my
24 declaration.

25 So in -- but in the summer of 1999, there --

1 there was a meeting between -- essentially between
2 some -- at least some people from the Bluetooth special
3 interest group and IEEE 802. I attended that meeting.
4 The specific goal of the meeting was to draft a license
5 agreement so that IEEE 802 could begin working on -- on
6 essentially it's -- those years, the idea was that IEEE
7 802 work on a set of open standards for wireless
8 personal area networking.

9 (Reporter requested clarification.)

10 THE WITNESS: And -- and so after that
11 meeting, I started attending -- started attending IEEE
12 802, both IEEE 802.15 and IEEE 802.11. And so I was at
13 least trying to attend both working groups as much as I
14 can. And I'm thinking the following year in 2000 I --
15 in particular, I started spending more time in 802.11.

16 BY MR. STEPHENS:

17 Q. And in your time at 3Com, you mentioned there
18 was another company that you went to work for.

19 Is that correct?

20 A. Yes.

21 Q. What was the name of that company?

22 A. Aware.

23 Q. Aware. Did your work at Aware relate to
24 802.11?

25 A. Yes.

1 Q. In what way?

2 A. Well, the -- I said I was -- that I was
3 attending regularly the meetings of the 802.11 working
4 group. In some cases even I contributed to documents
5 submitted to the working group. But also I was
6 participating in the development of -- of technology.
7 And in particular, the development of 802.11 compliant
8 chipset.

9 Q. Aware was involved in developing a -- an
10 802.11 compliant chipset?

11 A. Yes.

12 Q. And what was the timeframe of this work?

13 A. It's from the fall of 1999 to about the fall
14 of 2002.

15 Q. Did you leave Aware in -- in the fall of 2002?

16 A. Yes.

17 Q. So in the period of between the fall of '99
18 and the fall of 2002, you were attending 802.11 working
19 group meetings on behalf of Aware. Is that correct?

20 A. Yes.

21 Q. Were you a voting member of the working
22 group -- I'm sorry, the 802.11 working group at that
23 time?

24 A. Yes.

25 Q. Did you have colleagues at Aware that were not

1 voting members of the 802.11 working group?

2 A. Not voting members?

3 Q. Yes.

4 A. Well, yes, I had colleagues -- not everybody
5 at Aware at that time was a voting member. In fact, few
6 were voting members.

7 Q. Did you ever discuss 802.11 drafts that were
8 put up for a vote or for letter balloting with your
9 colleagues at Aware?

10 MR. MILKEY: Objection to form.

11 (Reporter requested clarification.)

12 THE WITNESS: No, I don't think I discussed
13 802.11 drafts.

14 BY MR. STEPHENS:

15 Q. Did Aware rely on your knowledge of what was
16 happening at 802.11 meetings in connection with its
17 development of the 802.11 compliant chipset?

18 MR. MILKEY: Objection to form. Outside the
19 scope.

20 THE WITNESS: Excuse me. What exactly is the
21 question? Did Aware rely on what?

22 BY MR. STEPHENS:

23 Q. Your knowledge of what was happening at 802.11
24 meetings.

25 MR. MILKEY: Same objections.

1 THE WITNESS: As far as rely, I think yes in
2 the sense that attendance at these meetings is -- is
3 something useful for -- for the company to orient itself
4 as far as generally what -- what other companies are
5 working on. So I think for Aware it was the fact that I
6 attended these meetings was of some importance.

7 BY MR. STEPHENS:

8 Q. Did you ever share any 802.11 drafts that were
9 put up for letter balloting at your colleagues that you
10 are aware?

11 MR. MILKEY: Object to form. Also object to
12 the scope. Counsel, you've been going on this line of
13 questioning for a while. I kind of assumed that you
14 were going to tie it to something in this IPR. You
15 haven't done so yet.

16 Are you planning to tie this to something
17 that's relevant to this IPR, or is this -- or, you know,
18 something that's submitted as part of this declaration,
19 or is this just something that is unrelated? I -- to me
20 this is clearly outside the scope of the declaration,
21 and I -- I -- I don't see the basis to continue with
22 this line of questioning.

23 MR. STEPHENS: Counsel, this goes directly to
24 his qualifications, which he's outlined in his
25 declaration. I'm asking about his involvement with

1 802.11 standards which is, I believe, the substance of
2 his testimony in this IPR.

3 MR. MILKEY: So whether his company relied
4 on -- on his involvement goes to his qualifications? I
5 really don't understand how this goes to his
6 qualifications.

7 MR. STEPHENS: Counsel, should we go off the
8 record?

9 MR. MILKEY: Sure.

10 (Recess.)

11 BY MR. STEPHENS:

12 Q. Dr. Cooklev, before the break we were
13 discussing your time at Aware, and I had a pending
14 question as to whether during your time at Aware you had
15 ever shared any 802.11 drafts with colleagues at Aware.

16 A. Yes, I --

17 MR. MILKEY: Object to form. Outside the
18 scope, to the extent there's a question.

19 THE WITNESS: I believe I -- and maybe I
20 answered once. But, no, I don't think I shared any
21 draft documents, any drafts with colleagues at Aware.

22 BY MR. STEPHENS:

23 Q. In paragraph 9 of your declaration --

24 A. Yes.

25 Q. -- you mention that between 2000 to 2002 and

1 2005 to 2008, you were a voting member in the 802.11
2 working group. Is that correct?

3 A. Yes. Yes.

4 Q. And from 2005 to 2007, you were the chair of a
5 study group within IEEE 802.11?

6 A. Yes.

7 Q. So in the period between 2000 to 2002, you
8 were a voting member and attending meetings -- 802.11
9 meetings in connection with your work with Aware; is
10 that correct?

11 MR. MILKEY: Object to form.

12 THE WITNESS: Yes.

13 (Reporter requested clarification.)

14 MR. MILKEY: Yeah. Objection to form.

15 BY MR. STEPHENS:

16 Q. And between 2005 to 2008, were you attending
17 802.11 meetings on behalf of any other party?

18 MR. MILKEY: Objection to form.

19 THE WITNESS: Yes.

20 BY MR. STEPHENS:

21 Q. And who is that?

22 A. I was a consultant for Hitachi Homematica out
23 of San Jose.

24 Q. And were you not a voting member between 2002
25 and 2005?

1 A. Yes.

2 Q. Have you been a voting member since 2008 in
3 the 802.11 working group?

4 A. No, I haven't.

5 Q. Are you involved in any other IEEE working
6 groups since 2008?

7 A. Well, you said IEEE working groups. I -- you
8 said "involved"?

9 Q. I'll clarify.

10 Are you a voting member of any IEEE 802
11 working groups outside of 802.11 since 2008?

12 A. No, I have not been a voting member. But I
13 have been -- I have been involved.

14 Q. The last sentence in paragraph 9 at the top of
15 page 3 --

16 A. Yes.

17 Q. -- states that "I have reviewed and voted on
18 most IEEE 802.11 standards and amendments published
19 since 2000."

20 A. Yes.

21 Q. Have you been voting on 802.11 drafts since
22 2008?

23 A. No, not on drafts. But just a moment ago I
24 said that I have been involved, even after 2008. And
25 this is what I -- this is what I meant. No -- although

1 I have not voted on drafts, but after -- after a draft
2 is approved, then -- then there is another level of
3 voting. Then there is the so-called ballot pool, and I
4 have been a member -- or I was a member of that ballot
5 pool several times.

6 Q. Are you familiar with 802.11ax?

7 A. Yes.

8 MR. MILKEY: Objection to form.

9 BY MR. STEPHENS:

10 Q. What is 802.11ax?

11 A. What is 802.11ax?

12 Q. That's correct.

13 A. Well, it can be considered as a standard for
14 wireless local area networking, or you could consider it
15 as an amendment to 802.11.

16 Q. Was there a task group that was responsible
17 for -- excuse me, one sec.

18 Strike that last question.

19 Are you familiar with an 802.11ax task group?

20 MR. MILKEY: Objection to form.

21 THE WITNESS: I'm not exactly sure -- what do
22 you mean, Counsel? But I am familiar with how the 802,
23 the entire working group -- the 802.11 working group
24 operates. And, generally, amendments such as 802.11ax
25 are developed in appropriate task groups.

1 BY MR. STEPHENS:

2 Q. So there was a task group that worked on the
3 802.11ax amendment; is that correct?

4 A. Generally this is how -- this is how
5 amendments are developed, so -- so, yes, the -- I think
6 there was a task group which had the task to come up
7 with 802.11ax.

8 Q. And do you recall the timeframe in which the
9 task group worked on the 802.11ax amendment?

10 A. I was not part of that task group to recall
11 that time.

12 Q. Did you contribute any -- well, strike that.
13 Can you describe any involvement that you had
14 with the 802.11ax amendment?

15 A. I'm not sure I had any involvement with the ax
16 amendment.

17 Q. I'd like to go to paragraph 44 of your
18 declaration.

19 A. 44. Just a second. I'm looking at paragraph
20 44.

21 Q. Okay. Great. It's about halfway down the
22 paragraph. There's a sentence that begins, "Instead."

23 Do you see that?

24 A. I'm -- I'm looking at the entire paragraph 44.

25 Q. Take a moment to review, if you'd like.

1 A. Yes, I -- so the -- I think this paragraph is
2 maybe two sentences. So you mean the second sentence of
3 this paragraph?

4 Q. I'm looking at -- it's on page 15 of the
5 declaration, and the sentence that begins seven lines
6 down with the word "instead."

7 Do you see that?

8 A. I do.

9 Q. And you state that it's your opinion that a
10 POSITA would have understood that in the context of the
11 prior art relied upon, when a SIG-B compression field of
12 the HE-SIG-A indicates full bandwidth MU-MIMO
13 transmission, the number of MU-MIMO users cannot be 1,
14 such that the hexadecimal value of the 0x0 that would
15 correspond to the number of the users being set to 1
16 should be reserved.

17 Did I read that correctly?

18 A. Yes.

19 Q. And is that still your opinion today, sir?

20 A. Yes.

21 Q. You mentioned the prior art relied upon. I
22 believe that's the prior art that's been cited in
23 Samsung's IPR petition, correct?

24 A. Yes, the prior art identified by Dr. Hansen.

25 Q. So that would include the Bharadwaj reference,

1 Sun, and 802.11ax D1.0?

2 MR. MILKEY: Objection to form.

3 (Reporter requested clarification.)

4 THE WITNESS: Well, yes, I -- that's my
5 understanding.

6 BY MR. STEPHENS:

7 Q. All right. I'd like to explore this opinion a
8 little bit further with reference to Exhibit 1004, which
9 is 802.11ax D1.0. Feel free to pull up that document,
10 Dr. Cooklev.

11 A. I'm looking at the document which you provided
12 in the chat at the beginning of today.

13 Q. Perfect. All right. I'd like to turn to page
14 239.

15 And for the record, I'll just note that when
16 I'm referring to page numbers, I'll refer to the page
17 number that's been stamped at the bottom center of the
18 page.

19 So this is page 213, when I type it in my PDF,
20 but page 239 is stamped in the center.

21 A. Yes. Yes, I'm looking at this page.

22 Q. Okay. Great.

23 So on this page at line 31 there's a section
24 that begins -- Section 28.1.4, PPDU formats.

25 Do you see that?

1 A. I do.

2 Q. And this section describes different PPDU
3 formats that are supported by 802.11ax D1.0, correct?

4 A. Yes.

5 Q. What does PPDU stand for?

6 A. PHY protocol data units, and PHY is P-H-Y.
7 That's the physical layer.

8 Q. And what's the function of a PPDU in 802.11?

9 A. Well, the function is at the high level so
10 that the devices that are part of the wireless local
11 area network can communicate. And so the PPDU of
12 this -- of the protocol data unit that is transmitted
13 has to have a certain structure.

14 So that's why the format of the PPDU is --
15 relates to this structure.

16 Q. The PPDU is a physical layer format? Is that
17 correct?

18 A. Of the -- I'm not sure you've phrased it
19 correctly. The PPDU is the physical layer protocol data
20 unit, but the format of the PPDU is -- I think is like
21 the structure of the PPDU.

22 Q. And there are various formats of the PPDU
23 listed on page 239, correct?

24 A. I think yes.

25 Q. All right. More precisely, I believe D1.0

1 refers to them as different -- well, I guess they do
2 refer to them as formats or types, I believe is another
3 word.

4 Do you agree with that?

5 A. That generally I do. They -- I mean, we have
6 seen the context, but, yeah, they could be referred to
7 as types.

8 Q. At line 48, one of the listed PPDU formats is
9 an HE SU PPDU.

10 Do you see that?

11 A. Yes.

12 Q. What is your understanding of an HE SU PPDU?

13 A. An HE -- HE is the acronym, high efficiency,
14 which stands for 802.11ax. And then SU is the single
15 user so -- and here it says this PPDU carries a single
16 PSDU, which is the PHY service data unit.

17 (Reporter requested clarification.)

18 THE WITNESS: PHY or P-H-Y.

19 BY MR. STEPHENS:

20 Q. What is a PHY service data unit?

21 A. This is the data unit which is received by the
22 physical layer. The PPDU is the data unit produced by
23 the physical layer, or the PPDU that is transmitted.

24 Q. Does the PHY service data unit carry data for
25 multiple users?

1 A. No, this is for a single user. Right? We're
2 talking about the HE SU PPDU, which I think is for a
3 single user.

4 Q. Are you aware of any instance in 802.11ax
5 where the PHY service data unit can carry data for more
6 than one user?

7 A. So the question is whether the PHY service
8 data unit can carry data for more than one user?

9 Q. Correct.

10 A. I don't think that's the case. I mean, but
11 maybe you'd be better if -- if you have a document in
12 mind or a section in this document in mind.

13 Q. In your experience, are you aware of any
14 PSDU and 802.11ax carrying data for more than one user?

15 A. I don't think -- again, the -- as you said, in
16 my experience, I don't think a PSDU carries -- carries
17 data for multiple users.

18 Q. At line -- it's about line 54 or 55 on page
19 239, there's another PPDU format, which is the HE MU
20 PPDU format.

21 Do you see that?

22 A. Which line was it?

23 Q. Yeah. I'm looking again at page 239 of D1.0
24 line 54 to 55. HE MU PPDU.

25 A. Yes, I see this.

1 Q. What's your understanding of an HE MU PPDU?

2 A. Well, this is a PPDU aimed at multiple users.
3 And it carries -- it carries PSDUs.

4 Q. Was the HE MU PPDU first introduced in
5 802.11ax?

6 THE WITNESS: Excuse me, the HE MU PPDU?

7 BY MR. STEPHENS:

8 Q. Correct. Yes.

9 MR. MILKEY: Objection to form.

10 THE WITNESS: Before 802.11ax there was
11 802.11ac. But the HE MU PPDU, I think this is probably
12 produced by 802.11ax.

13 BY MR. STEPHENS:

14 Q. So, again, reading the description of the
15 HE MU PPDU around lines 55 to 56, D1.0 states that the
16 HE MU PPDU format carries one or more PSDUs to one or
17 more users.

18 Do you see that?

19 A. I do.

20 Q. So this sentence mentions two characteristics
21 of the HE MU PPDU. One is that it can carry one or more
22 PSDUs, correct?

23 A. That's what it says here at this sentence.

24 Q. And the HE MU PPDU can be for one or more
25 users, correct?

1 A. Well, I see this sentence, but documents
2 like -- like this one, I think one should read the
3 entire document to decide and to determine whether --
4 whether this -- whether, for example, HE MU PPDU can be
5 sent to one user. So this sentence is not sufficient to
6 conclude that draft 1.0 allows this to happen.

7 Q. But you would agree that at least this
8 sentence states that an HE MU PPDU can be for one or
9 more users, correct?

10 A. Yes, I agree that this sentence says what it
11 says. I mean, just, again, my -- the answer that I
12 gave, I think is -- is correct, and I think a person of
13 skill reading draft 1.0 would understand, well, it's the
14 first draft. Right? It's -- or the first draft in
15 which many has now been assembled. And the standards,
16 it's -- it can have inaccuracies. And it can have
17 inconsistencies.

18 So a person of skill would want to read the
19 entire draft before coming to a conclusion.

20 Q. And did you review the entire draft in the
21 course of the preparation of your declaration?

22 A. I tried to. It's -- it's a little bit long
23 draft, but I tried to -- I reviewed the -- the -- at
24 least the portions in the sections that are relevant for
25 this work and that are cited by Dr. Hansen and cited by

1 me.

2 Q. Are you familiar with the concept of a
3 resource unit?

4 A. Yes, I am.

5 Q. And that sometimes is referred to as an RU,
6 correct?

7 A. Yes, that's correct.

8 Q. What's your understanding of a resource unit
9 in 802.11ax?

10 A. It's -- it may be defined; and if I may, I
11 will -- I'll -- but it's a frequency-domain construct,
12 so it's comprised of tones or subcarriers.

13 (Reporter requested clarification.)

14 BY MR. STEPHENS:

15 Q. Is it possible for a resource unit to carry
16 data for multiple users in 802.11ax?

17 A. Is it possible one resource unit to carry data
18 for multiple users?

19 Q. I'll clarify my question.

20 Can a resource unit be configured to carry
21 data for more than one user in 802.11ax, D1.0?

22 A. I believe, yes, but it would be helpful if --
23 it will be helpful if you -- if you have a specific
24 section in mind, it will be helpful to give you an
25 answer in the context of a specific section of perhaps

1 draft 1.0.

2 Q. You are free to reference any section of the
3 draft that you'd like. Right now I'm just trying to
4 establish some background on concepts that are described
5 in D1.0.

6 MR. MILKEY: Objection to form.

7 BY MR. STEPHENS:

8 Q. Just so I understand your last response,
9 Dr. Cooklev, you do believe that it's possible for a
10 resource unit to be configured to carry data for
11 multiple users in D1.0?

12 A. I believe, yes.

13 Q. Is it possible for a resource unit to be
14 configured to carry data for a single user in D1.0?

15 A. Is it possible the resource unit to carry data
16 for a single user? Let me just -- in the abstract, yes.

17 Q. What do you mean by "in the abstract, yes"?

18 MR. MILKEY: Objection to form.

19 THE WITNESS: Well, I mean in the abstract or
20 in general, so using the definition of a resource unit
21 that's -- and, again, I'm not -- not that I'm providing
22 a definition, but my -- with my understanding of what a
23 resource unit is, that I said it's -- it's basically a
24 collection of subcarriers or a collection of tones.

25 And can a transmission to a single user occupy

1 a selection of -- or a set of circuit areas. I think in
2 general, yes. Yes, that's possible.

3 BY MR. STEPHENS:

4 Q. And in 802.11ax channel, could there be
5 multiple resource units allocated within that channel?

6 MR. MILKEY: Objection to form.

7 THE WITNESS: So the question is: Could there
8 be multiple resource units?

9 BY MR. STEPHENS:

10 Q. Within the channel.

11 A. And what is a channel?

12 Q. I will try to point you to something in the
13 D1.0 spec that will illustrate what I'm referencing.

14 A. Okay.

15 Q. On page 35, which is page 9 in the PDF that I
16 uploaded --

17 A. Yes.

18 Q. -- around line 21 -- well, I'll say line 18
19 refers to 20 megahertz, 40 megahertz, 80 megahertz,
20 160 megahertz, and 80 plus 80 megahertz channels. So
21 what I was asking earlier was within one of those
22 channels, could there be multiple resource units?

23 MR. MILKEY: Objection to form.

24 THE WITNESS: Well, but I mean here it says,
25 yes, that there are multiple resource units in these --

1 in the 20 megahertz channel, 40 megahertz channel,
2 80 megahertz channel, and I think some examples of these
3 resource units are given here.

4 BY MR. STEPHENS:

5 Q. Did 802.11ax allow data for a single user to
6 be carried in different resource units of the same PPDU?

7 MR. MILKEY: Objection to form.

8 THE WITNESS: Different resource units to the
9 same user?

10 BY MR. STEPHENS:

11 Q. Yes.

12 A. You know, I was reading about this in the
13 document, I believe. But if you can point me to what
14 part it would be, it would help me. Otherwise, it's
15 difficult for me to -- how do I -- it's more difficult
16 for me to answer. This is a -- it's a fairly long
17 document.

18 Q. I'm trying to understand what some of these
19 disclosures would mean which, I think, a person of skill
20 in the art would bring their knowledge. So I was hoping
21 that your experience and your knowledge would be able to
22 help shed some light on what's disclosed in D1.0, and so
23 I'm not able to point to something specifically here for
24 the question, but I'm interested in, based on what you
25 know, can data for one user be transmitted in multiple

1 resource units?

2 MR. MILKEY: Objection to form.

3 THE WITNESS: Yes, I remember what I was
4 reading. I think the answer is no, that multiple
5 resource units can't be used when they're addressed to a
6 single station -- when the transmission is to a single
7 station.

8 BY MR. STEPHENS:

9 Q. So let me go back to page 239 of D1.0.

10 A. 239?

11 Q. That's correct. Or 213 of the PDF.

12 A. I'm there.

13 Q. I'm again looking at the description of HE MU
14 PPDU around lines 55 to 56.

15 A. Yes.

16 Q. And HE MU PPDU for one user would carry that
17 data -- that user's data in just one resource unit,
18 correct?

19 A. Well, now -- your question is in the context
20 of HE MU PPDU.

21 Q. Yes, that's correct.

22 A. And that PPDU addressed to one user; is that
23 what you said?

24 Q. Correct.

25 A. And if that can be -- I'm just trying to think

1 about the question. If that can be sent -- if that --
2 if only one resource unit can be used for that?

3 Q. That's correct.

4 A. Well, first, as I said, whether an HE MU PPDU
5 can be sent to one user that this sentence in this
6 paragraph is not enough to come to that conclusion.

7 The second part of the question, the resource
8 unit, that's a -- well, we have to -- I can't, at the
9 moment, give an informed opinion just based on my
10 recollection of draft 1.0.

11 Q. Let's assume, for the purposes of this
12 question, that the disclosure on page 239 is correct,
13 that an HE MU PPDU can be directed to a single user.
14 Okay?

15 Okay. In that instance, the data for that
16 single user would be contained in just a single resource
17 unit, correct?

18 A. Well, it's difficult for me to even assume
19 hypotheticals which -- which I don't think are quite
20 correct.

21 But I said a moment ago that a transmission to
22 a single user -- and, again, based on my recollection
23 here, but a transmission to single user can't use
24 multiple resource units.

25 And I think -- again, generally, I think it

1 doesn't matter what's the format as long as it's a
2 format that is appropriate for a single user. So
3 whatever the format for a single user, that transmission
4 or that PPDU will use one resource unit. Again, based
5 on my recollection here.

6 You know, but -- and I'm -- I'm giving you --
7 of course, trying to answer correctly and, to the extent
8 that I can, based on my knowledge and review of the
9 document. But obviously it's -- the document is very
10 complex.

11 And being an early draft, I said there are --
12 it's -- even -- even in published standards, you know,
13 sometimes -- sometimes there are inconsistencies because
14 the technology is so complex; and, again, it would be a
15 little bit better if it is in the context of a specific
16 paragraph.

17 But otherwise, in general, I believe that's
18 the -- my answer is correct.

19 Q. So you believe there may be inconsistencies in
20 the draft D1.0?

21 A. Do I believe there are inconsistencies in the
22 draft?

23 Q. Yeah.

24 A. Yes, I do.

25 Q. And I think your -- I believe -- my

1 understanding of your opinion is that you believe that
2 an HE MU PPDU format could not be used for a
3 transmission to just a single user? Is that correct?
4 Is my understanding of your opinion correct?

5 A. My opinions are stated in my declaration.

6 MR. MILKEY: I was muted. I'm sorry. My
7 objection was: Objection to form and misstates
8 testimony.

9 THE WITNESS: So you -- you directed me to
10 paragraph 44 of my declaration where I state, well,
11 when -- "when a SIG-B compression field of the
12 HE-SIG-A" -- that's a field -- "HE-SIG-A indicates full
13 bandwidth, MU-MIMO --" then the number of -- and MU-MIMO
14 users cannot be one. I think that's more accurately my
15 opinion.

16 But regarding here, page -- at the bottom, 239
17 of draft 1 -- 1.0, I think this is -- it is insufficient
18 to conclude that one would need to look at the entire
19 document.

20 Q. So on page 239, do you agree or disagree with
21 the statement that an HE MU PPDU format can be used for
22 just one user?

23 MR. MILKEY: Objection to form.

24 BY MR. STEPHENS:

25 Q. Dr. Cooklev, I think we've been waiting for

1 three minutes or so.

2 Do you have a response?

3 MR. MILKEY: Objection to form.

4 THE WITNESS: I -- I believe we do -- I took a
5 few minutes to think. I think this -- I was thinking
6 that your question that is -- your question was at the
7 same time in the context of page 239 and maybe in the
8 context of draft 1.0, the entire document. And if so
9 that is -- there's a -- there's a contradiction there.

10 I said that just based on this passage from
11 page 239, I think that's not enough to conclude that
12 draft 1.0 allows this. That one needs to do an
13 investigation for this question. I agree that the
14 sentence on page 39 [sic] says that, but like I said,
15 that's not enough in my opinion.

16 And I took a few minutes just to look at --
17 try to find additional context. But it is a -- it is a
18 fairly long and complex document.

19 BY MR. STEPHENS:

20 Q. I appreciate you being careful.

21 You mentioned in your last response that
22 there's a contradiction there.

23 Is there some other disclosure that you
24 believe contradicts the statement on page 239 that an HE
25 MU PPDU format can be for a single user?

1 MR. MILKEY: Objection to form.

2 THE WITNESS: Well, I think in my declaration,
3 for example, I explain the basis for my -- for my
4 opinion.

5 In particular, my opinion is in the context of
6 when the SIG-B compression field is set to one to
7 indicate the full bandwidth MU-MIMO transmission.
8 Then -- then the number of users, according to this
9 draft 1.0 document, cannot be one.

10 And so if we -- for example, I state in my
11 paragraph 50 that there is, in that case, Table 28-24.
12 28-24 applies. That's on page 322.

13 And this table, if we go there, we see that it
14 begins with a number of users being equal to two.

15 No, I'm sorry, I said 322, but it's actually
16 323. And we see that the number of users starts at two.

17 So, yes, this is why -- so the document does
18 contain here -- there is a case where it's --
19 illustrates this.

20 And I'd be happy to answer one or two, even,
21 more questions, then I ask for a break after that.

22 BY MR. STEPHENS:

23 Q. Why don't I -- I'm almost to the end of this
24 module, so maybe two or three more minutes, if that
25 works?

1 A. That's fine.

2 Q. If you'd like to take a break, though, we can
3 do that as well.

4 A. Let's -- let's perhaps try to finish here,
5 this, as you said, module.

6 Q. Looking again at page 239 of D1.0.

7 A. Okay. I will get there again.

8 I am there.

9 Q. Okay. And, again, the description of HE MU
10 PPDU format, page 239, states that, HE -- the HE MU PPDU
11 format carries one or more PSDUs. Correct?

12 A. Yes. That's what it says.

13 Q. And a PSDU carries data for just a single
14 user. Correct?

15 A. Yes.

16 Q. And in 802.11ax, a PSDU can be transmitted
17 only within a single resource unit, correct?

18 MR. MILKEY: Objection to form.

19 THE WITNESS: I believe -- I believe that's
20 the case, yes.

21 MR. STEPHENS: Okay. Let's take a break. Go
22 off the record.

23 (Recess.)

24 BY MR. STEPHENS:

25 Q. Dr. Cooklev, I'd like to pick up from where we

1 left off just before the break.

2 Do you recall we were looking at page 239 of
3 D1.0?

4 A. Yes.

5 Q. And we discussed how a PSDU is transmitted in
6 a single resource unit, correct?

7 A. Yes, there was a question. It's not on page
8 239, but yes.

9 Q. Okay. And data for a particular user or a
10 single user -- well, strike that.

11 Data for one user would be transmitted in a
12 single resource unit, correct?

13 MR. MILKEY: Objection. Form.

14 THE WITNESS: Yes.

15 BY MR. STEPHENS:

16 Q. And for HE MU PPDU, the configuration in which
17 there is a single resource unit is referred to as full
18 bandwidth mode, correct?

19 A. Well, in your question you were referring to
20 full bandwidth is a single resource unit. That's -- you
21 know, one -- that can be -- that can be misleading.
22 Full bandwidth is full bandwidth.

23 Q. What does full bandwidth mean in 802.11ax
24 D1.0?

25 MR. MILKEY: Objection to form.

1 THE WITNESS: Well, I think full bandwidth
2 means transmission over the entire 20 megahertz or the
3 entire 40 megahertz. And I think the drafts defines --
4 makes the -- or at least makes it clear. I will
5 probably find it.

6 And since the full bandwidth MU-MIMO is -- is
7 an important part of my declaration, I think it is
8 important to be precise.

9 BY MR. STEPHENS:

10 Q. Is it true that in full bandwidth MU-MIMO a
11 single resource unit spans the full bandwidth of the
12 transmission channel?

13 MR. MILKEY: Objection to form.

14 THE WITNESS: As I -- as I explain in my
15 declaration, draft 1.0 does not allow a full bandwidth
16 MU-MIMO to a single user. In particular, I state in --
17 in my -- on my page 19 of my declaration that when the
18 SIG-B compression field is set to one to indicate full
19 bandwidth MU-MIMO transmission, then -- then the number
20 of users is at least two.

21 BY MR. STEPHENS:

22 Q. All right. I understand what was in your
23 declaration, but I don't think that was my question.

24 I was just asking, in full bandwidth MU-MIMO,
25 does a single resource unit span the full bandwidth of

1 the transmission channel?

2 MR. MILKEY: Objection to form.

3 THE WITNESS: I don't think full bandwidth is
4 generally described using a single resource unit. I
5 don't think this is the case.

6 As I said, full bandwidth is full bandwidth.
7 So it means the entire bandwidth is being used.

8 BY MR. STEPHENS:

9 Q. If the entire bandwidth were being used, how
10 would there be other -- how would there be other
11 resource units accommodated within the bandwidth of the
12 channel?

13 MR. MILKEY: Objection to form.

14 THE WITNESS: Well, I -- not that there would
15 be multiple resource units. Full bandwidth is full
16 bandwidth, but it would be incorrect to -- which --
17 which is -- it will be incorrect to conclude that HE MU
18 PPDU can be sent to a single user.

19 And to any -- and sent over one resource unit,
20 and to take and to piece it together with the full
21 bandwidth transmission takes one resource unit.

22 Tying these two -- all of these things
23 together would be inaccurate.

24 So in this sense, I said a full bandwidth is
25 not described as or it's not referred as a transmission

1 involving only one resource unit.

2 Although, yes, there won't be -- there won't
3 be multiple resource units.

4 BY MR. STEPHENS:

5 Q. I'm not sure that I followed that response. I
6 think you just said a full bandwidth is not described or
7 referred to as a transmission involving only one
8 resource unit, although there won't be multiple resource
9 units.

10 So I'm just -- I'm trying to get on the same
11 page as to: In full bandwidth, does that refer to just
12 a single resource unit or can there be multiple resource
13 units in full bandwidth?

14 MR. MILKEY: Objection to form.

15 BY MR. STEPHENS:

16 Q. Do you understand my question, Dr. Cooklev?

17 A. I do. I think I do understand the question.
18 And I think I tried to give a complete answer.

19 Q. I'll just try it one more time.

20 A. It is just a -- in connection with a full
21 bandwidth transmission, in connection with that, I don't
22 think we are talking about resource units.

23 Q. It's your opinion that in 802.11ax D1.0, in
24 full bandwidth the HE MU PPDU does not include a
25 resource unit?

1 MR. MILKEY: Objection to form.

2 THE WITNESS: Well, I think it could be
3 incorrect to piece two or three things together to piece
4 the fact that a single-use transmission occupies one
5 resource unit and with the fact that HE MU PPDU may be
6 sent to a single user and with what you were just asking
7 about. I think piecing those things together would
8 be -- would lead to a wrong conclusion.

9 The answer is that when -- in the full context
10 of bandwidth transmission, it is -- we're not talking
11 about resource units because it is full bandwidth.

12 BY MR. STEPHENS:

13 Q. Would you turn to page 32 of D.10?

14 A. 32?

15 Q. 32, page 36 of the PDF.

16 A. I will -- I will get there. I'm there.

17 Q. Okay. Line 55, there's a definition of
18 non-orthogonal frequency division multiple access,
19 non-OFDMA.

20 Do you see that?

21 A. Yes.

22 Q. And here it says that, "A full bandwidth HE
23 transmission with 242-tone RU, 484-tone RU, 996-tone RU,
24 2x996-tone RU, or 2x9996-tone RU allocated for
25 20 megahertz, 40 megahertz, 80 megahertz, 160 megahertz

1 or 80 plus 80 megahertz transmission respectively."

2 Do you see that?

3 A. I do.

4 Q. So a full bandwidth HE transmission, according
5 to the disclosure that I just read, involves resource
6 units of different sizes depending on the bandwidth of
7 the transmission, correct?

8 A. Yes.

9 Q. So for a 20 megahertz transmission, full
10 bandwidth utilizes a 242-tone resource unit, correct?

11 A. As stated here, yes.

12 Q. So a 242-tone resource unit in a 20-megahertz
13 transmission corresponds to full bandwidth mode,
14 correct?

15 MR. MILKEY: Objection to form.

16 THE WITNESS: I'm -- I'm not sure the question
17 is different from what it states here. A full bandwidth
18 HE transmission with 242-tone RU is for 20 megahertz.

19 BY MR. STEPHENS:

20 Q. All right. So a 242 RU in a 20-megahertz
21 transmission would indicate full bandwidth, correct?

22 MR. MILKEY: Objection to form.

23 THE WITNESS: Well, I think it's -- it's maybe
24 the other way around that a full bandwidth HU
25 transmission, in the case of 20 megahertz, will indicate

1 a 242-tone RU.

2 BY MR. STEPHENS:

3 Q. And the parenthetical at line 55, non-OFDMA,
4 what does non-OFDMA mean?

5 A. Non-OFDMA?

6 Q. Yes.

7 A. A non-OFDMA here means full bandwidth.

8 Q. Let's go to page 255, please.

9 A. Yes, I'm looking at page 255.

10 Q. Okay. And so this page begins with Section
11 28.3.3.2, Resource Unit, Guard, and DC subcarriers.

12 Is that what you see?

13 A. Yes.

14 Q. And lines 7 to 8 refer to different RUs and
15 transmission bandwidths; for example, a 242-tone RU can
16 be used in a 20-megahertz transmission for HE MU PPDU,
17 correct?

18 A. Which line?

19 Q. Line 7 to 8.

20 A. Line 178?

21 Q. Lines 7 to 8.

22 A. Oh, 7 to 8. Yes. Yes, lines 7 through 8
23 stating that you have these RUs can be between 26 tones
24 to 242 tones. They're used in 20, 40, and 80 megahertz.
25 Excuse me, 80, 160. Says 80 plus 80 megahertz.

1 Q. Further down on the page, there's a table,
2 28-2.

3 Do you see that table?

4 A. I do.

5 Q. And this table defines the maximum number of
6 resource units for each channel width, correct?

7 A. Yes.

8 Q. And within the column CBW20, or the 242-tone
9 RU, the maximum number of -- the maximum number there is
10 1, correct?

11 A. Correct.

12 Q. Go to page 257, please.

13 A. I'm there.

14 Q. And could you just read the -- take a moment
15 to review the paragraph that begins at line 55.

16 A. I -- I reviewed this paragraph.

17 Q. Okay. And so starting at line 60, there's
18 three different figures referenced, 28-2, 28-3, and
19 28-4.

20 Do you see that?

21 A. I do.

22 Q. And Figure 28-2 is depicting RU locations in a
23 20 megahertz PPDU, correct?

24 A. Excuse me, you said figures or tables?

25 Q. I'm reading the text at line 60 with respect

1 to --

2 A. Oh, okay.

3 (Simultaneous speakers.)

4 THE WITNESS: Yes, yes, yes.

5 BY MR. STEPHENS:

6 Q. It says, "RU locations in a 20 megahertz
7 HE PPDU"? Do you see that?

8 A. I do. Where it says, Figure 28-2, which is
9 for 20 megahertz; 28-3 for 40 megahertz; and 28-4 for
10 80 megahertz.

11 Q. Yes.

12 A. Yes.

13 Q. And at line 61, it explains that these figures
14 depict the formats of HE MU PPDU for HE trigger-based
15 PPDU, correct?

16 A. Line 61?

17 Q. Well, the text doesn't line up with the line
18 numbers exactly, so between 61 and 62.

19 A. Okay. I am -- I -- and that's on page 257 at
20 the bottom. Yes, I'm looking at this.

21 Q. Yes. Page 257, lines 60 to 62.

22 A. Yes.

23 Q. And on page 258, you said figure 28-2,
24 correct?

25 A. Yes.

1 Q. This is a 20-megahertz HE MU PPDU, correct?

2 MR. MILKEY: Objection to form.

3 THE WITNESS: Well, these formats here I've
4 described is just HE PPDU.

5 BY MR. STEPHENS:

6 Q. That's correct as -- but as noted on the prior
7 page, the HE PPDU is either an HU MU PPDU or an HE
8 trigger-based PPDU, correct?

9 A. I think that's correct.

10 Q. And so what's shown in Figure 28-2 are four
11 different resource unit allocations in the 20-megahertz
12 channel, correct?

13 A. Yes.

14 Q. And from top to bottom, the first three
15 resource unit allocations are OFDMA configurations,
16 correct?

17 A. Yes.

18 Q. And the bottom configuration provides a single
19 resource unit of 242 tones, correct?

20 A. I believe, yes.

21 Q. And the 242-tone RU corresponds to full
22 bandwidth, correct?

23 A. Yes.

24 Q. And do you see the letters SU on the 242-tone
25 RU at the bottom of Figure 28-2?

1 A. Yes, I see it.

2 Q. What does SU stand for?

3 A. Well, I haven't, I think -- I did not review
4 this particular section in Figure -- but I believe SU
5 generally stands for single use.

6 Q. Could we go to page 271, please.

7 And, again, for the record, this is
8 Exhibit 1004.

9 A. 271?

10 Q. 271.

11 A. I'm there.

12 Q. Take a moment to review the description of
13 Figure 28-13 starting at line 26. I'll also note that
14 figure is shown on the next page, Figure 28-12, the
15 other figure shown above in that paragraph.

16 A. Yes, I have some understanding of Figures
17 28-12 and 28-13.

18 Q. Figure 28-13 is a transmitter block diagram
19 for the data field of an HE SU transmission, correct?

20 A. Yes. I mean, yes, clearly in a 26-, 52-, 106-
21 or 242-tone RU. And in the case of binary convolutional
22 encoding.

23 (Reporter requested clarification.)

24 THE WITNESS: In the case of binary
25 convolutional coding.

1 BY MR. STEPHENS:

2 Q. And this block diagram would apply to a
3 242-tone RU with BCC encoding, correct?

4 A. Yeah, it includes 242-tone RU with BCC
5 encoding, yes.

6 Q. And a HE MU PPDU in full bandwidth can use a
7 242-tone RU with BCC encoding, correct?

8 MR. MILKEY: Objection to form.

9 THE WITNESS: No, because -- I don't think
10 this document allows full bandwidth. MU-MIMO
11 transmission. That is aimed at the single user.

12 BY MR. STEPHENS:

13 Q. I don't think that answered my question. I'll
14 ask again. The HE MU PPDU in full bandwidth can use a
15 242-tone RU, correct?

16 MR. MILKEY: Objection to form.

17 THE WITNESS: Is the question the HE MU PPDU
18 in full bandwidth can use a 242-tone RU?

19 BY MR. STEPHENS:

20 Q. I'll clarify.

21 For a 20-megahertz transmission.

22 A. It would not be -- then it would not be aimed
23 at the single user, but yes.

24 Q. Can you help me to understand why the
25 description in Figure 28-13 refers to a single-user

1 transmission that can be used with an HE MU PPDU and
2 242-tone RU?

3 Do you believe those things are incompatible?

4 MR. MILKEY: Objection to form.

5 THE WITNESS: Well, it's -- I think those were
6 two questions. So first, is full bandwidth HE MU PPDU
7 compatible with a single-user transmission? I think in
8 my declaration I provide the reasons that it is not.

9 BY MR. STEPHENS:

10 Q. In that event, do you believe that the
11 description of Figure 28-13 and D1.0 is incorrect?

12 MR. MILKEY: Objection to form.

13 THE WITNESS: No.

14 BY MR. STEPHENS:

15 Q. Why not?

16 MR. MILKEY: Objection to form.

17 THE WITNESS: Well, do I believe that Figure
18 28-13 is incorrect here, or the -- the figure caption?
19 No, I don't think the figure is incorrect. It's just
20 that this figure does not apply when we -- in the case
21 of a full bandwidth MU-MIMO transmission.

22 BY MR. STEPHENS:

23 Q. This figure describes a 242-tone RU and a
24 single-user transmission.

25 Are you saying that those -- this figure does

1 not apply to that scenario?

2 MR. MILKEY: Objection to form.

3 THE WITNESS: No. No. This figure does apply
4 to a single-user transmission. In a 26-, 52-, 106-, or
5 242-tone RU, it does apply. It doesn't apply to a
6 single-user transmission in a full bandwidth MU-MIMO, I
7 think.

8 BY MR. STEPHENS:

9 Q. And what evidence do you see in 1D.0 that
10 supports your position?

11 MR. MILKEY: Objection to form.

12 THE WITNESS: Well, for example, on Table
13 28-24, which shows a minimum of two users.

14 BY MR. STEPHENS:

15 Q. That's not the table that would apply for a
16 single-user transmission in any event, correct?

17 MR. MILKEY: Objection to form.

18 THE WITNESS: Excuse me. I did not understand
19 the question.

20 BY MR. STEPHENS:

21 Q. Well, for example, the description on Figure
22 28-13 at line 29 mentions that this transmitter block
23 diagram, Figure 28-13, includes the single-user
24 transmission in an RU that is part of a downlink or
25 uplink OFDMA PPDU.

1 A. I'm sorry. We are reading from -- this is
2 page 272?

3 Q. 271.

4 A. Oh, 271.

5 Q. Yes.

6 A. I was still -- I was looking at the figure on
7 page 272.

8 Q. Oh, I'm sorry. Yes. The description of
9 Figure 28-13 but on page 271.

10 A. Yes, I understand.

11 Yes, I see this description.

12 Q. So the table that you just referenced is for a
13 multi-user allocation, correct?

14 A. Well, I reference Table 28-24, which -- and I
15 explain in my declaration -- which is relevant in the
16 case of a full bandwidth MU-MIMO transmission.

17 Q. Do you see essentially it says, "This also
18 includes the single-user transmission in a resource --
19 in an RU as part of a downlink or uplink OFDMA PPDU."
20 [As read.]

21 MR. MILKEY: Objection to form.

22 BY MR. STEPHENS:

23 Q. Do you see that disclosure, Dr. Cooklev?

24 A. I do. I see the sentence. "This also
25 includes the single-user transmission in an RU that is

1 part of a downlink or uplink OFDMA PPDU, and a
2 transmission from one station that is part of an uplink
3 MU-MIMO transmission in current resource unit." [As
4 read.]

5 Q. The fields in Table 28-24 would not be used in
6 a single-user transmission in an RU as part of a
7 downlink or uplink OFDMA PPDU, correct?

8 MR. MILKEY: Objection to form.

9 BY MR. STEPHENS:

10 Q. And I think I made a mistake. I said Table
11 28-24. I should have said Table 28-23.

12 MR. MILKEY: Objection to form.

13 BY MR. STEPHENS:

14 Q. I'll put my question more succinctly.
15 Table 28-23 is not susceptible to a
16 single-user transmission, correct?

17 MR. MILKEY: Objection to form.

18 THE WITNESS: I'm not sure I have provided an
19 opinion about this. Please correct me if I am wrong.

20 BY MR. STEPHENS:

21 Q. Did you consider Table 28-23 in forming the
22 opinions in your declaration?

23 A. I did. I did.

24 For example, I state in paragraph 50 of my
25 declaration that, "In the context of an MU-MIMO

1 allocation," and I state "an allocation where the
2 SIG-B compression field is set to 1 to indicate full
3 bandwidth MU-MIMO."

4 Then -- then the spatial configuration
5 subfield of Table 28-24 applies, and we see that in
6 Table 28-23, this is -- this is what it says for the
7 spatial configuration.

8 Q. For the single-user transmission scenarios
9 provided by Figure 28-13, Table 28-24 is inapplicable,
10 correct?

11 MR. MILKEY: Objection to form.

12 THE WITNESS: Well, Figure 28-13 applies to a
13 single-user transmission while Table 28-23, of which --
14 and together with Table 28-24. That's -- Table 28-23
15 directs to Table 28-24.

16 They apply to -- in the case of -- they say
17 MU-MIMO allocation.

18 BY MR. STEPHENS:

19 Q. Tables 28-23 and 28-24 are inapplicable to a
20 single-user transmission represented by Figure 28-13,
21 correct?

22 MR. MILKEY: Objection to form.

23 THE WITNESS: I think what's -- what is
24 relevant here is that Figure 28-13 is not applicable.
25 Figure 28-13 describing how the data fields is produced

1 at the transmitter in the single-user case, just as I
2 said, it doesn't apply.

3 BY MR. STEPHENS:

4 Q. I'll give you one more opportunity to explain
5 because I think I'm a little confused.

6 I see in Figure 28-13, single-user
7 transmission scenario, the 242-tone resource unit that
8 corresponds to full bandwidth.

9 Why is that not applicable?

10 A. No. And I said no.

11 MR. MILKEY: Objection to form.

12 THE WITNESS: I apologize for interrupting.
13 But it doesn't -- Figure 28-13 doesn't say full
14 bandwidth.

15 Where do you see that full bandwidth?

16 BY MR. STEPHENS:

17 Q. The 242-tone RU for 20-megahertz HE MU PPDU?

18 A. Well, in the special case of 20 megahertz, 242
19 RU would be full bandwidth, but is this -- is Figure
20 28-13 only for 20 megahertz?

21 Q. No, but it describes the example.

22 So I think the only thing you've pointed me to
23 so far, Dr. Cooklev, as to why Figure 28-13 doesn't
24 apply is you pointed to end users being two in Table
25 28-24, and I think we just established that Table 28-24

1 is inapplicable to single-user transmissions.

2 So is there anything else that tells you that
3 single-user full bandwidth does not apply to Figure
4 28-13?

5 MR. MILKEY: Objection to form.

6 THE WITNESS: Counsel, I think that that
7 became a long question. I don't agree we -- we
8 establish what you said we established.

9 I think Figure 28-13, this figure doesn't
10 apply to full bandwidth because -- to full bandwidth the
11 MU-MIMO transmission to a single user because there is
12 no full bandwidth MU-MIMO transmission to a single user.

13 Excuse me. Can we -- can we take a break?

14 MR. STEPHENS: We can take a break.

15 Would you mind going a minute? I just want
16 to -- I may have maybe one or two questions, and we can
17 close out this, or if you'd like to take a break, we can
18 do that as well.

19 THE WITNESS: It's one minute. Just one
20 minute.

21 MR. STEPHENS: No problem.

22 (Recess.)

23 BY MR. STEPHENS:

24 Q. Let's turn to page 265 of D1.0.

25 A. Well, a little bit back going to 265.

1 Q. Yes.

2 A. I'm there. I'm there.

3 Q. At lines 7 to 8, there is a sentence that
4 reads, "The number of spatial streams, $NSS_{r,u}$, is
5 indicated by the NSTS field."

6 Do you see that?

7 A. I do.

8 Q. What does $NSS_{r,u}$ stand for?

9 A. Well, N sub SS is number of spatial streams.
10 And I think there are two subscripts -- two additional
11 subscripts, R and U.

12 Q. What does R stand for?

13 A. If we -- if we look at the previous page 264,
14 we see that R is -- or denotes a resource unit. So
15 that's what R is.

16 Q. R denotes which resource unit in an MU-MIMO
17 transmission?

18 A. Yeah. R is an index denoting the resource
19 unit.

20 Q. And the subscript U is an index denoting the
21 user, correct?

22 A. I believe that's correct. I just wanted to
23 look at Table 28-22, which is referenced there. I
24 believe you are correct.

25 Q. What would the maximum value of R be in full

1 bandwidth?

2 (Reporter requested clarification.)

3 A. RB?

4 Q. What's the maximum value that R could take in
5 full bandwidth?

6 A. R?

7 Q. Yes.

8 A. There is no -- there is no need to indicate R
9 when full bandwidth is indicated. I mean, if we see at
10 the bottom of page 264, the sentence beginning there,
11 and continuing on page 265, if the value of the SIG-B
12 compression field in HE-SIG-A is 1, there is no RU
13 allocation signaling in HE-SIG-B common field. And the
14 HE-SIG-B contains only user specific fields.

15 Q. In full bandwidth, the HE MU PPDU is only a
16 single resource unit, correct?

17 A. Well, I believe I said that we don't need to
18 indicate -- it is not necessary to indicate the resource
19 units because -- because it's full bandwidth. And in
20 the sense there aren't multiple resource units, it's
21 just full bandwidth.

22 Q. So the maximum value of R would be 1 in full
23 bandwidth?

24 MR. MILKEY: Objection to form.

25 THE WITNESS: Well, formally -- just purely

1 formally, that will be true; but obviously one needs to
2 be careful analyzing full bandwidth of MU-MIMO
3 transmission.

4 BY MR. STEPHENS:

5 Q. I appreciate that. Yes. And for a
6 single-user transmission, U would equal 1, correct?

7 MR. MILKEY: Objection to form.

8 THE WITNESS: I mean, again, one needs to be
9 careful analyzing these cases. Formally, you would be
10 1, yes.

11 There may not be a single user. There may
12 not -- we don't need U, because it's a single-user
13 transmission.

14 MR. STEPHENS: No further questions.

15 MR. MILKEY: Okay. Could we take a 15-minute
16 break while I review my notes?

17 MR. STEPHENS: Sure.

18 (Recess.)

19 MR. MILKEY: No further questions for me.

20 COURT REPORTER: Mr. Milkey, would you like a
21 transcript?

22 MR. MILKEY: Just the rough is fine.

23 (Whereupon the proceedings concluded at
24 2:27 p.m.)
25

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1	ERRATA SHEET		
2	NAME OF CASE: SAMSUNG ELECTRONICS CO. LTD. V. WILUS		
3	INSTITUTE OF STANDARDS AND TECHNOLOGY INC.		
4	DATE OF DEPOSITION: MAY 13, 2026		
5	NAME OF WITNESS: DR. TODOR V. COOKLEV		
6	Reason Codes:		
7	1:	To clarify the record.	
8	2:	To conform to the facts.	
9	3:	To correct transcription error.	
10	Page	Line	Reason
11	From	to	
12	Page	Line	Reason
13	From	to	
14	Page	Line	Reason
15	From	to	
16	Page	Line	Reason
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18	Page	Line	Reason
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25	Date		

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DECLARATION UNDER PENALTY OF PERJURY

I, Dr. Todor V. Cooklev, do hereby certify under penalty of perjury that I have read the foregoing transcript of my deposition taken on May 13, 2026; that I have made such corrections as appear noted on the Deposition Errata Page(s), attached hereto, signed by me; that my testimony as contained herein, as corrected, is true and correct.

This Declaration is executed this _____ day of _____, 20____, at _____, California.

Dr. Todor V. Cooklev

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**I, Tamara Houston, RPR, CCRR, CSR No. 7244, a
Certified Shorthand Reporter in the State of California,
duly empowered to administer oaths, do hereby certify:**

That said deposition was taken down by me in shorthand at the time and place therein named, and thereafter reduced to typewriting by computer-aided transcription under my direction;

I further certify that I am not interested in the event of the action.

Dated: 18th of May, 2026.

TAMARA L. HOUSTON
CSR 7244, RPR, CCRR 140, CRG

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