Planet Depos
We Make It Happen™

Transcript of Dr. Iain Richardson, Volume 1

Date: February 26, 2025
Case: Amazon.com, Inc., et al. -v- Nokia Technologies Oy (PTAB)

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

---X

AMAZON.COM, INC. AND AMAZON.COM SERVICES LLC,

Petitioner,

CASE.: IPR2024-00626

-against-

NOKIA TECHNOLOGIES OY,

Patent Owner.

---X

DEPOSITION OF

DR. IAIN RICHARDSON

NEW YORK, NEW YORK

FEBRUARY 26, 2025

REPORTED BY: KIARA MILLER

FILE NO.: 566944

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

---X

AMAZON.COM, INC. AND AMAZON.COM SERVICES LLC,

Petitioner,

CASE.: IPR2024-00626

-against-

NOKIA TECHNOLOGIES OY,

Patent Owner.

---X

Deposition of DR. IAIN RICHARDSON, taken on behalf of PETITIONER, at 1301 AVENUE OF THE AMERICAS, New York, New York, commencing at 9:08 A.M., FEBRUARY 26, 2025, before Kiara Miller.

A P P E A R A N C E S:

ON BEHALF OF PETITIONER:

SHEPPARD MULLIN
1540 El Camino Real, Suite 120
Menlo Park, CA 94025

EMAIL: JLIANG@SHEPPARDMULLIN.COM

BY: JEFFREY LIANG, ESQ.

ON BEHALF OF PATENT OWNER:

PERKINS COIE
11452 El Camino Real, Suite 300
San Diego, CA 92130

EMAIL: KCANAVERA@PERKINSCOIE.COM

BY: KYLE R. CANAVERA, ESQ.

ON BEHALF OF PATENT OWNER:

MCKOOL SMITH
300 Crescent Court, Suite 1200
Dallas, TX 75201

EMAIL: MVERBONCOUER@MCKOOLSMITH.COM
EHANSEN@MCKOOLSMITH.COM

BY: MITCH VERBONCOEUR, ESQ.
ERIC S. HANSEN, ESQ.

DR. I A I N R I C H A R D S O N, after having first been duly sworn by a Notary Public of the State of New York, was examined and testified as follows:

EXAMINATION BY
MR. LIANG:

Q Good morning, Dr. Richardson.
A Good morning.
Q So we're here regarding two IPR proceedings today, right; IPR2024-00206 and also 2024-0026 -- or 627; is that correct?
A I think you might have missed a six in the first one.
Q 2024-626 and 2024-627.
A Yes. That's my understanding.
Q Okay. And you submitted a declaration in both of these proceedings, right?
A Yes.
Q And you submitted the same declaration in both of these proceedings, right?
A I think I submitted two declarations to date, and in each the same declaration, it's the same declaration for each of the

proceedings.
Q Great. You've given many depositions before, right?
A I've been deposed, yeah, quite a number of times.
Q How many times.
A I think it's over 20 now, I don't have the exact number in my mind.
Q I'm also going to go over some of ground rules, even though you, I'm sure heard of them before.
A That's fine.
Q So you understand that you're under oath today to tell the truth?
A Yes.
Q And since we do have a court reporter here, we'll need verbal responses for the court reporter to transcribe.
A Yes.
Q You can take a break whenever you want, but I do ask that there's no question pending.

A Okay.
Q Now, you understand you're not allowed to discuss your testimony today with your counsel during breaks, right?
A Yes.
MR. VERBONCOEUR: And I'll just clarify for the record, there are several depositions back to back. And so I understand that to refer to -- during this deposition, he's not going to discuss his testimony, if there's a break between depositions we can talk about other matters.
MR. LIANG: Right. If there's a break, but basically for other proceedings.
Q Yeah, but during the deposition for this proceeding, you're not allowed to the talk to your counsel.
A About this proceeding?
Q Correct, yes.
Okay. And you have to answer my

questions unless your attorney instructs you otherwise, right?
A Okay.
Q Are you on any medication today?
A No.
Q Is there any reason you can't provide truthful and accurate testimony today?
A Nope.
Q Now, you have some documents in front of you.
A I do.
Q What are those documents?
A So they're all documents that relate to these two proceedings. I have two binders; I'll start with the one on my left. In here, I have a printout of the patent owners preliminary response, POPR. The patent owners surreply to preliminary response. The patent owner's response, the POR. Copies of the two declarations that I mentioned, the Richardson POPR declaration, which I might call my first declaration; the Richardson POR

declaration, which I might call my second declaration.

And then in the other binder, I have a copy of the petition as filed for the '626 proceeding. The petition as filed for the '627 proceeding. The petitioner's preliminary reply to the POPR. The notice of decision to institute IPR. And, finally, a copy of four of the exhibits that are in play or involved Exhibit 1001, which is the patent ending in number '267.

Exhibit 1004, which is a patent publication to Walker.

Exhibit 1005, which is a patent publication to Karczewicz, which I think we -- I and petitioner -- describe as Karczewicz 1.

And, finally, Exhibit 1006, which is a patent publication to Karczewicz, which I believe the parties and myself refer to as Karczewicz 2.

Q Are all of the copies in front of clean

copies?
A Yes.
Q Are there any markings or annotations in them?
A Not as far as I'm aware, and I haven't added any.
Q Are there any errors in your declaration?
A I don't recall noticing any errors.
Q Is there anything in your declaration that you'd like to change today?
A Not that I recall.
Q What did you review before putting together your declaration?
A Which declaration?
Q Well, your declarations are the same in the both of the -- of these proceedings, right?
A Sorry. My confusion was I have two declaration that I've submitted.
Q Ah, okay. So I'm talking about your declaration that you submitted with a patent

owner response?
A Okay. So and if I call that my second declaration, that's just to keep myself straight.
Q And just to be on the same page, I believe we're talking about Exhibit 2015, correct?
A Yes. That's my understanding.
Q Okay. So -- and today when I'm referring to your declaration, I'll be referring to Exhibit 2015.
Does that make sense to you?
Dr. Richardson, yes?
A Yes. I'm checking something before I answer.
So I don't recall whether I stated it explicitly, but when I wrote the declaration -- what you're describing as my declaration -- the declaration in support of the patent owner's response, my intention was that this -- I intended this to be cumulative for my first declaration, which I submitted

in support of the patent owner's preliminary response.
Q Okay. Understood. And if there's a time you want to refer to the preliminary response declaration, feel free to specify that.
But I think otherwise, for purposes of today, when talking about your declaration, I'm referring to Exhibit 2015 in IPR 2024-00626?
A I will try and keep that in mind, yes.
Q Okay. And if at any time your answer may vary, just let me know, and tell me which different declaration you might talk about.
A Okay. Again, I'll do my best, yes.
Q Okay. What did you review before putting together your declaration, Exhibit 2015?
A So I have a list of materials on Pages 5 and 6 of that declaration, Paragraph 19, of my second declaration. And I've listed there documents that I reviewed, specifically

whilst putting together this declaration, as I also explained the opinions in the declaration are based on my professional judgment, education, experience, and knowledge regarding the video technology -- video code and technologies discussed in the '267 Patent, so this is not an exhaustive list, because what I've written in here is based on all of those things.

Q Did you review any other documents in preparation -- when you were preparing your declaration?

A I don't recall whether I might have looked other documents during the period, but these are the ones, you know, these are the ones that I felt appropriate to list, and that I specifically recall reviewing.

Q So you don't recall reviewing any other documents beyond the one's listed in Paragraph 19 of your declaration?

A That's not strictly true. So I prepared this declaration over a period of time. The

nature of what I do is that I'm constantly reviewing documents relating to video coding.
Q So what other documents do you recall reviewing for this declaration?
A I don't recall any other specific documents, but I would almost certainly have -- yeah, as a matter of course, if I'm spending, for example, a few weeks working on a document, I'm reviewing and reading video coding-related materials on a daily basis.
Q Are you aware that the '267 Patent was also asserted in a co-pending ITC proceeding?
A What do you mean by "co-pending"?
Q That there is an ITC proceeding involving this '267 Patent.
Are you aware of that, or not?
A I think it might have been mentioned to me. Yeah, so I think that have been -- yeah, said to me by attorneys.
Q Have you reviewed any materials from the ITC proceeding regarding the '267 Patent?
A My recollection is within the last two

or three weeks that I was given a copy of a post-hearing brief, and I reviewed that briefly.
Q Did you review any other materials from the ITC proceeding?
A I don't recall reviewing anything else from that proceeding. And unless it's something that I've referred to, but I don't -- again, that's not my recollection that I referred to any documents in my first or second declarations.
Q Have you reviewed the board's institution decision in this proceeding?
A I have, yes.
Yeah, it's not listed on Page 5 and 6, but that's -- actually, I would say -- yeah, I definitely reviewed it. It's in one of my binders here.
Q So why didn't you list it in -- why didn't you list the board's institution decision in your list of materials considered?

A I don't recall.
Q Were there any exhibits that you reviewed for this proceeding that you did not understand?
A Not that I recall. I would add, you know, with regard to, for example, the institution decision, clearly I'm not a patent attorney; so to the extent there are any legal arguments in there or, indeed, in the petition, they are not necessary in my field.
Q Regarding the post-hearing brief from the ITC that you reviewed.
A Yes.
Q Is that the post-hearing brief from Nokia?
A That's my recollection.
Q Did you review a post-hearing brief from Amazon?
A I don't actually recall.
Q Did you review public versions of the post-hearing briefs?

A That's my understanding, the document was provided by attorneys.
Q Have you signed a protective order for the ITC?
A What do you mean "for the ITC"?
Q Did you sign the ITC protective order?
A With regard to what?
Q With regard to the ITC proceeding for this '267 Patent, did you sign the protective order in that matter?
A Not that I recall.
MR. VERBONCOEUR: I'll object to scope. And I'll just clarify for the record, Dr. Richardson has not been given access to any confidential information. He's only been given documents that are publicly available.
Q And did you review the final initial determination in the ITC proceeding for the '267 Patent?
A Not that I recall.
Q Who wrote your declaration?

A I wrote the declaration.
I worked with counsel on some of the -- in finalizing the declaration, but it's my declaration.
Q You wrote every single word in it?
A I would hesitate to say I wrote "every single word," but, yeah. I worked with counsel to produce a declaration, but it's my declaration.
Q All right. So it's your declaration, but counsel helped you by writing some of the words in the declaration?
A That's not what I said.
Q Well, then --
A Sorry, what's the question?
Q I'm asking you: Did you write every word in your declaration?
A I don't recall that I wrote every word in the declaration.
Q Okay. So it's possible that someone else wrote some of the words in your declaration?

A In the normal process of going through revisions, working with counsel on these type of documents, it's possible that somebody changed a word and I changed it back, or something like that. But, yeah, I don't recall.
Q How much time did you spend preparing for this deposition?
A I actually don't know. I don't have a figure in mind.
Q I mean, just ballpark 10 hours? 20?
A Do you know what? It's really hard to answer because we have three depositions this week and I'm preparing for all of them. I've been preparing for all of them pretty much in parallel, so it's really hard for me to -- without consulting notes, to workout how much time I spent preparing for this deposition.
Q Well, what technical area is your bachelor's degree in? I noticed your CV doesn't say.
A It should do. I don't actually have a

copy of my CV in front of me. But I think the title was master of engineering in electronic and electrical engineering, or perhaps electrical and electronic engineer. So that's the subject area.
Q That's your master's degree?
A So it's a particular type of degree; it's called a master of engineering. And it's a five-year degree. So it includes the bachelor and master's -- oh, so maybe that's the confusion.
Q When did you start working as an expert witness in litigation matters?
A So my recollection is that maybe around 2005, 2006, around that time period was the first time I remember being contacted be a law firm to ask me to provide consultancy or services related to a patent matter. Yeah, okay.
Q How many times have you been hired as an expert in litigation matters?
A I don't know.

Q What about a ballpark?
A I honestly don't know.
Q More than 10?
A Pretty sure it's more than 10 times, yes.
Q More than 15?
A Sorry, just so I can be clear in my answer, do you, so for instance, this week I'm giving testimony on three different IPR proceedings, in fact, five different IPR proceedings, but my recollection is I was hired once, so you're asking matters, number of contracts or something else.
Q The number of proceedings. So I guess in this case, I would consider these three proceedings that you're about to give depositions for this week to be three matters.
How many proceedings have you been an expert for?
A Sorry, proceedings also include, for example ITC.

Q Yeah, ITC and district court?
A And non-US or US only.
Q Let's just stick with US only?
A Okay. I really don't know, it's more than 10.
Q Okay. More than 15?
A So for example, a few years ago I remember working on something like six or seven IPR proceedings more or less contemporaneously, so a similar way to this. So it's six or seven plus three that gets us to ten. I worked in a number of other IP0 proceedings, I've testified I think maybe five or six times at the ITC. I've testified two or three times in district court proceedings, so I think we're already up to more than 20.
Q Okay.
Do you ever -- do you have research publications?
A I do, yes.
Q How many publications have you had

since 2006, roughly?
A I don't have a copy of my CV in front of me, so I don't recall.
Q Do you perform research in the field of video, and coding and decoding?
A Yes.
Q Do you have any patents yourself?
A I'm named as an author on a number of patents.
Q How many patents are you a named inventor on?
A I think that's in my CV, but I actually don't recall. Unless I summarized it here. Oh yeah, Paragraph 16 of my second declaration, I'm a named inventor on 11 patents or patent applications.
Q When you write a patent application, do you write down everything you know about the field?
MR. VERBONCOEUR: Object to the form of the question.
A Which patent application are you

referring to, are you asking me personally in general.
Q No, you personally.
MR. VERBONCOEUR: Same objection.
A It's actually quite a while since I wrote a patent application or contributed to a patent application.
Q For the last patent application that you recall drafting, did you write down everything that you know about the field?
A Which patent application are we talking about? I don't have a copy of my CV in front of me.
Q What was the last -- do you recall drafting a patent application?
A I recall being involved in the drafting of a patent application.
Q Did you provide input to the drafting of that patent application?
A That's my recollection, yes.
Q And for that patent application that you recall, did you -- did you write down

everything that you know about the field?
MR. VERBONCOEUR: Objection to the form of the question.
A I didn't say I recall a particular patent application.
Q Oh, okay. So you don't recall any particular patent applications that you've had input to?
A Okay. I can recall, for example, one I think it was more than one patent application relating to configurable video coding.
Q Okay.
A That's in my head, for example.
Q So for the patent application that you recall about configurable video and coding, did you write down everything you know about configurable video decoding?
A I'm sorry. I just said -- I'm not trying to be difficult, I just said I recall more than one application.
Q Let's pick one.
A I don't actually have a specific one.

Q You recall more than one, why don't you pick one of them. So do you have in your mind an application that you contributed to for configurable video decoding?

MR. VERBONCOEUR: Dr. Richardson, I apologize for the interpretation, let's just try to give a pause between question and answer so we have a clean transcript.

A Okay. I think I just said I recall maybe two or three applications relating to configurable video coding. I don't at this point recall the details of them.

Q So you don't recall whether for any of those three configurable video decoding patent applications whether you wrote down everything you knew about the field?

A Um, for those particular applications, I don't recall writing down everything I knew about the field.

Q For your patent applications, are you more likely or less likely to include obvious

details in your patents?
MR. VERBONCOEUR: Object to the form of the question.
A What do you mean by the obvious details.
Q Well, little details relevant to your patent, if those details are obvious, does that make it more likely or less likely that you'll explicitly write about them in your patent?
MR. VERBONCOEUR: Same objection.
A Okay. So I'm honestly confused by your question. So I'm a technical expert, I mentioned in my second declaration around Paragraph 33, that the word "obvious" has a specific meaning in patent law, but I'm not a patent lawyer; so I really don't understand what you're asking me.
Q So you don't understand the word obvious?
MR. VERBONCOEUR: Object to the form of the question.
A That's not what I said.

Q What about the question do you not understand?
A You used the word "obvious," which I understand to have a very specific and particular meaning.
Q Right. Do you understand what that --
A Sorry, I haven't finished my answer.
MR. VERBONCOEUR: Please let the witness finish.
A I understand the word obvious has a specific particular meaning which is actually a legal term in the context of the proceeding that I'm answering questions about. So I don't know when you're asking about in the context of Paragraph 33, to -- sorry, Paragraph 33 to 40 in my second declaration or in another context.
Q So I'm asking you to apply -- did you apply, did you provide opinions about obviousness in this matter for your declaration?
A I set out in Paragraphs 33 to 40 of my

second declaration my general understanding of obviousness in the context of a patent claim and whether a patent claim can be found invalid as obvious. And I provided opinions throughout both of my declarations with regards to whether or not a certain patent is obvious.
Q And so you have an understanding of obvious that you applied when providing your opinions in your declaration, is that fair?
A I think that's reasonable, yes, but again, I'm not a patent lawyer, so I wouldn't like to go beyond the understanding that I summarized in the paragraphs that I just mentioned.
Q Applying your understanding of obviousness, the same one you applied when forming your opinions for this declaration, are you more likely or less likely to include obvious details in patent applications where you are a named inventor?
MR. VERBONCOEUR: Objection to the

form of the question.
A I don't understand the question.
Q What don't you understand about the question?
A So my understanding of obviousness as I used it in my second declaration, for example, relates to whether or not a patent claim can be found invalid. So I don't understand -- I'm not a patent lawyer, I don't understand how that applies to an engineer involved --
Q Okay.
A -- I'm not finished. An engineer involved in drafting a patent application.
Q Well, let's just apply the word, the vernacular meaning of obvious, right. Before you became an expert, you had -- you've heard of the word obvious before, right?
A In many contexts, yes.
Q Okay. So just in the plain vernacular meaning of the word obvious, all right, you understand what that means?

A I'm really confused now, because I don't, yeah, you have to give me some context here because there is a context, which I just pointed you to, which I understand to be relevant for invalidity in patent domain, I'm not sure what the context is you're not asking.
Q I'm asking you beyond the patent domain, if somebody used the word obvious with you tomorrow, would you be able to understand them or would you say I don't understand what you mean?
MR. VERBONCOEUR: Object to the form of the question.
A In what context?
Q On the street, if someone said the word obvious to you, are you going to behave the same way you're behaving now?
A I'm not trying to be difficult, but what is the context.
Q I mean, so you're saying -- you're saying if you walk up to someone on the

street asked you and said the word obvious to you, you would not understand what they mean, you would have to ask for context?
A If they said the word in isolation and I've never seen them before, I don't see what this has to be with my report and what you're asking me.
Q I'm asking you -- okay, when you're writing your patent applications, do you think there's some things that might be obvious to you about the subject matter?
A Obvious in what sense, in the sense of invalidity or something else.
Q Just in the sense that it's obvious. Like, hey, you know what, I'm writing about a car, maybe it's obvious that the car might have wheels. Do you understand that concept?
MR. VERBONCOEUR: Object to the form of the question.
A Of course I understand what you're saying.
Q Okay. So then, when you're writing a

patent application, do you think there might be some things that occur to you that might be obvious details that you might include in your patent application?
A I don't know what you want me to say here because now you're using obvious and patent application together. I'm not a patent lawyer. I don't know whether there's a meaning of obvious in patent law that is separate to the one that I've set out here or not.
Q Hmm.
So in a patent application that you have, right, let's say, you've worked on patent applications, do you think a person of ordinary skill in the art reading one of your patents might have found it obvious to use pixels of eight bits, for example, that could be potentially something obvious for a person to do, right?
A Which patent application, which context?
Q Well, actually -- all right. I'm

handing you what's been marked as Exhibit 1018.

(Whereupon, United States Patent No. 8,995,534 Richardson, et al. was marked as Exhibit 1018 for identification as of this date.)

Q I'm handing you a copy of 1018.

So, Dr. Richardson, I've handed you what's been marked as Exhibit 1018.

Do you recognize this document?

A I believe so, yes.

Q What is Exhibit 1018?

A So it appears to be a copy of the US Patent No. 8,995,534.

Q Are you the first named inventor on the patent on Exhibit 1018?

A Yes.

Q What is Exhibit 1018 about?

A The title is systems and and methods for encoding and decoding.

Q Does Exhibit --

A Yeah, sorry, I'm not quite finished, and as the patent sets out column one starting at Line 17, it relates to systems and methods for encoding and decoding audio/video and other digital data, yeah, and it goes on to give more details.

Q   I believe this patent provides a technique that enables decoders to decode unsupported formats of audio and video; is that right?

A   That's broadly my recollection. I don't actually recall exactly the details of what was claimed in this patent.

Q   And does this patent disclose all the techniques that you were aware of for decoding unsupported audio and video formats?

A   At what time?

Q   At the time you filed this patent, so it's 2011?

A   I recall being involved in drafting the application. I'm not sure that I've personally filed the patent. I think a patent agent or attorney might have done that for us. When I say "us" I mean myself and the other named inventor.

Q Well, does this patent disclose all the techniques that you were aware of for decoding unsupported audio or video file formats?

A I don't recall.

Q And does this patent disclose everything you know about for decoding video files in general?

MR. VERBONCOEUR: Object to the form of the question.

A At what time?

Q In 2011?

A So my recollection is I wrote or contributed to the writing of this in 2010. My general recollection is that by 2010, I had been working in the field of video coding and decoding for certainly more than 15 years and I've written, two, three books by this date on the subject. So it certainly doesn't disclose three books worth of text.

Q Now, this patent does deal with video pixels, correct?
A I don't recall.
Q Well, it deals with video, correct?
A So in Columns 1 and 2 in the patent, it's the description of related art, and there's some discussion of video coding formats. There's a discussion of some image formats. So there's certainly some discussion of, let's say, video at least in the coded form.
Q Now, if you could turn to the very last page of Exhibit 1018.
A Okay.
Q And you see Claim 1 that's written there?
A Yes.
Q If somebody today were to file a patent and they copied your Claim 1 exactly, but at the very end they wrote a limitation, wherein the video data includes pixels that are eight bits, would you view that new claim to be

obvious?
A I'm not a patent lawyer. I'm not trained in patent law. I don't know what a person of ordinary skill in the art would necessarily be for this patent, but assuming a person of ordinary skill in the art, for example, with some experience of working with video compression, then, yeah, video pixels comprising eight bits or whatever you said, would probably not seem to be something novel at this point in time, in the 2010 time frame.
Q Are you familiar with the H.264 Standard?
A Yes, I am.
Q What is the H.264 Standard?
A It's a standard, an international standard that relates to video compression. It's a standard that is copublished by the ITU-T and the ISO/IEC.
Q Did you participate in the development of the H.264 Standard?

A I was, if you like, an accredited expert at the time, with regard to the expert group that was putting together the standard.

My recollection is I didn't attend any standardization meetings, and I didn't submit any technical proposals during the development of the standard. And when I say I didn't submit technical proposals, I mean, I didn't submit any technical proposals to the joint video team.

Q Did you keep track of the developments of the H.264 Standard from the joint video team as the joint video team was meeting and drafting the standard?

A So my recollection is that in the time frame around 2000 to 2003, the joint video team met on a number of occasions. During those meetings and between the meetings, the draft H.264 Standard was being developed. My recollection, I was generally keeping track of those developments. And when I say that, I mean I was regularly, during that period, reviewing the contribution documents or proposals on the JVT, I think it was an FTP site in those days.

My recollection is also I was regularly reviewing email discussions relating to the development of the H.264 standard, which, if I recall, appeared in one or more email lists that I was subscribed to at the time.

Sorry, when I say "at the time," I mean during that time period around 2000 to 2003.

Q What about H.265, were you involved the development of the H.265 Standard?

A I did not submit any contribution documents or proposals to the JCT-VC, which was the working group responsible for developing what became the H.265 Standard. I did attend at least one of the meetings of that working group.

Q Which meeting did you attend?

A I don't recall precisely. I think it was possibly around 2012, and I think it was in -- hang on. It was in the San Francisco

area, possibly San Jose.
Q Were you keeping track of the various working drafts of the JCT-VC for H.265 as they were being released?
A Generally, yes.
Q How would you keep track of the working drafts from the JCT-VC for meetings that you didn't attend?
A My recollection is that all of the published working drafts -- yeah. All the -- that the working drafts were available, at least on the website that working group created and maintained.
My recollection is that I was also subscribed to and regularly reviewing email discussions relating to the development. I don't recall whether the working draft versions were circulated by email, but I certainly recall reviewing the working drafts that had been, let's say, uploaded to the website of the working group.
Q And so you would go onto the website for

the JCT-VC working group and download the working drafts that were put up on there?
A I recall doing that on a number of occasions during the 2010 to 2013 time frame, and after that as well.
Q Do you recall how you would find the working drafts on the website?
A Broadly, yes. My recollection is that the website, as the meetings progressed, each meeting had a letter. First one was A, second one was B, and so forth. And my recollection is that the website -- which I don't have in front of me, but my recollection it is or it was organized by meeting. And that in the page, if you like, for each meeting, all of the contributions relating to that meeting were listed and could generally be downloaded. And my recollection is that the working drafts which were numbered, if I recall correctly, were generally available as downloadable documents on those meeting pages or meeting lists.

Q Did you also look at any proposals that were made at meetings that you didn't attend?
A I recall that I did, yes.
Q And how would you access the proposals at meetings that you didn't attend?
A Well, the same -- actually, the same way I would access proposals at meeting or meetings that I did attend, which is via the same website. That's certainly one way of accessing those proposals.
My recollection is that, as I said, for each meeting, there was a list of proposals of contribution documents provided on the website and, in general, they were downloadable.
Q Do you recall if you had to have a password or anything like that to go download it, or could you just go on -- could anybody just go on and download from that website?
A My recollection -- sorry, I apologize if I spoke over you.
My recollection for the JCT-VC

contributions proposals website was that there was no password required and no access restrictions issued.

I should maybe say at the time, my recollection is that I was also a member of the MPEG group, and there were contributions there which did require password to download, but my recollection is specific JCT-VC contributions didn't require password.

Q If you could turn to Paragraph 34 of your declaration. I believe that's one of the paragraphs you've been indicating.

Do you see it? Let me know when you get there.

A I see it.

Q Okay. Now, Paragraph 34 says:

"I have been informed that to be obvious in light of a single prior art reference or multiple prior art references, there must be a reason either to modify the single prior art reference or to combine the two or more

prior art references to achieve the
claimed invention."
Do you see that?
A Yes.
Q And the next sentence reads:
"I've been informed by counsel that this reason may come from a teaching suggestion or motivation to combine which may come from the reference or references themselves."
Do you see that?
A Yes.
Q What would it look like for a motivation to combine to come from one of the references themselves?
MR. VERBONCOEUR: Object to the form.
A I don't know what you mean by "What would it look like."
Q Do you have in your mind any vision of what -- any examples of what it might look like for a motivation teaching suggestion or motivation combined to come from one of the

references?

MR. VERBONCOEUR: Object to the form.

A I'd rather not speculate on that. I think later in the same declaration I recall talking about this question with regard to two specific references.

Q If you were writing a paper today and you wanted to provide a teaching suggestion or motivation to combine your paper with other things that you know about, how would you do it?

A Are you asking --

MR. VERBONCOEUR: I'll object to the form of the question. I apologize, Dr. Richardson.

A Sorry. Are you asking about motivation to combine in terms of obviousness in patent invalidity or some other context?

Q I'm talking about Paragraph 34 of your declaration. Right?

A Okay.

Q So, based on your understanding of

Paragraph 34, if you wanted to provide a teaching suggestion or motivation in a paper that you were writing today, how might you go about that?

MR. VERBONCOEUR: Object to the form of the question.

A Do you mean in the context of patent invalidity or some other context?

Q Right. In terms of patent invalidity, in terms of Paragraph 34, right, in terms of you personally writing a paper, if you wanted to write a paper today and you thought, I want to provide a teaching suggestion or motivation to use this paper that I'm writing with something else that I know about, how would you go about doing that?

A I don't know how I would go about doing that in the context of patent invalidity, because I'm not a patent lawyer. So I'm sort of confused.

Q Okay.

A I can talk about technical aspects of

writing a paper and how I refer to the prior art, but that might not be the same as what you're asking me.
Q Right. So if you were writing a paper and you wanted to prevent somebody else from patenting something that you think, it's just a very obvious variation of what you're writing, so you want to provide a teaching suggestion or motivation to combine your paper with something else that you know, can you identify a single way that you might provide that teaching suggestion or motivation in your paper?
A I don't understand the part of your question when you say, I want to prevent somebody from patenting a paper. I don't know what you mean.
Q Yeah. So you don't understand the idea that if you write a paper, you might want to disclose the things in it so that someone else can't take your paper, make a slight modification, and then patent that

modification?
MR. VERBONCOEUR: Object to the form of the question.
A I don't ever recall writing a paper for those reasons.
Q Do you ever recall writing a patent where you might decide that, I want to include some additional teaching suggestion or motivation to combine this patent with something else that I know about?
A Not really, no.
Q Have you ever heard of incorporation by reference?
A In what context?
Q If the context of patents.
A Yes, I think so. Yes.
Q What does incorporation by reference mean?
MR. VERBONCOEUR: Object to the form of the question.
A So my recollection is that I talk about this later in my report with regard to a

specific paragraph, Karczewicz 1 and Karczewicz 2. Unless I've sort of set it out as part of my understanding of legal standards, then I wouldn't like to volunteer legal standard for incorporation by reference. But if you could -- you know, certainly happy to talk about any reference I might -- any use I might have made in my second declaration of incorporation by reference. And I recall there is one, but you can probably find it quicker than I can.

Q I'd like to just ask you some background questions about the technology of video and coding. And I know some of these things might be very basic to you, but I still just want to cover them, these fundamentals, to make sure that we're all on the same page.

So if we have a decimal number, what does each digit mean?

A So, for example, the decimal number, 102, and this is -- I'm not talking about video coding necessarily here. I'm talking about in basic mathematical, arithmetic concepts, and the number -- the digit two represents two things. The zero represents that there are no additional tens, if you like, and the one that the most significant digit place indicates that there's a single hundred.

So 102 in decimal, if I say I've got 102 apples, then -- yeah. I've got 100 apples from one and I've got two apples from the two. So I've got 102.

Q What is a binary number?

A A binary number is, generally speaking, it's a representation of a number where each digit can be one or zero.

Q So for the binary number 011, what would that be in decimal?

A That would, unless there's -- yeah. I guess it depends on -- it depends on the mapping, but the most straightforward mapping is going to be the decimal number 3.

Q Okay. And, then, the number, this is

just another example, what would the decimal number six be in binary?

A As I'm sure you're aware, you can use different numbers of -- any different numbers of bits to represent that. So, for example, you said 011, you used three bits there for three. The decimal number six in a representation I'm very familiar with, a binary representation I'm familiar with, could be represented as 110.

Q Is it correct that every time you append a zero at the end of a decimal number, it makes that number twice as big?

A A decimal number, no.

Q What happens with decimal number when you append a zero at the end?

A So if you mean -- when I write out a decimal number, if you mean at the end, if you mean the right-hand side, the least significant decimal digit, if I took the number 102 and wrote it out and then appended a zero, if that was understood to be the decimal number, 1020, then the relationship between the two is that 1020 is ten times 102.

Q What happens if you append a zero to the right side of a binary number?

A So, for example, if the decimal number 6 was represented as binary 110. If I wrote down 110, assuming that the binary representation, and appended a zero, so that I've now written down 1100, in a conventional binary representation that could represent -- would represent the decimal number 12.

And so I'm representing a different decimal number that is two times the decimal number I started from.

Q So what is bit shifting in the context of binary numbers?

A So, generally, my understanding of bit shifting is it's an operation or a class of operations in which the bits of a binary number are -- yeah. Kind of struggle to get that high level -- for example, what I just describe with taking the binary number 110, appending a zero at the right-hand side so I now have 1100, I would, generally, understand that to be a left shift. So that's a form of bit shift.

And if I took the binary number 110 and shifted it to right, there's actually at least a couple of things that I could end up with. But if I did that, and ended up with 11, that would be a form of right shift. There's at least one other form of right shift, both of those, I think, are examples of the bit shifting in my knowledge and experience. And examples that I've used in, for example, systems that I've developed or software that I have written.

Q So each time you bit shift a number left one bit, that's equivalent to multiplying that binary number by two, correct?

A In a common binary representation such as the one I had in mind when I gave you the example of 6 in binary, append the zero at the right-hand side, you get 12 represented in binary. That would be an example of a left shift.

In that example, because I have appended a zero, I've effectively multiplied the decimal equivalent number by two.

Q And then correspondingly, if you left shift a number by two bits, then that would be equivalent to multiplying that number by four?

A If I'm doing the left shift in such a way that I'm filling the spaces on the right-hand side with zeros, then, for example, starting with decimal six, which I represented as 110, if I left shift that by two places, and fill those places with zeros, I end up with the number 11000.

And in decimal terms, I've multiplied six by four to get 24.

Q How did you shift a binary number to the right?

Well, let me rephrase that.

What is a right shift in the context of binary numbers?
A Generally speaking, it's a little bit hard to generalize. But generally speaking, the binary digits that you started with -- well, let me give you an example.
If I started with 6 represented as 110, if I did one form of right shift and ended up with 11, then that gives me the binary number 11, which, depending on the representation, can correspond to decimal three. So that would be an example of a right shift. The reason I say "an example" is because there are different types of right shift in my experience of implementing right shifts.
Q A common version of right shift is to move the digits of a binary number right by one bit and to fill a zero on the left side; is that fair?
A So my recollection is that would be consistent with a logical right shift, I think I've got that the right way around.

And that's quite a common form of right shift in my field. I've used it many times in software and I think in hardware.
Q So each time you perform a logical right shift that is equivalent to dividing a number by two?
A So at least for a positive decimal number represented binary such as positive 6 represented in binary as 110. If I do a single right shift, logical right shift, I end up with the binary number 11. And that's consistent with decimal three. So that's divide six by two.
If I start with other numbers there I get different results, which are not necessarily divisions by two.
Q So for the number 10, if you do a logical right shift, it becomes 11, and that would be binary number three?
A That would be 11, as binary 11.
Q Right. Binary 11 is decimal number 3, right?

A In a common representations. There are other representations.
Q Does shifting values to the left, increase the number of possible values?
A Of what?
Q Does left shifting binary numbers increase the number of possible values for those binary numbers?
A I need to be like -- I need to have specific context now to answer that question.
Q So there are some context where left shifting a number will increase the number of possible values.
A No. All I'm saying is there are some context where it's kind of a meaningless question. In my mind, for example --
Q Well --
MR. VERBONCOEUR: Hang on. The witness isn't done.
A Yeah, for example, if it's a number, it's three and it's a constant, then it only has one possible value. So changing a

representation of that one possible value doesn't give me more possible values. It's kind of a weird counterexample, but it's sort of meaningless question, I think in that context.

Q If you have a variable that's not a constant value --

A Okay.

Q -- does left shifting a variable increase the number of possible values?

MR. VERBONCOEUR: I'll object to the form of the question.

A For example, if I have a variable and I know that it only has 16 possible values, and I can represent that as an unsigned binary as 4 zeros up to 4 ones. If I left shift the variable, and it's still defined to have 16 possible values, then it still has 16 possible values; I've just chose a way to represent it.

Q If you have a four bit variable and you left shift that variable one bit, did you increase the number of possible values for the variable?

MR. VERBONCOEUR: Object to the form of the question.

A By the left shift or by something else?

Q By using the left shift, did you increase the number of the possible values for the variable?

A Yeah, let me think about this. If I have a variable, call it A, it's got 16 possible possibilities -- I actually have a diagram that's relevant to this.

Yeah, for example, just above Paragraph 70 of my second declaration, I show a Variable P, which has 10 possible values, and I chose to multiply that by four, it still has 10 possible values. So if I achieve this multiplication or implemented that multiplication by left shifting two places, P still has 10 possible values.

So in that example, there's no increase in possible values.

Q Can you think of any example where left shifting a variable increases the number of the possible values for that variable?
A Absent something else happening, to be honest, I can't sitting here. If you give me an example, I can tell you whether it works or not, but I can't think of one.
Yeah, again, looking at my example on Page 31 in my second declaration, P had 10 possibilities before -- and there's lots of cases, for example, in the context of video coding where we define something or a standard defines something that has a certain number of possible values. It can either, then, represented in binary then left shift. I haven't changed that variable, I've just changed the representation.
Q I'd like you turn to Page 46 of your declaration.
As I said before, I know this is very basic, but I just want to cover some of the fundamentals of video coding.

So in Paragraph 46 you just have a high-level overview of video encoder and video decoder; is that fair?

It's the diagram -- you're looking at it there.

A Sorry, yes. I thought you were on Page 46 --

Q Oh, I'm looking at Paragraph 46, Page 16.

A Okay. Paragraph 46, Page 16 of my second declaration. Okay.

Q Yeah, so in Paragraph 46, you have some high-level representations of video encoder and a video decoder; is that fair?

A A video encoder, yeah. Not every video encoder, but -- yeah, a video encoder, a video decoder, yes.

Q And in particular, these would be representations of H.264 video encoder and decoders, correct?

A Not that I recall, no.

Q But what it says, if you read

Paragraph 46, that this is in reference -- that these diagrams are in reference to H.264?
A That's not what I say in Paragraph 46.
Q Okay. So what is Figure 3.51, then?
A It's a block diagram of a video encoder. It's from my 2010 book.
Q Okay. But does Figure 3.51 reflect how high-level operations of video encoder for H.264?
A Which video encoder?
Q The one shown in the Figure 3.51.
A Sorry. You said -- no. What's the video encoder you want me to ask -- imagine reflecting?
Q Yeah, does Figure 3.51 reflect, at all, H.264 operations?
A What do you mean by "H.264 operations"?
Q Well, okay. Is Figure 3.51 consistent with H.264?
A It doesn't come from H.264. It's my figure. I created this figure.

Q Okay. It doesn't reflect how H.264 operates?
A What do you mean "how H.264 operates"? I'm confused.
Q What was your purpose of making figure 3.51?
A You should probably look at the book and look at the context, Figure 3.51, it's a block diagram of a video encoder.
Q And what is -- so starting on the left side, what is the -- what is FN current?
A So I don't have my 2010 book in front of me. And I, obviously, wrote it a while ago, I think I can roughly remember the full context. But for full context, I look at my book.
Without looking at my book, my recollection is that F subscript N, in my Figure 3.51, is meant to illustrate a current video frame, it could represent a field. I can't remember. I think it was meant to represent a frame.

Q Well, I'm handing you what's been marked as -- actually, this one has already been marked as Exhibit 1012.

(Whereupon, The H.264 Advanced Video Compression Standard, Second Edition, Iain E Richardson was previously marked as Exhibit 1012.)

Q And it's your book. Well -- thank you.

Do you recognize Exhibit 1012 as a book that you wrote?

A I'm not sure that I do. Let me explain why. It's a -- I think I mentioned this to Counsel, at the time when I first saw this exhibit.

I'm not sure that this is a -- let's say a legal or valid copy of my book, so it's not a bound book. It doesn't look like a photocopy, and it doesn't look like the way that I happened to know that the electronic versions, electronic copies of this book looked like. I don't see any copyright

information. So I actually don't know.
Q Isn't the copyright information on the page -- the stamped Page 006?
A So let me explain again. If you or anyone else were to buy a copy of my book, which I hope you did, it would either be a physical bound copy, or it would be an electronic copy. And all of the electronic copies, that I've seen, have forms of watermark and a different presentation.
So this doesn't look like either of those things. And I suspect, because this has happened to me before, this is -- I am aware that there are hacked copies, hacked PDFs of my 2010 book in circulation on the internet. The publisher hasn't been able to take them down.
And to be honest, this looks like one of those. So I hope you bought a copy of this.
Q Yeah, I'm not sure where this version came from.
But are the contents of this document

consistent with your recollection of your book?
A I have no idea. If it's the hacked PDF copy, which it looks like to me, I have no idea what process that went through to get to this, this stage. The only people who have a clean PDF copy of my book are myself and publishers, anything else, I'm not aware. I don't know where it came from.
Q Hmm. Well, if you can turn to page --
THE WITNESS: Sorry. Is there a convenient time for a break? I think I could do with a break.
MR. VERBONCOEUR: Now's a good time.
(Whereupon, a recess was taken from 10:22 AM until 10:39 AM.)
Q So, Dr. Richardson, we were looking in your declaration on Page 16, Paragraph 46.
Do you see that?
A My second declaration, yes.
Q Okay. What is the FN current, the box on the top left of Figure 3.51?

A So I don't have what I believe to be a correct copy of my -- or a valid copy of my book in front of me, but my recollection is that it is either describing a frame or a field. And the subscript N, in my recollection, is that's meant to denote a current frame of field, possibly a frame, at this point, I can't remember.
Q Right. But you did put this in your declaration for your IPR?
A Sure.
Q What did you intend to convey with the box FN current?
A So my recollection of why I put this in my declaration, was that it's in the public domain, it's in my 2010 book, these two diagrams. And it's to illustrate the first sentence of Paragraph 46, this is my recollection, that certain common architectures for video coding systems have been established over the years. So these are example of known video compression or

video coding architectures, that's what I recall.
Q Right, that common architecture, FN current would be the current frame or field, right?
A In the illustration Figure 3.51 from my 2010 book, that's my recollection, that's what I was illustrating there. In block diagram form, obviously this is not an actual implementation, it's an illustration.
Q Okay, then we get to a box motion estimation, what is that?
A Motion estimate generally in known architectures or systems for video coding, one can have a process of motion estimation where in an encoder, an encoder attempts to find a block or region or, yeah, a block or region in a different video frame that could be used to predict a block or region in a current video frame.
Q Okay. Then you have a box that says motion compensation, what is that?

A My recollection is that there I'm illustrating the process of generating a, I think in this diagram a prediction labeled P.
Q How does motion prediction relate to these boxes?
A What do you mean by motion prediction.
Q Are you familiar -- what is motion prediction.
A In what context?
Q For video coding?
A Do you mean motion compensated prediction or something else.
Q Right. Motion compensated predictions, what is that?
A Generally motion compensated prediction is, I guess you could characterize it in different ways, but it's broadly consistent with what I'm illustrating here where a prediction is created based on typically other video frames from the current -- a current video frame. And the term motion compensation is known in the field to broadly

refer to the fact that an encoder and/or a decoder can compensate for motion in that process and I think to somebody of skill in the art that would be consistent with offsetting a region using a motion vector. Something like that.

Q Have you heard motion compensated prediction referred to in the shorthand as motion prediction?

A I can't remember.

Q What is D.C.T?

A In the context of video coding and decoding it would often mean -- be shorthand for a discrete cosine transform or a practical implementation of a discrete cosine transform.

Q And then what is quant?

A My recollection is that what I'm illustrating here is a quantize process, a forward quantize process or forward quantization.

Q I think the next box here is reorder,

what is reorder?
A My recollection is that I was illustrating a process such as taking a block or blocks of coefficients and organizing them in a certain way prior to entropy coding.
Q What is entropy coding?
A Generally in the context of video coding it's a process of producing a compressed or encoded bit stream that represents values to be communicated in an efficient form, typically in some sort of binary form.
Q And then in this common architecture that you're representing in Paragraph 46, entropy encoding is the last stage before the coded bit stream?
A In this block diagram of Figure 3.51 from my 2010 book, yes.
Q And then, if we go to the figure 3.52, the coded bit stream -- actually, let me ask you, what is the coded bit stream?
A In this context, in the context of video coding, it's a representation of video data

in a compressed form.
Q Okay. So in Figure 3.52, the coded bit stream comes into the set up from the right side; is that right?
A In the way I've illustrated it in the block diagram of my original Figure 3.52, yes.
Q Okay. So then the first stage here is entropy decode, what does that do?
A Generally in this context it decodes from the coded bit stream values and those values are typically then further processed during the video decoding process. So generally, in this context entropy decode effectively reverses the operations of the entropy encoder that I illustrated above.
Q So the output of the entropy decode is no longer compressed?
A No. Not correct.
Q Okay. The output of the entropy decode is still compressed?
A The output of entropy decode step is

what it is, it's a set of values.
Q Is that set of values compressed?
A So the context here is video encoding which is also often described as video compression and video decoding, which is often described as video decompression. So if you consider the video decoder, the coded bit stream which I illustrated on the right-hand side, that is a compressed representation of video data. And way over on the left-hand side of my Figure 3.52 I have an F, an FN or an F prime N and that is a decoded video frame. So by the time you get to the left there video has been decoded and decompressed.
Q If we go back and look at Figure 3.51, for the encoder, is it correct that the F on the left side is uncompressed?
A So at the top left of my Figure 3.51, FN which illustrates a current frame, I think it would be reasonable to describe that as an uncompressed video frame in the context of

this video compression process.
Q And the one below it, we'll call it F prime N minus one reference, do you see this block?
A Yes.
Q Would it also be reasonable to describe that as uncompressed video frame?
A I would say, so yes.
Q Now, do -- how do motion vectors play into motion compensation?
A So in the typical video codec such as the typical video codecs I've attempted to illustrate here, video encoder and decoder. In video encoder, the motion estimation process will or can identify a motion vector and a motion vector is a term that's often used in this field to describe an offset between a block or region that we're trying to predict or the encoder is trying to predict in current frame and the block or region in a previously coded or reference frame.

So the offset or distance often in XY terms between those two, that would often be described as motion vector.

In these diagrams, you'll see that in Figure 3.51, there's an arrow saying vectors and headers going into the entropy encoder and what I'm trying to illustrate there is it was known around this time to encode that motion vector or motion vectors, as part of the compressed or coded bit stream and to decode them at the decoder side. And then the decoder would, again, in known video codecs, the decoder could use those motion vectors to carry out the motion compensate process that I've also illustrated. And it doesn't have to be, but often in practical systems or codecs, the motion compensate or the encode side and the decode side should mirror each other. So the decoder will often attempt to create the same prediction as the encoder using the same motion vector or motion vectors.

Q If you could turn to Exhibit 1012. And if you could turn to Page 58 of Exhibit 1012.
A Okay.
Q So I'm going to read some portions of Exhibit 1012 and I want you to let me know if you agree with these statements that they are accurate or if you disagree with them. Okay. So starting below Section 3.2, it says.

"Video codec, Figure 3.3, encodes a source image or video sequence into compressed form and decodes this to produce a copy or approximation of the source sequence. If the decoded video sequence is identical to the original then the coding process is lossless. If the decoded sequence differs from the original then the process is lossy."

Do you agree with that statement?
A I think that's a reasonable summary at the time I wrote it, in the context that I wrote it. Again, assuming that this is an

accurate reflection of my 2010 book and I'm not sure that it is.
Q I'm just asking just sitting here today, you know, reading this, if that is a reasonable statement to you?
A I think in the context of a high level overview of video coding, which is what I recall I wrote in chapter three of my 2010 book, I think it's reasonable.
Q Okay. And do you recall any differences between what is written here and what you believe is in your 2010 book?
A I don't recall.
Q Okay. And looking at Figure 3.3, would you consider Figure 3.3 to be a reasonable representation of a video encoder block diagram?
A It's a very high level video encoder block diagram as we've already discussed. In my 2010 book I recall providing more detailed block diagrams which are also reasonable. So at a high level, it's one way to, if you

like, understand some of the concepts of video coding.
Q Okay. And do you recall any differences between Figure 3.3 of Exhibit 1012 and your 2010 book?
A I don't recall.
Q I'm going to read the next paragraph to you:

"The codec represents the original video sequence by a model in an efficient coded representation that can be used to reconstruct an approximation of the video data. Ideally, the model should represent the sequence using as few bits as possible with as high a fidelity as possible. These two goals, compression efficiency and high quality, are usually conflicting, i.e., lower compressed bit rate typically produces reduced image quality at the decoder."

Is that a reasonable statement?

A I would say at this very high level that I was -- I recall writing about in my 2010 book, yes.
Q Do you recall any differences between what I just read and your 2010 book?
A I don't recall.
Q Okay. So the next paragraph reads:

"A video encoder, Figure 3.3, consists of three main functional units. A prediction unit, a spatial model and an entropy encoder. The input to the prediction model is an uncompressed raw video sequence, a prediction model attempts to reduce redundancy by exploiting the similarities between neighboring video frames and/or neighboring image samples typically by constructing a prediction of the current frame or block of video data. In H.264/ADC. the prediction is formed from data in the current frame and one of the previous and/or future frames."

So pausing there, would you consider what I just read to be a reasonable statement?

A I think at the very high level overview, which is what this I recall writing in chapter three of my 2010 book, I think all of that is reasonable.

Q Do you recall any differences between what I just read and your 2010 book?

A Not that I recall.

Q Do you disagree with any statements that I just read?

A What do you mean by disagree?

Q Disagree with them? Do you think they're inaccurate?

A They're high level as I've explained and I think is very, very, clear from reading the book. I think all of these concepts are explained in a lot more detail later in the book, but as an attempt to provide this really high level summary of some of the

concepts that I explore in the book, I can't think of how I might do it differently today.
Q Now, can motion vectors point to a sub-pixel?
A In what context?
Q Let's say for the H.264 context, can motion vectors point to a sub-pixel?
A So in the H.264 Standard, as I recall, specifies that motion vectors, MV or motion vector components can point to integer or sub-pixel positions in a reference frame or reference picture.
Q And what is a reference frame?
A In what context?
Q In the context you just explained, so motion vector in the context of motion vectors, what's a reference frame?
A I don't understand the question.
Q Well, you just used -- in your answer you just mentioned reference frame, I was just asking, well, what's a reference frame?
A I was talking about the context of H.264

which I think you asked me about.
Q Right. What's a reference frame in the context of H.264?
A I think actually the term is reference picture and the standard defines what that is.
Q Right. What is that?
A I don't have the standard in front of me.
Q Okay. So without the standard you can't explain to me what a reference picture is?
A So you asked me about the context of H.264, and it's my understanding is that you're asking me what is a reference picture in H.264, it has a very specific meaning in H.264. I recall that it's defined in H.264, I don't recall the wording of the definition.
Q So when I asked you to explain motion vectors in the context of H.264, you used in your answer, reference frame, so I'm just wondering why you would use that word if you can't explain what it means?

A   Multiple problems with your question. Could you break it down a bit, please.
Q   Right. I'm just asking you why did you use the word reference frame in your earlier answer if you can't explain what it means?
     MR. VERBONCOEUR: Object to the form of the question.
A   I actually can't remember the earlier answer. I don't agree with premise of your question.
Q   You don't agree that you used the word reference frame in an earlier answer?
A   That's not what I said.
Q   What do you disagree with about the premise of my question?
A   I think this is sounding a little bit argumentative with respect. I think you said I can't explain something. I don't recall.
Q   Right --
A   Sorry, I finished my answer. I don't recall at any point saying I cannot explain whatever it was that you're asking about.

Q To be honest, I'm just asking about what I thought would be just some basic background. And so it does surprise me that you refused to answer the earlier question about what a reference frame is. I guess I'll ask again.

What's a reference frame in the context of H.264?

MR. VERBONCOEUR: I'll object to the characterization and the form of the question.

A Yeah. So H.264 is a standard. H.264 uses very -- some specific terminology, uses the terminology reference picture, if I remember correctly.

H.264, as a standard, has a definition of exactly what it means by reference picture. So if that's what you're asking me, I would refer to the definition in the standard.

Q And --

A If you're asking me something else, then

I'm not clear what it is.
Q Right. So you can't describe to me how you understand a reference picture in H.264 without having the standard in front of you?
A I disagree.
Q Okay. Then please provide me with your understanding of a reference picture in H.264.
A My understanding covers a lot of different concepts.
What are you asking?
Q I'm asking if you can provide any explanation of what you understand a reference picture to be in the context of H.264.
A There's many aspects to it. It's something that's stored, for example, in a decoded picture buffer.
Q Okay. Is there anything else that you're able to say about a reference picture if the context of H.264?
MR. VERBONCOEUR: I'll object to the

form of the question.
A Yes.
Q Okay. And what is that?
A Lots of things.
Q Give me an example.
A My recollection is that H.264 defines reference pictures. My recollection is that H.264 goes into a great deal of detail as to how reference pictures are to be used in a conforming decoder.
My recollection is that H.264 specifies, for example, how predictions are to be formed involving reference pictures. My recollection includes that H.264 defines that reference pictures are -- can be stored after, at the end of decoding pictures and so on. But there's literally, as I recall, tens of pages in the standard, maybe hundreds of pages that relate to reference pictures.
Q In H.264, can motion vectors point to sub-pixel positions?
A I think you answered -- you asked me

that already. So I refer you to my previous answer.
Q Well, I assume the answer is yes, right?
A I think I gave you an answer already. I don't want to give you the same question multiple times. I don't have a transcript in front of me. I'm not trying to be unhelpful, but I want to be as precise as I can with my answers.
Q So what are sub-pixels?
A In what context?
Q In the H.264 context.
A I don't recall whether sub-pixels themselves are defined in the standard.
Q So you don't recall if H.264 allows for sub-pixels?
MR. VERBONCOEUR: Object to the form of the question and characterization.
A Well, what do you mean by a sub-pixel in this -- in that question?
Q A location that is not an integer pixel location.

A Okay. I still don't know what you're referring to in H.264 with that question.
Q So, in your view, H.264 does not discuss sub-pixels?
MR. VERBONCOEUR: Object to the form of the question.
A I didn't say that.
Q Okay. H.264 does discuss sub-pixels?
A I'm assuming you're perfectly aware that the H.264 standard has at least 600 pages. I think it's maybe quite a few more by now. I don't know every word that's used in the H.264. I don't actually know what you mean by "sub-pixel" in that question.
Q So you don't know if the H.264 standard uses the term "sub-pixels" or not?
A I don't know what you mean by a sub-pixel -- what do you mean by a sub-pixel in that question?
Q So by sub-pixel, I'm referring to pixel locations that are not in an integer pixel location, right. So half pixel location or a

quarter pixel location.
A I'm confused why you think those are pixel locations.
Q Okay. What is a half pixel to you, then?
A A half pixel or a half pixel location or something else?
Q What's a half pix pixel location?
A In what context?
Q Have you ever heard that used before?
A Yes.
Q In what context have you heard it used before?
A I think I probably used it myself in high level descriptions, for example, interpolation to sub-pixel positions in video coding processes.
Q And in terms of sub-pixel interpolation, you've heard of the terms quarter pixel, half pixel, center pixel, correct?
A In what context?
Q In the context of sub-pixel

interpolation.
A I've certainly heard of, you've probably used the term such as half pixel location, but you said half pixel. Do you mean without the word "location" or do you mean something else?
Q All right. So in the context of sub-pixel interpolation, you are familiar with the term half pixel location, correct?
A I recall that term. I think I probably used that term myself, a half pixel location, in the context of sub-pixel interpolation, in the context of video coding.
Q Right. In the context of sub-pixel interpolation, what is a half pixel location?
A In general, with respect to a particular standard or something else?
Q In general.
A I can't remember if I wrote about this.
Yeah. And, for example, in my first declaration, it's a declaration that I submitted, as I recall, alongside or together

with the patent owner's preliminary response. So I call that my first declaration. Roundabout Paragraph 67 of that declaration, I talk about sub-pixel interpolation in video coding in general.

And I talk about full pixel values, interpolated values in Paragraph 68. I can't remember if I used the word "half pixel location" in that section. And I've forgotten the question, sorry.

Q In the context of sub-pixel interpolation, what is a half pixel location?

A So, for instance, if you look at Page 32 of my first declaration, which is a figure from the H.264 Standard, it shows integer sample locations, and I think the person of ordinary skill in the art, and certainly me, we would sometimes use sample and pixel somewhat interchangeably. Technically, they are not necessarily the same thing.

But if we consider, for example, uppercase G and uppercase H to be integer pixel positions, or integer sample positions, then lowercase "b" in that figure, I think a person of ordinary skill in the art, and also me, you would sometimes refer to that as a half pixel position. Even though in the standard, as I said, it talks about sample positions and interpolated positions, colloquially, I think it would be reasonable to describe B as a half pixel location.

So that is a position in this example equally distanced between two integer pixel or integer sample positions.

Q What is a quarter pixel location?

A So with the same preface that, colloquially, in the field, if uppercase G and uppercase H were considered integer pixel or integer sample locations, then lowercase A and C, for example, in this figure on Page 32 of my first declaration, these might be described as a quarter pixel positions, or you could describe A as one quarter and C as three quarter.

So I think all of these might be terms that would at least generally be used in the art. They're not necessarily in the H.264 Standard itself.
Q What is a center pixel position?
A I'm not sure that that's a widely used term in this context.
Q I think you're looking at the figure on top of or below Paragraph 49 in your declaration, correct?
A No. I'm at the first declaration, Page 32.
Q Okay. So looking at that figure -- okay. So looking at the figure on Page 32 of your declaration, is there a center pixel depicted on Page 32?
A Page 32 of my first declaration is a figure from H.264. I don't see any labels in that figure that say center pixel, and I don't recall any labels, any use in the surrounding text of H.264 that says center pixel. Though, I don't have the standard in

front of me.
Q   Okay. So if I were -- but -- so looking on Page 32 of your declaration, you wouldn't be able to identify what the center pixel is?
A   So Page 32 is a figure from H.264 showing samples, not necessarily pixels.
Q   Right. So looking at Page 32 of your declaration, are you able to identify what the center pixel position is?
A   What do you mean by "center pixel position" in this context?
Q   Well, I'm asking you. In your -- hearing the term "center pixel position," are you able to point to any pixel on Page 32 of your declaration?
A   There's no pixel in the center of that diagram. There is no pixel in the center of that diagram. If that's what you're asking me.
Q   I'm going to ask my question, right. I didn't say pixel, I said pixel position. So I'll rephrase the question and give you a

chance to answer.
On Page 32 of your declaration, are you able to point to anything on Page 32 that would indicate a center pixel position?
MR. VERBONCOEUR: Object to the form of the question.
A With respect, I think you said center pixel, not center pixel position, but maybe I'm remembering wrong.
Page 32 is a figure from H.264, which specifies integer sample positions shaded with upper case letters and fractional sample positions. That's what it represents. It's a specific figure with a specific context. It doesn't use the word "center pixel" in the diagram of what I've shown here.
My recollection of H.264 is that section doesn't use center pixel either or center pixel position.
Q Earlier you described to me the reference Karczewicz 2.
Do you recall that? It's in your

binder.
A Yeah. I think I was referring to Exhibit 1006.
Q Correct. Does Exhibit 1006, Karczewicz 2, does it use the term "center pixel"?
A I'm not sure.
Q Let me ask you this. Let's go back to -- let's go back to your third paragraph here on Page 32 of your declaration.
Can you turn to that, please.
A Page 32 of my first declaration. Got it.
Q Okay. Now, what would you describe to be indicated by J?
A Uppercase or lower case?
Q Lowercase J.
A So lowercase J is on the following page, is also an extract of H.264, is described as a final prediction value. And is also described on the same extract of H.264 as a half sample position labeled as J.
I think both of those are consistent

with my recollection of the standard and reasonable in this context.
Q On Page 32 of your declaration, J is an average of two half pixel locations, correct?
A J is just a letter on Page 32. There's some text on the following page from the standard which talks about how J can be calculated.
Q In the deposition, if I refer to the pixel position indicated by lowercase J as the center pixel position, will you understand that I'm referring to the pixel position indicated by lowercase J?
A I'm not comfortable with that because this is a figure from the H.264 Standard. I'm very familiar with the standard. It's described as half sample position labeled as J.
Q All right. The half sample position --
A Sorry. I'm not finished. It's described as that in the standard. If you start calling it something else, I might get

confused in my answers. So I'm not happy with that.

Q If you want to call it --

A I'm not --

MR. VERBONCOEUR: Hang on a second. Please let the witness finish his answers before asking the next question.

A So with respect, I'm not comfortable with that way of referring to it, I would find it confusing.

Q So you want to refer to J as the half pixel position at location J?

A I'm not comfortable with that either.

Q Okay. How would you refer to the pixel location J on Page 32?

A With respect to Page 32 and Figure 8.4 or 8-4 from the H.264 Standard, I would or would be comfortable referring to J today as a half sample position labeled as J.

Q Okay. So H.264 includes fractional pixel positions, correct?

A What do you mean by that question?
Q H.264 allows fractional pixel positions, correct?
A In what context? In what aspect of H.264?
Q Well, they're discussed in the standard, right?
A So there's an interpolation process in H.264 discussed that includes the generation of fractional sample positions.
Q And those fractional sample positions would include the positions indicated or shown on Page 32 of your declaration, correct?
A So interpolated fractional sample positions for luma interpolation in H.264 include the positions illustrated on that page of my first declaration.
Q Page 32, correct?
A Yes.
Q What is bi-prediction?
A In what context?

Q In the context of video encoding, what is bi-prediction generally?

A So, generally, the term "bi-prediction" I've heard it used a lot, and I've used it myself, to describe constructing a prediction from -- to reference areas or reference blocks.

Q Does bi-prediction involve two motion vectors?

A It can be.

Q In H.264, does bi-prediction involve two motion vectors?

A So I think I talk about this. So I talk in the general about the bi-prediction at, for example, my first declaration around Paragraph 62. My recollection is I also talk about some of the specifics of, you know, specific types of the bi-prediction, such as, I think explicit and implicit, I forgot the exact terminology I use. Yeah, it's a long-winded answer.

My recollection is H.264 supports

bi-prediction where two motion vectors are sent for a particular block. My recollection is that it also supports bi-prediction where no motion vectors are sent for a particular block.
Q Does the H.264 support bi-prediction to where the motion vectors point to fractional sample positions?
A My recollection is yes, it does in respect, you know, in the situation where motion vectors are actually transmitted for a block.
Q Does H.264 support each motion vector pointing to a different fractional pixel position?
MR. VERBONCOEUR: I'll object to the form of the question.
A Okay. So my recollection is that H.264 supports bi-prediction of a block, in which two motion vectors can be transmitted for that block. Each motion vector can -- each of those two motion vectors can point to a

reference area in two different reference frames. And those vectors can be constructed independently of each other by an encoder, if the encoder choses to do that. And each of those vectors could point to an integer or fractional sample position in the respective reference picture.

Q So, for example, in H.264, when you have bi-prediction, how are the two -- scratch that. Let me rephrase.

Does H.264 bi-prediction average two predictions together?

A Okay. Now we need to get into the standard, if you want me to sort of go through an answer to that question.

Q Do you recall in H.264 if there's a default case of averaging two predictions together that are based on two reference areas?

A I don't recall that wording in H.264 default case, with respect to bi-prediction, if it's there, I just don't remember.

Q Is that consistent with how you understand H.264 to work?
A I understand H.264 bi-prediction, I've analyzed it. I've been through, if you like, that section of the specification, many times. My recollection's quite a large and complex part of the specification. I don't recall whether I've described any aspect of it as a default case, but I think -- you know, I think you're asking me about standard?
Q Well, maybe we can shortcut it. If we can turn to Exhibit 1012, and you turn to the stamped page at the bottom, 0195. Let me know when you get there.
Well, actually, let's go to 194.
If you could review, on Page 194, the section starting 6.4.5.2, and let me know when you're ready for questions.
A Okay.
Okay.
Q Does the section including the diagram

and the text on Page 194, Section 6.4.5.2 of Exhibit 1012, does it accurately reflect a depiction of bi-prediction?
A It is a depiction of bi-prediction.
Q If you look at the next page, 195, if you see the Section 6.4.5.3, "Weighted Prediction."
Do you see that?
A Yes.
Q If you could read the text on Page 195 for the section titled "Weighted Prediction," and let me know when you're ready for questions.
A Okay.
Q Does the Section 6.4.5.3 in Exhibit 1012, accurately reflect the types of weighted predictions in H.264?
A I think it's a reasonable summary. It doesn't let H.264, as I recall, takes a number of pages to define and specify weighted predictions. So this section of my book, if this is accurate, doesn't define

weighted prediction in H.264. It's -- it was, when I wrote it, if I wrote the description in my 2010 book, as I recall, I intended to provide a reasonable summary of some aspects of H.264, but it's not a complete reflection of what's -- the standard, which I think goes to many pages.

Q Have you seen anything on Pages 194 or 195 that you believe are inaccurate?

A As a high-level summary of a pretty complex part of the H.264, I don't see anything that's inaccurate as a summary.

Q Okay. If we turn back a few pages to Page 184, let me know when you get there.

A Okay.

Q Actually, if we could go back one page to 183, and you see there's a Section 6.4.1, "Reference Pictures."

Do you see that?

A Okay.

Q Okay. If you could review this Section 6.4.1 on Pages 183 and 184, and let

me know if you have questions, or let me know when you're ready for questions.
A Okay.
Go ahead.
Q Okay. Did you see anything in your review of Pages 183 and 184 that you viewed to be inaccurate?
A "Inaccurate" with respect to what?
Q With description of how reference pictures are used for video encoding.
A Well, this is a description of how reference pictures -- a summary of how certain aspects of how reference pictures are used in -- or described in the H.264 Standard. So I think it's a reasonable high-level summary, but it's certainly not complete, with respect to the standard.
And the terminology is my terminology, not necessarily the specific terminology of the standard. But I don't see anything that's inaccurate as a high-level summary.
Q So if we could turn back to your

declaration, and back to Page 32, there's this diagram about H.264.

Let me know when you get there.

A Okay. I'm looking at Page 32 of my first declaration.

Q In H.264, how would the Pixel Position B be interpolated -- let me rephrase the question.

How does H.264 calculate the pixel value for Pixel Position B, as shown on Page 32 of your declaration?

A Okay. H.264 doesn't calculate anything. It's a document. And B, there's no Pixel Position B shown on this page.

Q Pixel Position B on Page 32?

A I think I've explained at some length this shows integer and fractional sample positions, not necessarily pixel positions.

Q Okay. So how does the H.264 Standard calculate the fractional sample position shown as lowercase B on Page 32 of your declaration?

A Okay. The H.264 Standard doesn't calculate anything. It's a document written on paper.
Q How does the H.264 Standard instruct one to calculate fractional sample position, lowercase B on Page 32 of your declaration?
A It specifies across several pages how to do exactly that. And this is an extract from that specification shown on Page 33 of my declaration, but my recollection is not the whole thing.
So to answer your question, I would need the standard in front of me and then I can step you through it.
Q So without the standard in front of you, are you able to provide any explanation for how the sample position B, lowercase B, on Page 32 would be calculated?
A By what?
Q Well, let me ask you: In the context of H.264, can you give me any explanation of how the sample position, lowercase B, would be

calculated?
A   By what? I'm now confused. Are you asking me about the standard, or about a device, or something else?
Q   I'm asking you about the standard.
     If you are operating in accordance with the standard, how do you calculate lowercase "b" for -- on Page 32?
A   Okay. If a decoder is operating in accordance with or conforming to the H.264 Standard, than the decoder has to go through a decoding process that has to produce the same result as the decoding process specified in the H.264 Standard. That's how a decoder gets to fractional sample position B, it follows a process that produces the same result as the process that's specified in the standard. That's how it works, that's what the standard says.
Q   How does the process that's specified in the H.264 Standard calculate lowercase B on Page 32 of your declaration?

A The standard tells a decoder or the developer of a decoder exactly how that process works.
Q Right. And how does the process work?
A The standard tells you.
Q Are you able to describe it at all?
A Yes. I can describe it as it's three or four pages of standard, it's text. I don't have the text in front of me. I think I've said that about, you know, however many times already.
Q So without the text in front of you, are you able to provide even just a high-level explanation of how the process that's specified in the H.264 Standard calculates lowercase B?
MR. VERBONCOEUR: I'll object to the form of the question.
A I could, but, you know, if you -- I could, for example, refer you to the extract on Page 33 of my first declaration, which states the samples -- and it's partial, so I

don't have the piece immediately before it, but it states here, the samples of half sample position is labeled B. And I think, although, I don't have it in front of me, my recollection is that's referring to Figure 8.4 of the H.264 Standard.

And then it says how these samples are derived, and then it gives a number of steps that specify the derivation of half sample positions labeled B, ending up with equation 8-245.

Q Would you agree that the H.264 Standard uses interpolation?

A The H.264 Standard specifies, as part of its specification, the interpolation of luma samples and chroma samples at fractional sample position. But that's a form of interpolation or -- yeah.

Q Would you agree the H.264 Standard specifies the interpolation of samples to calculate the fractional sample position B on Page 32?

A I'm not sure I would use those exact words. The standard is deliberately, logically clear, for example, of the partial extract shown on my Page 33 of my first declaration, describes a process that derives or calculates fractional sample positions with an input of integer sample positions. And I think the text starts before this and goes beyond this standard. I don't know if that answers your question or not.
Q Would you consider -- on Page 32, you see in values lowercase A, B, C, D, E, F, G, all the way through Q.
Do you see that?
A Yes.
Q Would your consider those to be sub-pixel interpolated values?
A It's just a diagram.
Q It wouldn't make sense for you to refer to lowercase letters A through R as sub-pixel interpolated values?
MR. VERBONCOEUR: Object to the form

of the question.
A I didn't say it wouldn't make sense, but this is a diagram with description. I think we've been around, you know, discussed already that the description is -- describes the positions labeled A through R as fractional sample positions. That's different from what you just said.
Q So you wouldn't call lowercase A through R on Page 32, sub-pixel interpolated values.
A I didn't say that.
Q Okay. So we can just call values A through R sub-pixel interpolated values; that would be fair, right?
A We could. But if we're referring to Figure 8-4 of the H.264 Standard and discussing the standard itself, I would find it more convenient, or less confusing, in our discussions to use the terminology of this figure.
Q Okay. So it would be confusing to you if we referred to values A through R on

Page 32 of your declaration as sub-pixel interpolated values?

MR. VERBONCOEUR: Object to the form of the question.

A I did not say that. So, no, I disagree with that.

MR. VERBONCOEUR: I can take a break when it's convenient, in the near future.

MR. LIANG: Let me just finish this line of questions real quick.

Q Circling back around, it sounds like, in fact, it does make sense to call lowercase A through R on Page 32 of your declaration, sub-pixel interpolated values?

A What do you mean "makes sense"? I didn't use those words.

MR. LIANG: All right. We can take a break.

MR. VERBONCOEUR: And lunch is here. So partially my motivation for asking for the break.

(Whereupon, a recess was taken from 11:46 AM until 12:31 PM.)

Q Dr. Richardson, did you speak with your counsel at all during the break we just had?

A Not about this.

Q Nothing about this IPR proceeding at all?

A No.

Q Okay. So I'd like you turn to, I believe you have in your binder, I can give you a copy as well, but Exhibit 1006, which I believe we are referring to as Karczewicz 2, correct?

(Whereupon, Karczewicz 2 was previously marked as Exhibit 1006.)

Q Okay. If we can turn to Figure 4B.

A Okay.

Q Would you agree that, okay, pixel lowercase B here, do you see the pixel lowercase B in Figure 4B?

A Yes, I do.

Q Would you agree pixel lowercase B refers to a half pixel position?
A So Paragraph 70 of this reference, that's Exhibit 1006, describes B as I think a half pixel interpolation of a pixel location. It says half pixel interpolations of pixel locations B and H. I'm not quite sure whether the author -- yeah, pixel location B, so they described it as pixel location B in the context of Figure 4B.
Q Right. So lowercase B in Figure 4B is a half pixel location; is that fair?
A The author of this exhibit describe it to, as an interpolated value of a pixel location or a pixel location B, so yeah, I think I'm happy with the way the author -- the author described it the way they wanted to describe it.
Q And lowercase H in Figure 4B, would also be a half pixel position, correct?
A It's described in a similar way as Paragraph 70 of this exhibit. Half pixel

interpolation of pixel location H.
Q So B and H in Figure 4B are half pixel interpolations of pixel locations, correct?
A That's the way the authors of this document describe it, which is slightly different example from the way the authors of the H.264 Standard describe that figure.
Q Now, if you could turn to Paragraph 93 of Karczewicz 2, this Exhibit 1006?
A Okay.
Q What does Paragraph 93 describe?
A He's talking about sub-pixel motion vectors. It's talking about what the authors describe as an interpolation process for sub-pixels, they're describing this in the context of H.264 as I understand it. And then there's the beginnings of a description of calculating what the authors of this exhibit describe as sub-pixels B and H.
Q Would you agree that K2 provides a method for calculating the interpolation process for sub-pixels B and H?

A So Paragraphs 93 and 94 of K2 that's Exhibit 1006.

I think they're intended to summarize the H.264 interpolation process for what these authors describe as sub-pixels B and H, which I think they're talking about H.264 describes in Figure 8.4 we talked about earlier as fractional sample positions B and H, and my understanding is these two Paragraphs 93 and 94 of Exhibit 1006 are summarizing that H.264 process, which is a process for interpolating to obtain values lowercase B and lowercase H.

Q In Karczewicz 2, the interpolation method for calculating B and H is described in Paragraphs 93 and 94, correct?

A I think there are other -- that is a process for calculating what Karczewicz describes as sub-pixel positions or sub-pixel locations B and H. My recollection is that there are other descriptions in Karczewicz that also refer to sub-pixel or sub sample or

fractional sample values B and H and the calculations of these.
Q Can you point me to another location in Exhibit 1006 where Karczewicz 2 provides a method for interpolating sub-pixels B or H?
A Paragraph 103 of this exhibit, Exhibit 1006, around half way down the paragraph there's a sentence in the interpolation of B and H, lowercase B and lowercase H, may be the same if not defined above. So I think it's actually saying, I'm paraphrasing, use that same process in Paragraphs 93 and 94, but it's a reference, yeah, so I might have said there's a reference there to interpolation B and H, but it seems to be talking about the same process when it says above.
Q If you go back to Paragraph 93, do you see there's an equation for B1?
A I do, yes.
Q If B1 is the equation Karczewicz 2 uses for calculating sub-pixel B, when a motion

vector points to a location that falls in between two integer pixels horizontally?
A It's an equation, it's not the -- at least the second part of that process, which is in Paragraph 94, which involves taking B1 and then doing something further to it to generate B.
Q Karczewicz 2 only discloses one equation for calculating B1, right?
A I'm not sure.
Q Are you able to point to any other equations in Karczewicz 2 for calculating B1?
A Yeah, I'm looking quickly and I can't see another equation. Maybe there is one, but I don't see one.
Yeah, so far I've just seen the one equation for the B1 in Paragraph 93 of Karczewicz 2.
Q Karczewicz 2 only discloses one equation for calculating H1, correct?
A Similar answer, there's an equation in Paragraph 93 of Karczewicz 2, which discloses

calculating an intermediate value H1. I don't recall whether there's another equation for H1 and I don't see one looking through just now.

Q We can go back to Figure 4B.

A Figure 4B, okay, yeah, got it.

Q Do you see how there's also a lowercase BB box, lowercase double B box?

A Oh, yes, I do. In Figure 4B of Karczewicz 2, yeah.

Q Would you agree that lowercase BB is also a half pixel interpolation of pixel locations?

A I see it referred in text Paragraph 95 as a position, BB. I think given the way 4B is laid out and describes, I think BB would be -- yeah, I think that would be consistent with Karczewicz and her coauthors description of what she calls sub-pixel B in Figure 4B. so BB is a corresponding value in between integer pixel positions or sample positions B3 and B4, but B3 is uppercase, B4 is

lowercase.
Q Did you review Dr. Freedman's declaration?
A Yes. Sorry, declaration, yes I did, yes.
Q In the IPR, yeah?
A Yeah, in the IPR.
Q Is it in front of you?
A I don't think it is. Let me just check.
Q In any case, I'm handing it to you. What I'm handing is Exhibit 1003, Dr. Freedman's declaration.
Have you ever seen this document before?
(Whereupon, Dr. Freedman's Declaration was previously marked as Exhibit 1003.)
A Yes. I believe so, yes.
Q So I'd like you to turn to Paragraph 151.
A Okay.
Q Do you see that there's a scenario one?
A Yes, I do, yes.

Q And Dr. Freedman discussed three scenarios in his declaration, right, you recall that?
A I do and I think I talk about it starting at Paragraph 141 of my second declaration, I talk about Dr. Freedman's three distinct scenarios.
Q Okay. In scenario one, the first motion vector points to a half pixel position and second motion vector points to an integer pixel position, correct?
A That's the way Dr. Freedman seems to describe it in his Paragraph 151.
Q And that's the scenario that you analyze for providing opinion in this IPR, correct?
A I certainly provide some analysis of that, for example, in Paragraph 141 of my second declaration onwards.
Q Okay. Then if you look at scenario two on Paragraph 157 of Dr. Freedman's declaration. Scenario two, in scenario two the first motion vector points to a second

pixel position and the second motion vector points to a half pixel position.
Do you see that?
A I see that in Dr. Friedman's declaration.
Q Did you understand the scenario that Dr. Freedman was describing in Paragraph 157?
A My recollection is that I did in the context of Dr. Freedman's declaration. I'm just, yeah, I don't recall precisely whether he used this word center pixel position earlier, but my recollection is that in the context I understood it.
Q Okay. And you see in Paragraph 157 he does use the word center pixel position?
A He uses that the term, yes.
Q Did you understand what he meant by center pixel position?
A In the context of his declaration, my recollection is I did understand it, yes.
Q If we look at the Karczewicz Figure 4B, Karczewicz 2 Figure 4B let me know when you

get there?
A Yes.
Q Looking at Karczewicz Exhibit 4B, that's the Exhibit 1006, what is your understanding of what Dr. Freedman meant by a center pixel position?
A Well, for example, Dr. Freedman at Paragraph 158 describes the center pixel value e.g. lowercase J and he's referring to Karczewicz 4D, Figure 4D, of Exhibit 1006. So he's saying lowercase J, I'm paraphrasing, lowercase J in Figure 4B is what he's describing as the center pixel. That's my understanding. He's saying -- I don't think it's Karczewicz's terminology, not that I remember anyway. But he's using the terminology center pixel as a shorthand for fractional pixel position J in Karczewicz 4B, that's what I understand.
Q If you turn to the next page, Paragraph 163, you see there's a description of scenario three?

A I see that, yes.
Q Would you agree that all three of the scenarios described by Dr. Freedman involve a half pixel prediction location?
A A half pixel prediction location, what do you mean by that?
Q Well, they all involve predictions with half pixel locations, correct?
A Scenario three I'm looking at the moment describes motion vectors pointed to half pixel locations or half pixel positions. I don't see the word prediction there.
Q In your understanding, scenario three does not involve motion prediction?
MR. VERBONCOEUR: Object to the form of the question.
A That's not what I said. I'm not sure what you're asking me now.
Q That was my previous question.
So my question was: Do you agree that all three scenarios described by Dr. Freedman include motion vectors pointing to half pixel

positions?
A That seems to be a different question.
Q Can you answer the question?
A Okay. So scenario three proposed by Dr. Freedman talks about, as he put it, both motion vectors pointed to half pixel positions, so he's talking about half pixel positions there. Scenario two, talks about a second motion vector pointing to a half pixel position according to Dr. Freedman. Scenario one, talks about the first motion vector pointing to a half pixel position; so in all three of his scenarios that Dr. Freedman proposes at least one of the motion vectors points to, as he puts it, a half pixel position.
Q Now, all three of these scenarios described by Dr. Freedman, would involve a half pixel interpolation of either pixel location B or H, correct?
A Could you just ask the question one more time?

Q All three of the scenarios described by Dr. Freedman, would involve a half pixel interpolation of either pixel location B or pixel location H, correct?
A Not necessarily. If we're talking about lowercase B, lowercase H as in Karczewicz Figure 4s, which refer you to half sample positions with those labels, so not necessarily.
Q Okay. What situations would a scenario involve -- or strike that.
In what situation would one of these scenarios not involve half pixel interpolation of B or H, lowercase B or H?
A Well, as I understand it, Dr. Freedman describes his scenario one as the first motion vector pointed to a half pixel position, but he doesn't limit that as I understand it to B and H, so for example, using Karczewicz Figure 4D, there's a position lowercase J that's, that has a half pixel horizontal and vertical component. So

I think that's consistent with the half pixel position in his terminology. I think we're all using slightly different terminology here trying to keep it straight, so in terms of his terminology -- yeah, sorry, just to -- and again, Dr. Freedman uses the term center pixel position in Paragraph 146, for example. But he does describe that as a half pixel position. So I think that's all consistent. And this is his terminology not my terminology, so I apologize to Dr. Freedman if I'm misunderstanding him, but...

Q Following Dr. Freedman's terminology, would you agree that all three of his scenarios described by Dr. Freedman involve a half pixel prediction?

A So I don't think he ever gets a half pixel prediction, but he certainly talks about a half pixel position in each scenario. His prediction and maybe this is part of my confusion, for example, 156 he does talk about a prediction as a result of scenario one, but that prediction equation in Paragraph 156 that's not in Karczewicz 1 that's not in Karczewicz 2, so that doesn't seem to be in his combination.

Q Let me ask it a different way, following Dr. Freedman's terminology, would you agree that all three of the scenarios described by Dr. Freedman involve interpolation for a half pixel position?

A If I understand his scenarios, and I'm not sure I completely understand them, for at least the reason I just discussed, he certainly talks about in Paragraph 152, I think he's talking about his scenario one. And he's talking about Karczewicz 2 using a calculation to interpolate, I know that's a quarter pixel position. So that's something else.

I actually don't know if he gets to the half pixel interpolation in scenario one. It's kind of confusing the way it's set out. For example, the equations, I pointed you to, the pred equation, which are not in either reference. Is he actually outputting a half pixel interpolation position, I'm not sure.

He starts with a motion vector pointing to half pixel position. The second motion vector pointing to an integer pixel position. That's Freedman's declaration of 151. And he talks in Paragraph 156 about keeping a half pixel prediction at a higher non-rounded position. I'm just quoting Dr. Freedman here.

Then he says, "This combination results in the following equation," then he gives an equation which isn't in either reference. I'm not actually sure if he generates a half pixel, half sample position or a half pixel position. Maybe I'm missing something.

Q Does Karczewicz 2 provide a teaching in the context of H.264?

A I guess H.264 is part of the context of Karczewicz. If by that, you mean the background and the technical field, H.264 is mentioned in the background as are other standards. I think Karczewicz was filed on -- in May 2008. And by that time H.264 was certainly available.

And my recollection is that Karczewicz give -- the authors give their own summary or description of things that happened in the H.264 Standard. It's not necessarily the way I would describe things, but, you know, it's their -- I guess their attempt to summarize what happens in H.264.

So certainly -- it's certainly relevant, if you like. It's part of it's -- H.264 is discussed several times in Karczewicz 2.

Q If you could turn to Karczewicz 1, which is Exhibit 1005.

A Yeah. Got it.

Q Would you agree that Karczewicz 1 also provides its teachings in the context of H.264?

A So I didn't use the words -- well, no, sorry, I did, I did actually. So Karczewicz

2, in a similar way -- Karczewicz 1, sorry. I'll start again.

Karczewicz 1, in a similar way to Karczewicz 2, mentions the H.264 Standard in the background, and I think in one or two points or several points after that. So it's certainly part of the context or the background to the disclosure of Karczewicz 1.

Q Do you see on Paragraph 60 of Karczewicz 1, there's a default weighted prediction for bi-prediction?

Do you see that?

A I see those words. I see default weighted prediction. I see the sentence:

"Default weighted prediction may be defined by the following equations for unidirectional prediction and bidirectional prediction."

Q And do you see for the equation for bidirectional prediction, there's a value (pred0) and a function of I and J.

Do you see that?

A Yes.
Q In Paragraph 60 of Karczewicz 1, that's Exhibit 1005, how is (pred0) calculated?
A It doesn't actually say. It describes pred0 as prediction data from list zero to list one.
Q What --
A Sorry, just to finish. It doesn't say how it's calculated from list zero to list one.
Q Would a person of ordinary skill in the art have been able to follow the teachings of Karczewicz 1 and calculate (pred0)?
A I think a person of ordinary skill in the art, reading Paragraph 60 of Karczewicz, would probably read it in context as part of a description that starts at Paragraph 55, which is a summary -- Karczewicz authors a summary of certain things that happen according to the H.264 Standard.
So a person of ordinary skill picking up Karczewicz would be able to follow or

understand or work through the connection between what's being described in Karczewicz 1, Paragraph 60, and, for example, the H.264 Standard.
Q So with that in mind, how would a person of ordinary in the skill in the art have calculated (pred0)?
A They would probably look at the standard, the H.264 Standard, and I'm summarizing a lot, but the standard specifies how a decoder can construct a prediction for a pixel or sample within a block of pixels and samples, and that would include the calculation such as the -- calculating pred0, calculating (pred1) as listed in Paragraph 60 of Karczewicz 1.
Q Now, if we could go back to Karczewicz 2, which is Exhibit 1006.
Let me know when you get there.
A Okay. Yep.
Q Would you agree that Karczewicz 2 is directed to sub-pixel interpolation?

A So Karczewicz 2, Paragraph 2, this disclosure relates to digital video coding, and more particularly, fractional interpolations of predictive data used in video coding. And I think that's consistent with Karczewicz 2 talking later on about half pixel interpolation, quarter pixel interpolation, and most likely talking about sub-pixel interpolation. I think I'm pretty sure that terminology is used later.
So, yeah, it's a long way of saying is directed to fractional interpolation, which I think would be consistent with sub-pixel interpolation.
Q When applied to H.264, would the fractional pixel calculation of Karczewicz 2 end up being carried out millions of times per second?
A How would you apply them to H.264?
MR. VERBONCOEUR: I'll object to the form of the question.
Q When you apply the teachings of

Karczewicz 2 to a decoder that implements its process in accordance with the H.264 Standard, would the fractional pixel calculations taught by Karczewicz 2 end up, in most cases, getting carried out millions of times per second?

MR. VERBONCOEUR: Object to the form of the question.

A So my recollection is that Karczewicz 2 discloses calculations that are not -- certainly some calculations that are not in accordance with the H.264 Standard.

So you're asking me to consider a decoder that maybe, let's say, was designed to implement H.264 decoding, and then, subsequently, was modified according to Karczewicz 2.

Q Correct.

A Okay. And what else do you want me to consider about the decoder?

Q That's it.

A Okay. So if I remember your question, I

think the answer is not necessarily.
Q Okay. Why not?
A Well, I could implement an H.264 decoder that goes very, very slowly, for example.
Q Um-hmm.
A I could decode, implement an H.264 decoder that decodes -- the first video code that I ever implemented decoded one frame in about 30 minutes.
Q And that first one was many decades ago, right?
A It was a few decades ago, yeah.
Q Let's talk about the 2010 time frame.
A Okay.
Q And we're just talking about typical decoders, not ones that are made intentionally slow or something like that, right?
A So with that in mind, the 2010 time frame, there was still a massive range in terms of decoders that I was familiar with, that were capable of decoding H.264 bit

stream, so it's a massive range of capabilities in terms of the rate of decoding.
Q So in 2010 -- in 2010, the use of Karczewicz 2's teachings would have resulted in millions of calculations per second on some decoders but not on others?
MR. VERBONCOEUR: Object to the form of the question.
A I don't know the video resolution for the frame rate we're discussing. So I can't answer that without going to a specific or at least a ballpark range of video resolution, frame rate, decoder capabilities, whether it's realtime or non-realtime, et cetera.
Q Okay. So you agree that -- but in 2010 there are some realtime decoders that existed, right?
A So in 2010 there was certainly decoder implementations capable of decoding at least certain resolutions of video conforming to H.264 and decoding in realtime, say, frame

rates of 25, 30 or more frames per second.
Q Were there some decoders in 2010 that were not implemented to decode those same frame rates in realtime?
A Yes.
Q Okay. And then --
A And, sorry, I have in mind like resolutions up to, for example, high definition video, just to give a ballpark.
Q Okay. Let's keep that in mind then, resolutions up to high definition video.
For those resolutions, in the 2010 time frame, realtime decoders using the teachings of Karczewicz 2 would have ended up carrying out Karczewicz 2 sub-pixel calculations millions of times per second, correct?
A I'm not aware of any realtime decoder from that time frame that implemented the teachings of Karczewicz 2. I'm not saying they didn't exist, but I'm not aware of any.
Q Right. So I'm asking you to consider if a decoder had, in fact, implemented the

teachings of Karczewicz 2, would you know one way or the other whether a decoder, in the 2010 time frame, for resolutions up to, say, 1080P would have ended up calculating Karczewicz 2's sub-pixel calculations millions of times per second?

A I don't know if such a decoder existed. If a decoder implementing Karczewicz 2 existed, and I think at least one probably did exist, but it wasn't necessarily a realtime decoder, if such a decoder existed, I could work it out. But I'd need to be able to measure the decoder performance or know the decoder performance with the proposed non-H.264 aspects of Karczewicz 2 implemented. So I need to know what the decoder was.

Q What aspects of the decoder would you need to know to make the calculation?

A How many macro blocks is it processing per second.

Q That's it?

A I'd need to know whether or not it was actually implementing these calculations -- applying these calculations.

So, for example, if you gave me such a decoder as a piece of software or hardware as a way to interface to it, I could -- I'm speculating a little bit, but I could probably feed in a video, an H.264 -- it's not an H.264 sequence, though, is it?

Okay. I need a decoder, I also need an encode video sequence with these modifications in place during encoding, I think, or do I?

Yeah. There's probably a few variables I'd have to consider.

Q Would you have to actually run the test to figure it out or could you just ballpark it?

A If I had enough performance data, then I could -- and I knew that -- and I was confident in the source of the data, I could probably give a ballpark estimate, but I

would need to know the -- for example, the interpolation calculations disclosed in Karczewicz 2 were actually being carried out.
     So if I had like enough data and enough confidence and enough information about how the data was generated, speed measurements or whatever, throughput measurements, then I could give you a ballpark answer, yes.
Q   So, obviously, sitting here today, we're not going to run tests or create measurements. So without those tests or measurements, would you be able to give me any kind of ballpark analysis of whether Karczewicz 2's sub-pixel calculations would end up getting carried out millions of times a second?
A   I just -- I just don't know if such a decoder actually ever existed. So Karczewicz 2 if -- let me see if I got this right way round.
     Yeah. I write something that's relevant, I think, to these questions. Let

me just find it.

Yeah. Paragraph 136 of my second declaration. Karczewicz 2 and the disclosure of the aspects of Karczewicz 2 that are not in H.264, my recollection is that disclosure is also in a standards documents, VCEG-AI33. And I have read that document, but I don't recall it, as I sit here, but to the extent that described tests carried out with the reference software, then that would be Karczewicz and her coauthors describing an implementation, but the reference software is not realtime. It's not fast. It wasn't fast at the time.

So that's going to be like the only base point that I can think of at the moment. If somebody had implemented a realtime version, then I don't know what that is, and I don't know how fast it's running. So it's a lot of hypotheticals here.

Q Right. And you know that I'm asking a hypothetical question, if somebody had implemented Karczewicz 2, I'm not asking whether someone actually did it, right.

I'm just asking you do you understand this question. For the purpose of this hypothetical, do you understand the question that I'm asking is to assume that somebody had implemented Karczewicz 2, and then I'm going to ask you some questions about that.

A Okay. If, for example, you're asking me to assume that somebody had implemented Karczewicz 2, and had managed to successfully make it run at -- managed to successfully implement it in a video decoder with decoded 30 frames per second at high definition resolution, then, you know, I can assume all of that. I don't know that occurred, but I could answer a hypothetical like that, if that's helpful.

Q So let's assume all of that, right?

A Okay.

Q So in that hypothetical decoder that's been implemented, to decode high resolution at 30 frames per second, following the teachings that are described in Karczewicz 2, would you agree that the sub-pixel calculations taught by Karczewicz 2 would end up getting carried out millions of times per second?

A And one further assumption is that the video that's being processed is actually being decoded using the sub-pixel positions, you know, motion vector point to the sub-pixel positions articulated in Karczewicz 2.

Assuming all of that, then calculations such as the set of calculations outlined in Table 5 of Karczewicz 2, Table 6 of Karczewicz 2, Table 7 of Karczewicz 2, would, I think, be implemented, I think it would be millions of times per second, yes.

Q Was Marta Karczewicz a highly regarded person in the field of video encoding?

A Did you say "is" or "was"?

Q Is, is.

A Yes. She's still alive, I hope. Yes, yes. Indeed.
Q Why?
A So I summarize this in Paragraph 135. I don't want to read my summary. Going back before the development of H.264. I know because I kept track of standards contributions that Marta Karczewicz made many contributions to -- was a coauthor of many such contributions around the time of H.264 development, also around the time H.265 HEVC development. I'm aware that she's been a recipient of an award from the European Patent Office, as I state in my Paragraph 135 of my second declaration.
My recollection is that she chaired or cochaired at least ad hoc groups of the H.264 and H.265 development efforts. I'm aware that she attends and contributes to MPEG meetings. And I'm aware that she's, as I understand it, currently a vice president of technology at Qualcomm and her

responsibilities, as far as I'm aware, relate very closely to video coding.

So yeah, put all of that together, and I've been familiar with her work for many years. Would regard her as having made a significant contribution to the field.

Q Would a POSITA have known about Marta Karczewicz's patents?

A At which time?

Q In the 2010 to 2011 time frame, would a POSITA have known about Marta Karczewicz's patents?

A I don't know that they would necessarily have come across her patents. If they were working reasonably closely with video coding standards, for example, H.264, which was very well-known at the time, and if they read one of my books on H.264, they would see -- I think pretty sure citations to at least papers and contributions by Marta Karczewicz.

I couldn't say whether or not they'd be familiar with the patents. They might be familiar with the technical papers and standards contributions authored by Dr. Karczewicz.

Q For the opinions you provided in this case, did you envision the POSITA having knowledge of Marta Karczewicz's patents?

A I'm not a patent lawyer, but I don't think that's the standard, as I necessarily recall.

So I talk about my understanding of a person of ordinary skill in the art around Paragraphs 41 and 42 of my second declaration.

I don't recall the statement that you just put to me as part of any assumptions or bases for my opinions.

Q Now, let's look Exhibit 1006. That's Karczewicz 2, right?

A Okay.

Q Would a POSITA have known about Karczewicz 2?

A What do you mean "known about"?

Q Let me ask a different question. Given Marta Karczewicz's stature in the field of video encoding, would a POSITA have been motivated to apply the teachings of Karczewicz 2?
A To what?
Q So video decoders.
A Not necessarily.
Q Why not?
A So a POSITA, as I think -- as I set out in my -- Paragraph 41 of my second declaration, they'd have a bachelor degree in a relevant field, familiarity with the relevant video coding standards, at least two years of work experience in matters relating to video coding hardware and/or software. But Karczewicz 2 proposes something that's not in the H.264 Standard, and that was maybe the dominant standard by about 2010.
So put it another way, I could imagine somebody who satisfied all the requirements

of a POSITA, maybe even somebody familiar with implementing standards in hardware or software who doesn't have a need to improve upon the standard and to do something that's not in the standard at the time.

Q So if we think about the other way, can you think of -- can you imagine somebody who is a POSITA that might read Karczewicz 2 and think, "I really like Marta Karczewicz. I respect her. And so I want to use what she is saying and apply the teachings of Karczewicz 2"?

A So if, for example, a person of ordinary skill wanted to, in the scenario you just described, try and implement Karczewicz 2, I think they could at least attempt to do that, based on the disclosure. I haven't tried it myself, so I don't know whether there are any kind of uncertainties in the disclosure.

But it does describe for example in -- yeah, some of the paragraphs we've been discussing, how to generate interpolated pixel positions in the way the authors of Karczewicz 2 intended, which is different from the way H.264 does it. So one could -- I could imagine somebody trying to implement these in software or hardware, if that's what you're asking.

Q And given your respect for Marta Karczewicz, you would except that, in fact, the teachings of Karczewicz 2 are functional, that they work as she describes them?

MR. VERBONCOEUR: Object to the form of the question.

A Could I just ask for clarification, does "functional" have a specific meaning in this sort of context?

Q Do the teachings work as she describes them, that somebody could take them and use them?

A I honestly don't know if there is enough information in this patent application itself to successfully implement the teachings. It's not a standards document. There are

fairly expensive tables of showing certain register operations, if I recall correctly. Whether that's enough information, I'm just not sure.
Q Do you believe a POSITA would have been able to make and use the teachings of Karczewicz 2?
A Based on what?
Q Just reading Karczewicz 2.
A They'd probably have to have a starting point, so fully working video decoder, that didn't use Karczewicz 2. I'm speculating here. And then the question would be whether the -- there's enough information here to, for example, implement the tables and the description around the tables in that decoder. So I think it would depend on their starting point.
Q So you aren't sure whether a POSITA would have been able to make and use the teachings of Karczewicz 2?
A Well, for example, you know, I've

employed people who pretty much met the definition here of a person of ordinary skill in the art around that time period.

I've supervised -- I've supervised, I guess, research assistants a few years previous but with sort of similar backgrounds with a relevant degree, a couple of years of experience. Not all of them, in my mind, would necessarily have been able to implement this. Some of them probably would if there's enough information disclosure in this document to do so.

Q So you haven't applied an assumption that a POSITA would be able to make and use the teachings of Karczewicz 2?

A I don't recall writing those words or necessarily relying on that assumption.

Q So given how well-known Marta Karczewicz was, would you agree that there would have been at least some POSITAs out there that would have some motivation to apply the teachings of Karczewicz 2 to calculate

sub-pixel positions?
A Motivations, what do you mean by motivations?
Q A motivation, right, you understand motivation?
A Generally, yes, yes.
What's the motivation here, sorry?
Q Well, I'm asking you that would there be at least some POSITAs out there, given the stature of Marta Karczewicz in the field of video encoding, would there have been some POSITAs that would have some motivation to take the teachings of Karczewicz 2 and to use them to calculate sub-pixel positions?
MR. VERBONCOEUR: I'll object to the form of the question.
A I'm not quite sure what the motivation would -- I'd have to sort of speculate as to what motivation might be because, like in many, many applications of video encoding, the motivation -- a common motivation is to use and follow standards.

Q And so --
A And so many -- yeah, many POSITAs that I can think of would not necessarily have a need or a requirement to change the way interpolation is done unless there's some benefit to doing it. I know Karczewicz talks about a benefit, but is that a benefit from the perspective of a typical POSITA?
If they're a researcher, do they want to duplicate somebody else's research? What does that buy them? If they're in the commercial domain, do they want to implement something nonstandard? What's the advantage of that? So I'm not actually sure.
Q So you can't imagine a single POSITA reading Karczewicz 2 would feel any motivation to just follow Karczewicz 2, these teachings, as written in the reference?
A I could imagine it, but I have to speculate where that motivation comes from.
Q And where would that motivation come from then?

A I don't know. That's what I'm saying. I have to speculate.

I could speculate, for example, a POSITA who's a research assistant and their professor says to them, "I want you to come up with some new interpolation methods. Why don't you start by implementing what Karczewicz, Ye and Chen did in this document? Why don't you try that?"

MR. VERBONCOEUR: I'll object to the form.

Sorry, Dr. Richardson.

I'll object to the form on that as well.

Q And why would a professor direct his or her research assistants to look at teachings of Karczewicz 2?

MR. VERBONCOEUR: I'll object to the form. And characterization.

A I have no idea.

Q Okay. So in the end, I think, it sounds like you really can't imagine a POSITA would

have read Karczewicz 2 and been motivated to follow its teachings?
A With respect, you're saying the exact opposite of what I just said. I just imagined a scenario. I just imagined a scenario.
Q Now, I would like to go to Paragraph 142 of your declaration.
THE WITNESS: Can we get a break soon or now if it's convenient to you?
MR. LIANG: Yeah. We can take a break.
MR. VERBONCOEUR: Five, ten minutes?
THE WITNESS: Five minutes is fine. Thank you.
(Whereupon, a recess was taken from 1:34 PM until 1:50 PM.)
Q I think -- so we were on Paragraph 142 of your declaration.
A Sure.
Q So Paragraph 142 describes some steps taken by a video encoder, correct?

A Yeah. If a video encoder is carrying out motion-compensated -- yeah, motion estimation for the purposes of motion-compensated prediction, yeah.

Q And here you're describing a process where the encoder will repeatedly test possible pairs of motion vectors to determine which pair minimizes the residual error; is that fair?

A I don't think I talk about repeatedly testing pairs of motion vectors.

Q Okay. Well, what is Paragraph 142 describing?

A So an encoder determining a motion vector. Finding a block or a region in a frame which closely matches a macroblock. Searching for a block of pixels to minimize a matching criteria. And for bi-prediction doing that two times.

So -- yeah, so searching, you know, fairly often -- searching previously coded video frames very often means doing it multiple times, and that can be the case. But there's also ways of, depending on your criteria, for example, minimizing the complexity and limiting your number of searches so that it's a smaller number. There are situations where you could try and get to the vector as quickly as possible.

So it's certainly well-known by the 2010 time frame to do this searching by checking multiple positions and evaluating each one. That's well-known, yeah.

Q And you'd agree that the decoder carries out this same process from Paragraph 142?

A No. No, the decoder doesn't do any searching. The decoder would -- in a typical video encoder around this time, the decoder would use a motion vector supplied by the encoder.

Q In your opinions that you've provided in these IPRs, what meaning of prediction did you use to formulate your opinions?

MR. VERBONCOEUR: Object to the form

of the question.
A So Paragraph 1 -- sorry. Paragraph 66 of my second declaration, I talk about my understanding of how prediction is used in the context of the '267 Patent. A prediction is a value or set of values that is intended to approximately represent pixel values for a block. I'm paraphrasing there.
Q So the construction explained in Paragraph 66 and 67 of your declaration, Exhibit 2015, is the construction that you applied for purposes of your opinions?
A I would hesitate to use the word "construction." I know it has a legal meaning in this context. I'm not a lawyer.
So I don't recall offering -- I could be wrong because it's three IPRs on the go. But for this proceeding, I don't recall offering an opinion on construction in particular terms other than just the plain or plain and ordinary meaning.
Yeah. Paragraph 29, this is my

understanding of claim construction. The words of the claim are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art. So I haven't, as far as I recall, given a particular claim construction opinion if that's what you're asking.
Q So you haven't given an opinion about how the term "prediction" should be construed?
MR. VERBONCOEUR: I'll object to the form of the question.
A It sounds like quite a legal question, to be honest. It's not a -- I don't have a section proposing a claim construction for that term if that's what you mean.
Q Let's go back to Paragraph 66 of your declaration.
A Sure.
Q Is the description in Paragraph 66 to 67 of your declaration, is that reflective of your understanding of how the term

"prediction" should be understood?
A "Prediction" is a word that's used a lot in video coding. Certainly by the 2010 time frame, it was -- I probably used it many hundreds of times in my books. I think it comes up many, many times in the known standards, such as H.264.
So it's certainly not the entirety of my understanding, if that's what you mean. But I'm just trying to summarize what I believe to be the way the word "prediction" is -- aspects of the way the word "prediction" is used within the '267 Patent. In -- sorry -- used in the context of the '267 Patent.
Q The -- these Paragraphs 66 and 67, they reflect your understanding of how the claim term prediction in the context of '267 Patent, how that claim term should be understood?
A That's not what I said and that's not the way I would put it, no.
Q What's wrong -- why wouldn't you put it

that way?
A The way you put it just now seems to sort of limit it or something like that. Again, I'm not a patent lawyer. But my understanding of prediction in this context, a POSITA's understanding of a prediction in this context is not entirely captured by Paragraphs 66 and 67.
Q Is there somewhere else in your declaration where you provided an understanding of how a POSITA would have understood prediction in the context of the '267 Patent?
A Yeah, throughout my declaration. I mean you've just go got to go pages before prediction, prediction, prediction it's on almost every page of the declaration, right.
Q So those other pages, are they consistent with your description of prediction in Paragraphs 66 through 67?
A I don't recall a place where I've been inconsistent with that. But 66 and 67

doesn't understand, doesn't comprise the entirety of my understanding of prediction in this context and I don't think it would comprise the entirety of a POSITA's understanding, but it would be it's a summary, if you like, of what it means to be a prediction in this context.

Q So do you understand one of things that the board is going to do is come up with a construction for prediction, and to do that they're going to analyze, well, what should prediction mean in the context of the '267 Patent. So we've looked at Paragraphs 66 and 67 of your declaration, is there anything else in your declaration that you think the board should consider when formulating the construction for prediction?

A I have no knowledge of whether or not the board formulates a construction prediction, I don't know how they operate.

Q Is there any other paragraph of your declaration that you would like the board to consider when they decide the meaning of the word prediction?

A I don't know whether or not the board decides the meaning of the word prediction in this context.

Q Are there any other paragraphs of your declaration that you would like to identify for the board regarding the meaning of the word prediction?

MR. VERBONCOEUR: Object to the form of the question.

A What do you mean would like to identify for the board. I'm just getting my technical opinions in the document.

Q I'm giving you an opportunity right now, if you want the board to consider another paragraph of your declaration when thinking about, hey, what does prediction mean, this is your chance to point those paragraphs out?

MR. VERBONCOEUR: I will object to the form of the question.

A I haven't been asked to make a

recommendation to the board as I recall, if that's what you're describing, if I was asked by counsel to do so, I would take my time. I don't recall being asked to offer such a recommendation to the board and, yeah, I just stand by my declaration.
Q Did you consider -- so did you review the board's institution decision?
A I did, yes. I think it's in one of my binders, yeah.
Q Do you have an opinion as to whether the board's analysis regarding the term prediction as that term is used in the '267 Patent whether the board's analysis is correct?
A Where is that analysis, sorry?
Q Well, I'm asking you not to form -- I'm just asking you whether you have an opinion?
A I'm asking -- yeah, I'm not sure what analysis you're asking about.
Q Do you recall ever reviewing a claim construction analysis in the board's

institution decision regarding the claim term prediction?

MR. VERBONCOEUR: I'll object to the form of the question.

A So I've read the institution decision, I'm not a lawyer, so I wouldn't claim to understand, for example, references to federal circuit citations, yeah, if you want to point me to it, I'll look at it, if not, I'll try and find it.

Q Dr. Richardson --

A I see we provide a preliminary construction for the term prediction. Yeah, you can probably point me to it quicker than I can find it.

Q Dr. Richardson, do you recall having formed any opinion regarding points of board's analysis and the institution decision that you disagree with regarding the meaning of the term prediction?

A I don't fully agree with the board's analysis, if that's what you're asking me.

I'm trying to find whether they had a particular discussion of prediction. You can point me to it or I can try and find an easy reference. 2D2A whatever that is. Where is that.

Two -- slightly confused by the headings and sub headings.

Q Why don't you try looking at Page 16 of the institution decision.

A Thank you.

Okay, which part.

Q Do you see the part that says, "The term prediction encompasses values used for prediction that are calculated by mathematical operations including multiplying pixel values in reference blocks with weights."

Do you see that?

A The term prediction encompasses. Okay, I see that, yep, I see that.

Q Do you agree or disagree with that statement from the board?

A The term prediction encompasses, so it doesn't have to be entirely limited to -- I'm just sort of trying to parse this again. As of right now I don't see anything I necessarily disagree with in that sentence. For example, my Paragraph 66, the value or set of values generated through some coding process is a mathematical operation including multiplying pixel values and reference blocks with weights and generally is consistent with, for example, weighted at least part of a weighted prediction process, so I don't think -- I don't see anything I disagree with.
Q Can you turn Exhibit 1001 Column 2, that's the '267 patent by the way. Column 2.
A Yeah, just a second.
Okay.
Q Do you see the sentence that says around Line 51, it says, "It should be noted here that one picture may include different types of blocks, i.e., blocks in the picture that

may be interblocks, uni-predicted blocks and/or by-predicted blocks."

Do you see that?

A Yes.

Q Oh, I'm sorry. I'm looking at the wrong place. Okay. Do you see around Line 20, let me see. Okay, Column 2, Line 23, it says, "In MCP prediction for a current frame is formed using a previously encoded frame where only the difference between the original prediction and prediction signals representative of the current and predictive frames is encoded and sent to the decoder"?

A Okay, yeah, I see that.

Q The next part says, "A prediction signal representative of a current frame is formed by first providing the current in two blocks e.g. macro blocks, searching for a best match in the reference frame for each block. In this way the motion of a block relative to the reference frame is determined and the motion information is coded into bit stream."

Do you see that?
A You didn't finish the sentence and I think you misread, sorry, representative of a prediction frame, I think you said current frame, but otherwise I see that, yes.
Q All right. So the portion back around Line 24 that says.
"Where only the difference between the original and prediction signals."
Do you see that phrase?
A Yes.
Q So this is referring to, this is comparing the original signal to the prediction signal to determine the residual, correct?
A Yes. Where signal in this context could be, for example, original pixel or sample values.
Q And the difference that's referred to in Line 24 of Column 2 is the residual, correct?
A Yeah, the words difference and residual

here are some what interchangeable.
Q So what's being described here is that you subtract the prediction signal on the original signal and that gives you the residual, correct?
A Yes. And residual difference error is a word I've used and used in the art in my Paragraph 66.
Q And then on the decoding side you add the residual to the prediction signal to get the reconstructed original signal, correct?
A Where do you get reconstructed original signal or are you just paraphrasing?
Q I'm just paraphrasing.
Is that accurate to how you understand what's being described in Column 2?
A It's certainly a reconstructed version of the original signal, in lossy coding it's typically not the original signal.
Q Now, let's take a look at Claim 7 of -- so if you turn to the end of the '267 Patent, I just want to look at Claim 7.

A Okay.
Q What is -- do you see that there is a reference to the first prediction?
A Yes.
Q Would you agree that in Claim 7, the first prediction is not subtracted from the original signal to get the residual?
MR. VERBONCOEUR: Object to the form of the question.
A I don't see the claim excluding the first prediction being subtracted, but in the element that begins -- you said first reference block to -- sorry. Yeah, you said first reference block to obtain first prediction.
Q What about the last --
A Yeah, I'm sorry not quite finished, there's another element that says, yeah, and that first prediction, paraphrasing, is used to obtain a combined prediction, which is right shifted and a residual is determined based on the shifted combined prediction and

the block of pixels.
Q If you look at the last step, it says, the last step that begins with encode, do you see that?
A Yes.
Q In the last step the combined prediction is compared with the original block of pixels to form the residual, correct?
A You could describe it that way. It's slightly different in the way it describes it here is based on a difference between, which is consistent with, for example, subtracting the combined prediction from the block of pixels that would give you a difference between those two things.
Q So Claim 7 subtracts the combined prediction from the block of pixels to obtain the residual, correct?
A So Claim 7 is an apparatus for encoding a block of pixels and one of the elements of that claim states that residual data is determined based on, and I'll paraphrase

here, could be based on subtracted and combined prediction from a block of pixels. I mean, technically the way the claim is written it could be the other way around, it just has a difference between the two.
Q So Claim 7 requires encoding the residual data either by subtracting the combined prediction from the block of pixels or subtracting the block of pixels from the combined prediction; is that fair?
A Sorry, what does it mean for the claim to require in that context.
Q It requires like it must happen in order for the claim to be satisfied.
A Okay.
Again, my understanding of the way the claim works is that all the elements need to be satisfied to satisfy the claim. I'm not sure if that's the right terminology and there's an element of the claim here where residual data is encoded, and it's obtained or determined at least based on the

difference between two things, which are the two things we discussed. The combined prediction and the block of pixels.

Q So this last step of Claim 7 compares the combined prediction with the block of pixels to obtain the residual data, correct?

A It doesn't use the word compare.

Q Oh, okay.

This last encode step of Claim 7 calculates a difference between the combined prediction and the block of pixels to create the residual data; is that fair?

A It doesn't say calculated difference. It just stays determine something, residual data based on a difference between the combined prediction and the block of pixels.

Q In your opinion Claim 7 doesn't require calculating a difference?

A I haven't been asked to make that determination, I'm just reading out the language of the claim. I haven't actually asked what this claim element requires.

Q Are you able --
MR. VERBONCOEUR: Hang on one second.
A As I recall I haven't been asked to determine or give an opinion on that.
Q Sitting here today, are you aware of a way for Claim 7 to function if it never calculates a difference between the combined prediction and the block of pixels?
A Do you mean the apparatus doesn't calculate a difference?
Q Right.
A I haven't thought about that, I haven't been asked to think about that. Yeah, I'd want to consider that question.
Q So you would agree then that in Claim 7 the residual is based on a difference between the combined prediction and the block of pixels?
A I just see the words in the claim, the residual data is determined based on a difference between the combined prediction and the block of pixels. I would certainly

agree that those words are in the language of Claim 7.

Q If we go back to your Paragraph 66.

A Okay.

Q Do you see how you use the term "approximately represent" in that first sentence?

A Yes.

Q How close does something have to be to approximately represent another value?

A I don't think I formed an opinion on that. I think, with respect, you're taking words out of context there.

It's my understanding, prediction in this context is something that's intended to approximately represent. So predictions don't always get it right. Prediction can be really close or not so close. You can have a really bad prediction, but it's intended to approximately represent.

As I explain in the final sentence there, in this context, the efficiency of a prediction method is correlated with the extent to which it minimizes the residual value. So there's an underlying assumption in this aspect of video coding that a better prediction in one sense is one that gets closer to.

So I think if you compare two predictions, say one gets closer to the block I'm trying to predict, it minimizes the residual more than another prediction.

Q Would a value of five approximately represent a pixel value that is actually eight?

A If that value of five was developed with the intention of approximately representing that pixel block, then that's how it was developed. It was -- yeah, intended to approximately represent the pixel, that pixel value.

Q Would a value of five approximately represent a pixel value that is actually 500?

A So if I have a -- let's say -- let's say

I'm generating prediction values by a motion search, the point of that process is that the intention of each step is to try to approximate the pixel values that I'm trying to predict. Actually, it might even be part of a good prediction because in this context, I'm talking about blocks, not individual pixels.

So the question that -- the practical question for video coding is, does the prediction minimize the residual for the block of pixels. And so if five was generated in the process that is intended to approximately represent the pixel values for the block, then that's consistent with the prediction, forming a prediction in video coding.

Q Does a value of five approximately represent a pixel value that has actually 32,000?

A 32,000, how many pixels is that?

That's a lot of bit depth, possibly.

Possibly, a lot of bit depth, depending, assuming that all pixel values are possible.

Again, it could be part of a process that is intended to approximately represent the pixel values of a complete block. The block, by the way, in some video coding standards can be 128 pixels by 128 pixels.

So you can get anomalies in that block, but if the process is intending to approximately represent the pixel values of the block and to minimize residual value, that's consistent with the way we generate predictions in video coding. And I think, in my opinion, it's consistent with the way predictions used in the '267 Patent for the block.

Q So there's no line you can draw to say that a value is close enough or too far away to approximately represent a pixel value?

A Well, I can find you values or blocks that I don't think, in my view, are not predictions because they are not intended to approximately represent blocks of pixel values.

For example, if I take -- and I say this in my report, if I take the Walker reference pred0, which is a prediction, and is intended to approximately represent a pixel or a pixel in a block, if I multiply that by a factor W0, and the factor happens to be a hundred, those two things together are not intended to represent approximately or otherwise pixels of a block. So, in my view, that's not a prediction.

Q So it's based more on the intention than the actual value?

A Is it generated through a coding process that is intended to approximately represent pixel values for a block. If it is, then in this context that meets the way the prediction is used in the '267 Patent, in my opinion.

Q And whose intention would we be looking at?

A I think it's kind of clear in the context of the patent and the person of ordinary skill reads a document like this, or if they read the Walker patent and they look at pred0, which is a prediction intended to represent pixel values within a block, and they look at in Walker again the final prediction, which is a prediction intended and described as such in Walker to represent the pixel values of the block.

And then they look at some intermediate value such as (pred0)xw0, in my view, a person of ordinary skill in the art knows which of those things are intended to represent pixel values, intended to act as predictions, and which are not.

Q Does Walker's intention control whether the -- withdrawn.

Walker is the named inventor of Walker, correct?

A Okay. When I say "Walker," I'm referring to Exhibit 1004, which is a patent

application publication to two inventors, one of them is Walker.
Q Okay. Does Gordon Kent Walker's intention control whether values in the Walker patent are predictions?
A I don't even think we need to look at Gordon Kent Walker's intentions. We just need to look at the disclosure of Walker. For example -- let me see.
Yeah. Walker, Paragraph 59, final_pred equals, and then it's an equation to generate a value final pred. Final_pred, Paragraph 60, is the result in prediction which will be used in pixel reconstruction.
So it's very clear to a POSITA reading that, the final_pred is intended to predict pixel values. Whether it's -- how accurate it is, that's what it's intended to do.
The plus 1 in that equation, Walker, that's not intended to represent or describe or however you want to put it, to represent pixel values. I mean, a POSITA can work this

out pretty easy without having to know what's going on in the head of Gordon Walker.

Q And if Gordon Walker disagreed with your analysis, would that change whether predictions discussed in Walker are, in fact, predictions in the context of the '267 Patent?

A I really don't think it would. I think, from the perspective of a POSITA, POSITA doesn't need to know Gordon Walker's opinions or thoughts at a particular point in time, they just need to read the document. And equation eight is pretty clear, final_pred is a prediction. It's used -- it's set out in the document here as a prediction for pixel values. Terms of that equation are just terms of the equation.

Q What if Gordon Walker, when he was writing his patent, had in his mind, you know what, I want -- I want (pred0) times w0 to be a prediction, not a good prediction, but a prediction, would Gordon Walker's intention

mean that (pred0) times w0 is a prediction?
A I think a POSITA in the skill of the art would see that as a ridiculous suggestion, with respect. Because they would read the document -- now, this is a patent application -- patent application publication, so I guess -- I don't know.
I'm not that familiar, but I think you can always write anything you like in an application. It might not become a patent. But, to me, for example, when I read this I'm a POSITA, I was a POSITA at the time of our patent's invention, when I read this, I understand, by the context and the description, that Paragraph 74, final_ pred is intended to represent a prediction. It's an equation that represents a prediction. Paragraph 60 says, final_ pred is the result of prediction.
You can read this document and you know what's a prediction and what's not a prediction because of the context and the

description in the document.
Q So Gordon Walker's actual intention is irrelevant to our analysis because your construction depends on your interpretation of what he intended, correct?
MR. VERBONCOEUR: Object to the form of the question.
A What do you mean by my construction?
Q Your proposed -- in your view, whether a value is a prediction in the context of the '267 Patent, is governed by how you interpret the intent of the Walker patent rather than the actual intention of Gordon Walker, correct?
A No. No. I don't agree with that.
Q So the actual intention of Gordon Walker does matter for whether values in the Walker patent are predictions?
A I don't agree with that. I don't agree with that, sorry.
Q Okay. Then the actual intention of Gordon Walker does not matter for determining

whether values in the Walker patent are predictions, correct?

MR. VERBONCOEUR: Object to the form of the question.

A I have no opinion on that. I've given no opinion on that.

Q Are you taking back your earlier answer -- so you're saying you have no opinion. Are you taking back your earlier answer that the actual intention of Gordon Walker does not matter?

A With respect, it's a bizarre question. I don't recall expressing an opinion on that. If I did, I was thrown by the question. It's not a relevant question.

In my opinion, in terms of what does prediction -- how does the '267 Patent use the term "prediction." And it's important to know, and for me to talk about how, in my view, the patent uses the term "prediction," because it's at the heart of some of the disputes. And I've set that out in my

declaration.
Q So if we're trying to figure out, well, what's the intent of a particular value in Walker, wouldn't it make sense to find out what Gordon Walker intended when he wrote this document?
A Why do I need to do that? Why does a POSITA need to do that?
Q Whose intent are we looking at, then?
A Let's consider final_ pred, Equation 8, Paragraph 59, of the Walker reference. Paragraph 60 says:

"Final_ pred is the result in prediction which will be used in pixel reconstruction."

It's the value or set of values generated through a coding process, final_pred, I mean. It's intended to approximately represent the pixel values for that block. That's what that value is.

Yes. It's my way of describing it, but I think a POSITA reading what I say and reading Walker, gets what's going on. They

understand the final_pred is a prediction.
They also would understand that taking Equation A and picking out one term from that equation, such as a +1 on its own, without other information, that's not a prediction. That's not intended to represent any pixel values, that +1.
Q So whether a value as a prediction is governed by our interpretation of what was intended by the Walker document, rather than what the author of the document actually intended; is that fair?
A I'm getting confused by that question.
I think it's going way beyond what a POSITA needs to know and would understand from reading Walker or indeed from reading my declaration.
Q I see. So you're looking at -- well, what's the intention of the document, not what's the intention of the author.
Is that fair?
A I would agree that one would look at

context in the document. For example, when considering final_ pred, Equation A -- actually, a better one to consider, a more complicated equation is, final_ pred, Equation 14, at Paragraph 74 of Walker.

A POSITA reading Walker, reads the entirety of the document, they already know what final_ pred is, it's a prediction, and they know that Equation 14 in this context is intended to, is directed to, whatever terminology you want to use, forming a prediction that is going to -- is intended to be, it's going to represent pixel values for a block, it's going to be used to form a residual. That's the purpose of final_ pred in this context. Purpose, intention, that's what it's there for. That's what it does. That's a thing that it does.

Q Can you turn to Paragraph 102 of your declaration.

Are you there?

A Yes.

Q So you have this formula here. You see in parenthesis, there's something on the left side, five times (pred0) plus 11 times (pred1), plus eight, correct?
A Okay. I see the pieces of an equation.
Q Okay. And those pieces of an equation are in between parenthesis, correct?
A Yes.
Q Okay. And then, the portion of the equation in between parenthesis is then, right shifted by four to result in 118; is that correct?
A Yes.
Q Before right-shifting, the value on the left side of the equation is 1881; is that correct?
A I'm willing to take that representation or I can sit and work it out.
Q I think down below, or in the hypothetical -- or, no, right above it, it says, the current pixel value is 120. So that is the actual pixel value that we are

working with in Paragraph 102, correct?
A In this example, yes.
Q Can a value of 1881 approximately represent 120?
A What's the 120 in that example? What does 120 represent in that example?
Q I'm talking about your example in Paragraph 102. In your Paragraph 102, can a value of 1881 approximately represent 120?
A That's not in my example. So tell me what the example is.
Q Yeah. I'm asking whether, in your example in Paragraph 102, can the value that's in between parenthesis be a prediction for the current pixel value?
A What's the current pixel value?
Q So you need to know what the current pixel value is in order to answer the question?
A No. I'm just asking you to clarify your question, because you're asking me about the example of 102, but you're, I think, giving

me a different example.
Q No. I'm just asking about Paragraph 102. Does your Paragraph 102 have a current pixel value?
A Yes. I talk about a current pixel value of 120.
Q All right. So I'm asking you about this example in Paragraph 102, right.
A Okay. Go ahead. Ask away.
Q All right. So in this example that you provided in Paragraph 102, can the value that's in between parentheses on the left side of the right shift in your equation, can that value be a prediction for the current pixel value?
A That's not my example. You just created a new example.
Q So you don't know whether the portion of your equation that's in between parentheses in Paragraph 102, whether that portion on the left side of the right shift operation, you don't have an opinion about whether that can

be a prediction for the current pixel value?
A That's a different question. Which question do you want me to answer?
Q The question that I just asked you.
A Okay.
Yeah, you've taken me out of the scenario that's here in the question, so I don't quite understand the question.
Q Well, I'm asking -- okay. So do you think the value -- in your example in Paragraph 102 do you think the value 118 is a prediction for the current pixel value?
A It is a prediction for the current pixel value in this context, specifically taken from at least a -- sorry. Let me start over again.
It's represent -- it's my representation of Walker's combined prediction in slightly simplified terminology. It's described in Walker as final underscore prediction. It's intended to be a prediction. It's designed to be a prediction, if you'd like. And

that's what Walker says you do. And in fact, that's an equation that's based on the H.264 Standard, as I recall, a part of the standard that's creating a prediction.
Q Okay. So then in your Paragraph 102 example -- I'm just asking about this particular example, right, the value from 5 times (pred0) plus 11 times (pred1) plus 8, that value is also a prediction for the current pixel value, correct?
A It's not Walker's combined prediction value in this equation.
Q I'm not talking about -- I'm just asking about this example in Paragraph 102, okay?
(Crosstalk.)
A -- you are not. You are taking my example; you are changing it to something else and then asking me about that other thing.
Q I'm not changing anything. I'm asking -- you understand that I'm asking you about the portion that you've written down in

parentheses? I didn't change that at all. I'm just asking about this portion between parentheses.
Do you understand that?
A I'm not trying to be argumentative, but how does removing a right shift mean -- equate to not changing?
Q Okay.
A How does that equate to not changing? That's what I don't understand.
Q Let me ask you this then: This equation you have in Paragraph 102, you'd agree it is definitely a prediction after you perform the right shift and you get the result of 118, correct?
A The equation is a prediction.
Q Okay. Before you get the right shift, right, before you do the right shift, is this value that's on the left also a prediction?
A Of what?
Q The current pixel value.
A Which current pixel value?

Q The one you have in example -- in Paragraph 102, the current pixel value of 120.
A Okay. You're asking me to consider a new example where I or somebody creates something that's called a prediction, it's the same equation without the right shift by four --
Q No.
A -- and that --
Q No --
A Sorry. That equation is applied to a pixel value of 120.
Q That is not my question.
A What is your question?
Q I didn't say "new equation." I'm just asking about this exact equation in this exact example that you have in Paragraph 102.
So you keep asking, like, "What's the current pixel value?" I mean, it's right here in Paragraph 102. You understand that it says it in your own declaration, right,

current pixel value is 120? Do you see that?
A I see that.
Q Okay. So in this example of Paragraph 102, I'm not changing this equation, I'm asking -- do you see how there's an equation written in Paragraph 102?
A Yes. I wrote it.
Q Okay. Do you agree that this equation would be calculated by doing the operation 5 times (pred0) plus 11 times pred1 plus 8, and then after you have made that calculation, you right shift the whole thing by four bits, and you get the result of 118; is that correct?
A That's broadly correct.
Q Okay. So while you're doing this calculation that you've written out, when you do the calculation on the left side of the right shift, 5 times pred0 plus 11 times pred1 plus 8, at that point -- I'm about to do the right shift, but I haven't done it yet -- is the thing on the left a prediction?

A It's a new equation. You've now -- we are in a different head space here. You're saying it's not a new equation. It's a new equation.
Q Now, I'm about to do the right shift, but I haven't done it yet, so I'm just acting like this intermediate value that I've created by -- before I do the right shift by four bits, is that value a prediction?
MR. VERBONCOEUR: I'll object to the form of the question.
A So you've created a new equation. Is that equation created in the context of an intention to approximately represent the pixel value of 120?
Q I have not created a new equation. Do you understand I'm following the equation?
A No. I do not understand, and I do not agree that you have not created a new equation.
Q Is your equation in Paragraph 102, the right shift operation happens last, correct?

A Says who?
Q Oh. Okay. In your view, the right shift operations cannot be done last in this equation?
A I didn't express that view.
Q Okay.
A I didn't express any order of steps in this. I'm just providing an equation as I'm -- in this, as a mathematical equation. It's an equation.
Q Right.
A It's a unit. I mean, actually, this is really similar to something that I talk about at length in my report. That if we take Equation 14 and take out of Walker and take one term (pred0) times w0 out, that's not the same equation. It's a term. You've just taken a term of the equation out, and you keep saying it's the same equation.
Q Right. You agreed earlier -- so let's just make sure we're all clear -- I can perform this equation from Paragraph 102 by

doing the following calculations in sequence 5 plus pred0 -- sorry. Let me restart. 5 times (pred0) plus the result of 11 times (pred1) plus 8. And after I have an intermediate value that's -- that reflects that calculation, I can take the whole thing and right shift it by four bits to get 118; is that accurate?

MR. VERBONCOEUR: I'll object to the form of the question.

A One can calculate 5 times (pred0), add it to 11 times (pred1), add 8 and take the result of that, right shift by 4, and one gets to 118.

Q Okay. And during that calculation, you agree that there's a point where we have run the calculation, and we're right about to do the right shift by four bits; is that correct?

A One could calculate it that way.

Q Okay. And at that point right before one has -- is about to do the right shift, is

the value that has been calculated a prediction of the current pixel value 120?
A Not according to Walker. Walker says that it's the entire equation. Walker says that final_pred, Equation 14 is the whole thing.
Q Okay. So then the value before conducting a left shift in this equation -- or sorry. A right shift -- let me rephrase.
The value before conducting a right shift in your equation in Paragraph 102 would not be a prediction as "prediction" is used by the '267 Patent?
MR. VERBONCOEUR: Object to the form of the question.
A It's not Walker's prediction. It's not Walker's prediction. I'm talking about Walker's prediction.
Q So I'm going to give you --
A You can point me --
MR. VERBONCOEUR: Hold on.
A Yeah. Sorry. Go ahead.

MR. VERBONCOEUR: No. I'm letting you finish.

A All right. You can point to me something else, but this is Walker's combined prediction. I don't know how many times I need to say that same thing. It's Walker's combined prediction.

Q So I'm going to give you one opportunity to provide an answer to the board to this question: In your equation that you have in Paragraph 102 of your declaration, is the value between parentheses, which is 5 times (pred0) plus 11 times (pred1) plus 8, is that value in your example a prediction as that term is used by the '267 Patent?

A I do not know the context anymore. It's not Walker's prediction anymore. I don't know what the context that you're applying -- or asking me to apply that parenthetical to. I do not know what that context is. It could be some other context in video coding, you know, hypothetically where it's used to predict something in a different way. But it's not Walker's prediction.

Q So you're unwilling to exclude the fact that the value in parentheses could in fact be a prediction under the '267 Patent?

MR. VERBONCOEUR: Object to the form of the question.

A I didn't say anything about being willing or unwilling to include or exclude. I'm just explaining what I'm saying in Paragraph 102. It has a context. It's my -- an illustration of Walker's combined prediction.

MR. VERBONCOEUR: Jeff, when you reach a good breaking point, I think we've been going about an hour 15 minutes. Just let us know.

MR. LIANG: All right. We'll stop.

(Whereupon, a recess was taken from 2:56 PM until 3:13 PM.)

Q So how do you determine how many bits are needed to represent a number?

A So generally, in this field, the number of bits needed to represent a number -- or in this context, the number of bits needed to represent a variable, for example, depends on the number of values that variable can take.
Q And how many bits do you need to represent the number 1,000?
A So to answer that question, I need to -- assuming that's it a value of a variable, I need to know how many possible values that variable has.
Q How many bits do you need to represent the number 9,288?
A Again, if it's a -- assuming that it's a variable, I need to know what are the possibilities. How many -- what's the range of possible values that number has -- that variable has, sorry.
Q So you wouldn't be able to tell, just based on the value alone, how many bits are needed to represent 9,288?
A So particularly in the context of the

'267 Patent, you know, I've stated in my Paragraph 68, the number of the bits needed to represent possible values, I think that's critical to our discussions about prediction -- precision -- sorry. Our dispute, discussions about precision.

So possible values would be, like I just said, the number you've given, assuming it's the value of a variable, what are the possible values that variable can take? Does it have four possible values? Does it have 16? Does it have 1,024 possible values?

Q How many bits do you need to represent the number 9,312?

A And same answer.

Q Would it be fair to say that the values 9,288 and 9,312 require 14 bits and, therefore, have a higher precision than a 10-bit number?

A I think I'm missing information to answer that question. So again, assuming that we're talking about a variable -- in fact, I gave an example in Paragraph 172 of my second declaration.

If we had a variable that could only take one of those two values that you suggested, I could actually represent it using a single bit. My example was a variable that can take a value of 0 or a variable that can take a value of a million. I can represent that number of bits needed to represent that variable as 1.

Q Would you disagree with an analysis that, okay, 2 to the 13 equals 8,192 and 2 to the 14 is 16,384 so, therefore, in order to represent the value of 9,288, since it falls between those ranges, I need 14 bits?

A And again, you're making, I think, assumptions there. You're assuming -- I think there's a tacit assumption that this is a variable that can take all the other values in that range. I think that seems to be an assumption in your question.

As I explained in Paragraph 72, if your

variable can only take two values, you'll need a single bit to represent it. All of my discussion in these paragraphs relates to precision, which is, I think, an important matter for the board to understand.

Q So in your view, it would be incorrect to just look at the values, in this case, let's say, 9,288 and 9,312, figure out, okay, you know, because 2 to the 13 is 8,192 and 2 to the 14 is 16,384, I'm going to conclude, because it falls in that range, I need 14 bits and, therefore, these values have higher precision than a 10-bit number?

MR. VERBONCOEUR: Object to the scope and form and characterization.

A Yeah, I think you've made a lot of assumption or there's a lot of gaps in that question. I can turn it around and let's say you're a POSITA and I'm your supervisor and I say, right, I want you to design a circuit to store either 9328 or whatever the number is or 9713 and you infer from that that you need

14 bits precision and I give the same problem to somebody else and say I can do that with a single bit value of 0 represents the first number, value of one represents the second number. So the second solution is certainly more elegant and in my scenario where a variable can only take those two values it can be represented with a single bit as I explain in my Paragraph 72.

Q   Let's assume I was conducting a test and I have some testing equipment that demonstrated that a product contained prediction from reference blocks and that those predictions exceed the range of a ten bit number and therefore required 14 bits to represent, so those values include the numbers 9288 and 9312.

     Would it be erroneous to conclude that the 14 bit values have higher precision than 10 bit values.

     MR. VERBONCOEUR: I will object to the scope and the form of the question and

characterization.
A So in the context of this patent, you're still giving me an example that actually fits with my example of, I believe of Paragraph 72. If your apparatus can only give those two numbers as an output, that I only need one bit to represent those predictions.
Q So then it would be erroneous to conclude that you need 14 bits to represent those values 9312 and 9288?
MR. VERBONCOEUR: Same objections.
A If your hypothetical apparatus output, if we consider that as a variable and if that variable can only take two values, I only need one bit to represent that variable.
Q So to figure out the number of bits needed you have to go back and see, okay, for this particular calculation here are all the possible resulting values and I'm going to figure out the minimum number of bits in some kind of a scheme to represent them?

MR. VERBONCOEUR: Object to the form of the question.

A We're talking about, I believe, the '267 Patent and we're talking about, as I understand it, the precision in the context of the '267 Patent. The '267 Patent is -- relates to video coding, relates to predictions, it relates to systems where variables at each stage in the system the number of possibilities are known.

Q In your opinion, when two numbers with -- withdrawn.

In your opinion, when two variables have the same number of possible values, those two variables always have the same precision, correct?

A If I consider a first variable and I consider the definition -- that I understand the petitioner, the patent owner, Dr. Freedman and myself all agree that the definition of precision is that a number of bits needed to represent possible values,

then, yeah, if two variables each have the same number of possible values the number of bits needed to represent those two variables is going to be the same.
Q If you have two rulers --
A Sure.
Q The first ruler can measure 10 possible lengths one centimeter, two centimeters, three, four and so on up to 10 centimeters. You follow me so far?
A Sure.
Q Your second ruler can also measure 10 possible lengths except they are one millimeter, two millimeters, three millimeters and so on up to 10 millimeters, do these two rulers have the same precision?
A So in the context of the '267 Patent precision relates to a number of bits; so where are the bits in this example? What are the bits, do they encode? Are the bits used to store, transmit whatever those

measurements.
Q Okay. So in your view a ruler analogy has no relevance in the '267 Patent because that's talking about distances and things and not about bits, like we're dealing with in the '267 Patent?
MR. VERBONCOEUR: Object to the form of the question.
A Yeah, so I didn't say that. I didn't say it has no relevance, I just asked for clarification.
Q Okay. So let me ask again.
If you have the first ruler that's 10 possible lengths one centimeter through 10 centimeters, your second ruler has 10 possible lengths one millimeter through 10 millimeters, do the rulers have the same precision?
A So the precision relates to possible values in the context of the '267 Patent, what's the number of bits needed to represent possible values. All the parties as I

understand it, agree on that definition, Paragraph 68 of my second declaration.

So in your analogy if we want to represent the possible values from ruler one or represent the possible values from ruler two, in each case we're gonna need, let's say four bits for the sake of convenience.

Let's say we had 16 possible values on each, one to 16 centimeters on the first ruler, one to 16 millimeters on the second ruler and we want to represent a value measured by ruler one, a value measured by ruler two and then without other constraints we would use four bits for each. They would have the same precision in terms of number of bits, which is the same precision as it's used in the '267 Patent.

If I could just add to that very close analogy to my example of Paragraph 69 of my report, where I compare P in my diagram, which has 10 possible values and Px4 which also has 10 possible values and in my view in the context of the '267 Patent, P and Px4 can be represented with the same precision.

Q If I understand you correctly, then, in my example of two rulers, one that measures in centimeters, one to 10 centimeters and the other one that measures in millimeters, one to 10 millimeters, those two rulers have the same precision?

A The values, so the ruler is just a piece of wood or metal or plastic. Just a piece of wood or metal or plastic, but we use a ruler to measure things, I think you said assuming we're using the rulers to the measure things, if I tell somebody use the first ruler and take a series of measurements, they're going to measure something in millimeters. And the measurement could have 10 possible values, maybe it's 11 if you go from zero to 10, I'm not sure. If I tell somebody else to use the second ruler to measure, make a series of measurements, the measurements are also going to have 10 or 11 possible values. The number of possible value in each case is the same, so if we want to represent the measurements in bits we need the same number of bits. We could use more, but we need the same number of bits.

It's very analogous to my Page 31 example in my second declaration, in fact, you can say that P can be your millimeter ruler and Px4 can be getting close to a centimeter ruler. But there's still only 10 possible measurements that each ruler can provide.

So the precision of the ruler I think in terms of the '267 Patent is how many possible measurement values does that ruler produce.

Q Now, let's look at the example that you've been referring to. I believe it's on Page 31 of Exhibit 2015; is that correct?

A Yes. That's what I'm looking at.

Q Okay. So on the left here of your example on Page 31, you have a variable with P with possible value 0 through nine?

A Yes. Integer value 0 to nine.
Q So in the Px4 here you still, in your view, there are still 10 possible values; is that accurate?
A Not in my view, there are. You can't argue with that, sorry, there are still 10 possible values.
Q Okay. And so --
A And so just to clarify my previous answer. I'm not disagreeing with you, I'm saying this is not just my view, this is very basic arithmetic.
Q So therefore in Paragraph 70, you're explaining how you can use four bits to represent Px4 rather than six bits from just a conventional binary representation; is that right?
A I don't talk about four bits or six bits or conventional binary representation, none of that's in this paragraph.
Q Well, how many bits do you need to represent PX4?

A In terms of information content it's somewhere between three and four, but in terms of whole numbers of bits, you need four bits.
Q How many bits do you need to represent Q?
A More than that. Again, speaking in whole bits you would need six bits. The reason I say that is that with five bits I could represent a number in the range number 0 to 31, with six bits I could represent a number in the range 0 to 63, Q in my example is in the range 0 to 36. If I want to use whole bits then six bits would suffice.
Q So it is possible to use six bits to represent the range of possible values in Px4?
A That is not the number of bits needed, that is more than the number of bits need.
Q It is possible to use six bits to represent the range, correct?
A Yeah, if I need for example four bits to

represent a number. I can represent it with five bits or 100 bits, but I only need four bits.

Q So by knowing the number of actual possible values, you've compressed the number of bits you need from instead of using six bits to use four bits in this example?

MR. VERBONCOEUR: I'll object to the form of the question.

A I would not characterize it that way.

Q So you're not using -- you're not going from six bits to four?

MR. VERBONCOEUR: Same objection.

A Going from where to where, sorry.

Q Well, from Q, right, you have six bits for Q, but instead because you know how many values you have for Px4, you're going to use four bits instead?

A I need six bits to represent Q, if I'm using whole number of bits, I need four bits to represent Px4.

Q In your example here in this Px4 example in the middle column, your first bit -- let's say you have a value, right, you talk about four bits, you have a value of 01, in your scheme for Px4, what is the decimal value for 01?

MR. VERBONCOEUR: Objection. Form.

A I don't understand the question.

Q Okay. So we talked before about using four bits for Px4, correct?

A Yeah.

Q So let's say those four bits are 0001.

A Okay.

Q What would that mean in decimal?

A So you're confusing a few things here. So how many bits do I need to represent Px4? I could chose for example to assign the bit pattern 0000 to represent the value of 0.

I could chose to use the bit pattern 0001 to represent the value of four and so on up to the bit pattern, yeah, whatever, yeah, whatever the bit pattern, 1010, I think, to represent 36. If I make those choices then

0001 represents the value four.
Q In your view, other choices could be made so in anything that maps these 10 values in Px4 to the four bits that you've allocated to it, correct?
A I'll give you another example. If I'm working with H.264 and I want to represent a motion vector of plus 0.25, I would represent -- or a difference, a motion vector difference of 0.25, I could represent that for H.264, I think tells me to represent that with a bit ends in a single one, a lot of 0s ending in a one.

If I were to represent -- sorry, I'm just creating a really bad example, I'll just drop that.

I think what I was trying to get at is that the steps between possible motion vector values is each one-quarter and each one is represented by a unique bit pattern. But that's a bad example because the representation is also variable length coded which adds confusion.

Q For your example in Px4. Let me back up for one moment -- strike that.

What is variable length coding?

A Okay. I introduced it. That's something that is -- it's a type of entropy coding, we talked briefly about entropy coding earlier.

Q For this example, in Px4, you know what you said before the value four could be represented by 0001 --

A Yes.

Q But it could also be other values as well?

A Yeah, for example, if we're using four bits to represent Px4, then I can assign 1110 to represent four, that's also available to me.

Q Is there any limitation in terms of what numbers you can use to represent four in this Px4 example?

A Well, going back to the number of possible values, what is the number of bits needed to represent the possible values, so. If I'm using whole values then, I'm -- in our example, we're using four bits, what the mapping is doesn't really affect what the mapping from four bit value to a value of Px4 or vice versa, doesn't really affect the precision as that term is used as we all I think agree is used in the '267 Patent.
Q So in your view -- in your example here, on Page 31, Px4 could be represented in those four bits followed with the mapping where one, 0001 is four. 0010 is eight. 0011 is 12 and so on?
A Um-hmm.
Q Is that a yes?
A Yes, yes you could rep -- yes.
Q But alternatively, you -- it's your view that you can map the 10 values, the 10 possible values of Px4, to the four bits that you're using any way that you would like?

A If the question is how many bits do you need to represent the range of values, the answer is still four regardless of, you know, we use, for example, different encoding different representation schemes for positive and negative numbers and two's compliment. I think Dr. Freedman talks about and there's alternative ways of representing negative numbers. You can represent negative numbers as two compliment number or as an unsigned number with a separate sign bit. You end up with the same number of bits, you know, if you have the same number of possible values.
Q So in the example on Page 31, what if instead of multiplying by four, I multiplied by five?
A Okay.
Q Then how many bits would I need to represent the final result?
A So, once again, assuming that every time we consider a value of -- every time a value of -- let's say it's a, for the sake of

argument, P sits in a register somewhere, and I've got a process and I generate Px5, and I know that I'm always multiplying by a constant value of five, regardless of the value of P, then I still have ten possible values of Px5.

So I can still represent those ten values in the new part of my process, whatever it is, this new system, using the same number of bits, four bits. Or if I have -- or if you go -- if you start with the one millimeter ruler with 10 one millimeter placings, and then go to a ruler with ten, two centimeter placings, that still only can measure ten possible values. I still require the same number of bits. The number of bits needed does not change.

Q In your example here, you multiply P by a constant value four, correct?

A Yes.

Q What happens instead if you multiply P by a two bit variable? You don't know what the variable is, it could be anything, zero, one, two or three.

A Okay.

Q Then, how many -- what would be the number of possible values that result?

A So if P is a value that can take 10 -- is a variable that can take 10 possible values, let's call it Q, is a variable that can take four possible values, and you're asking me how many bits required to represent P times Q; is that right?

Q Yes.

A Okay. So P times Q could take 40 possible values. So using whole numbers or bits, we're up to six bits.

But now we're not -- the question is not how many bits does P require, the question is how many bits does this new variable, P times Q require, and it now has a greater number of possible values.

Q So when you multiply the variable P by a constant, that never changes the number of

possible values of P, fair?
A Yes.
Q But if you multiply P by a variable, then that can change the number of possible values for the result?
A P from the start up was a variable. Multiplying a variable by another variable gives us a third variable. So the question is, how many possible values can -- it's the same question. How many possible values can our variable take, whether that variable was P, whether it's (pred0), whether it's PQ or something else.
Q You'd agree that multiplying a variable that can take the full range of its possible values, by another variable that can take it's range of possible values, increases the number of possible values for the resulting product?
A Assuming those two variables that you started with are independent of each other, I think could, would, it depends on the range

of the second one, but it could increase the number of possible values.
Q So if we have an example where P -- let's give it a different number. Let's say we have an example where the variable X ranges from 0 to 3. Follow me?
A Yeah. Sure.
Q How many possible values does it have?
A If they're integers, then it's four.
Q So if we multiply our variable X by four, how many possible values does it have?
A Assuming that X is a variable and four is a constant, then it still has four possible values.
Q And just for the transcript to be clear, let's assume that I'm talking about uppercase X for this variable. Okay? All right.
A Yes, sure.
Q So if I want to take my variable of X times four, and I want to add that to the variable Px4 that you've described here in Page 31 of your declaration, how do I do

that?
A You just add them.
Q Okay. So, for example, your value of four in Px4, right, your example, that would be 0001, correct?
A Hang on. Hang on. Maybe the choice isn't correct.
What are you talking about? Are you talking about the constant of four that I multiply P by or the result of that as being equal four?
Q Okay. So let's -- yes, let's use --
A If P equals one and constant is four, then Px4 is four. Is that what you mean?
Q Right. So let's go back to the X example. Right. We've got X times four. We started out with 0 to 3, we multiplied that by four, so the resulting possible values would be 4, 8, 12 and 0?
A 0, 4, 8, 12, yes, okay.
Q So 0, 4, 8, 12. So then in our X times four example, the value of say 0001 would be

four. The value of -- well, withdrawn.
Let me ask you another example. Let's say a length is expressed as 150 centimeters. All right. Would you agree that 150 centimeters could be alternatively expressed as 15 centimeters?
A For length, no.
Q Why not?
A 150 centimeters has -- the centimeter is defined -- is it the French who defined it first? I think they did. I think they defined a centimeter as a particular length. A centimeter is a centimeter. It's -- like a centimeter is a constant.
Q Okay. Let me ask this question again.
150 millimeters could alternatively be expressed as 15 centimeters, correct?
A Yes.
Q So if you read a measurement and it says 150 millimeters, would you take that to mean that the measured length is somewhere between 149.5 to 150.4 millimeters?

MR. VERBONCOEUR: Object to the form
of the question.
A Logically, 150 is between -- did you say
145 and 154? So 150 is between those two
numbers.
Q Right. So when you look at -- if you
see that there's a measurement, right, a
reported measurement, and this is
150 millimeters.
A Um-hmm.
Q Remember in school we were taught, okay,
you have this measurement, it's like 150, it
may not be exactly, it might actually be
149.99, but because we -- if we are only
going with integers, it gets rounded, so it's
150 centimeters.
Do you recall -- so with that
understanding, when you see a measurement is
150 millimeters, would it be reasonable to
think, okay, this measurement is somewhere
between 149.5 to 150.4?
A 150 is somewhere between 149.5 and

150.4. That's a logical proposition I agree with.

Q When you see a measurement of 15 centimeters, would it be reasonable to conclude that the measured length is somewhere between 140 -- withdrawn.

When you read a measurement of 15 centimeters, would it logical and reasonable to conclude that the measured length is somewhere between 14.5 to 15.4 centimeters?

A The number 15 is between -- exists between 14.5 and 15.4.

Q Right. So if the measurement says 15, you'd conclude, well, that measurement is going to fall somewhere in that range of 14.5 to 15.4 centimeters, correct?

A I would say the measurement -- a measurement of 15 is in the range, exists in the range 14.5 to 15.4. It's a specific point.

Q So if you read a measurement and it says 15.0 centimeters.

A Okay.
Q That the extra .0 tells us that a measured value is not, for example, 15.1, correct?
A But I already knew that with your previous example. I didn't need any information to tell me. I already knew that 15 is 15.
Q What if a measurement reports 15.0, the reason that has the extra .0 is to let you know that, in fact, hey, we did measure that with.1 level, right, and it came out as 0. Is that a notation that you're familiar with?
A I think you're inferring way too much without some other kind of information about accuracy bounds or what is doing the measuring. You are asking me whether 15 is between 14.5 and 15.4. It is.
It's also between 14.1 and 15.0. It's also between 14.9999 and 15.0001. 15 is between those two things.
Q Have you ever seen a measurement result

that ends in .0?
A Sure. I have -- pretty sure that my kitchen scales give me a .0, if not my bathroom scales. Actually, I just bought some new bathroom scales, the old ones went to .0, went to -- sorry, one decimal point, the new ones go to two decimal points.
Q Have you ever gone to IKEA?
A The old ones came from IKEA.
Q If you go and you look and you say, hey, this table, and there's a table and it says, this thing is like 15.0 meters long, it's a really long table. Okay?
A Yeah.
Q In your view, it would be entirely redundant to have a .0 at the end, it shouldn't just say 15 meters, correct?
MR. VERBONCOEUR: Object to the form of the question.
A No. No, it's -- I can express 15 meters in a lot of different ways. It's not redundant. It's just how somebody choses to

label it. If it's 50 meters, it's 50 meters.
Q So why would IKEA ever tell you that a table is like 2.0 meters as opposed to just saying 2 meters? Is that even a possible thing?
A I have no idea. Yeah. We get the measurements -- yeah, I --
Q So you've never seen a time when somebody tells you -- you've never seen an example where something reports a measurement of, say, 2.0 to let you know that, in fact, that extra tenth was measured and it came out as zero, you've never seen that notation before?
A I don't know what you're asking me to assume, to be honest. Two is two. Whether I express it as 2.0 or 10 divided by five, it's still two.
Q So you never had in a science class where you were told, hey, you know what, you should use your -- the number of -- the number of digits that's appropriate to show

the precision of your measurement?

A   Okay. What are we talking about now? This is different.

Q   I'm just talking about science class.

You never heard of this idea that you should use significant digits to represent the precision of your measurements?

A   I've used -- yeah. I've used different numbers of significant digits in my education and career. If that's what you're asking me.

Q   Why do you use different number of significant digits?

A   Can we go to a specific example. This is like a little bit vague.

I mean, maybe we can talk about my Paragraph 78, if you want to talk about that, significant digits.

Q   Would you agree the number two and 2.0 are different because the number two only has one significant digit and the number 2.0 has two significant digits?

A   The representation of the quantity two

is -- you're representing it in two different ways, but it's still the quantity two.
Q But you agree that there is a difference in that the number two has a single significant digit, but the number 2.0 has two significant digits, correct?
A So I could express the number 2.0 as 2.0 or I could express it as two. It's still the number 2.0.
Q It's the same thing in your mind?
A The number hasn't changed. The number hasn't changed. The representation has changed, if that's what you're asking. I think that's what you're talking about.
Conversely, as I say in Paragraph 78 of my declaration, the value 8582.2 could be expressed with less precision, but 8582.2 is not the same number as 8582. There's kind of a counter example to the one, it's not quite what you're asking me.
Q So if you're reading a scientific paper --

A Yes.
Q -- and it reports a measured value of 2 meters, in your view, is that exactly the same as if it had reported a measured value of 2.5 meters?
A No. Of course not.
Q Why not?
A One is two, one is 2.5.
Q If you had read a scientific paper and it reported a measured value of 2 meters, would that be exactly the same as if it had reported a measured value of 2.0 meters?
A The value itself is two in each case. The way it's being represented is different. It might tell me something about the measurement, it might simply be a choice of a person writing the number.
Q So if you see that the reported value is 2.0, would you think that maybe the actual value still might be 2.1?
A If the reported value is 2.0, then it's not 2.1.

Q But if you see in a paper a reported value of 2 meters, is it possible that the actual value might be 2.1 meters?
A Well, 2 and 2.1 are not the same number. If it's a measurement of something, then 2.1 measured to the nearest meter is two, for example.
Q And if you see a measurement in a paper and it reports 15 centimeters, then all you know is that they measured 15 centimeters, you don't know if the actual value might be say 15.1, correct?
A Well, if it's a measurement of 15 centimeters, it's a measurement of 15 centimeters.
If it's in a paper and it's describing measuring an IKEA table with a ruler, I don't know how they did it unless they describe how they did it and explain the accuracy of their process.
Q In a scientific paper, if you see a measurement that reports 15 centimeters, that

tells you that they at least measured down to the closest centimeter; is that fair?

MR. VERBONCOEUR: Object to the form of the question.

A They measured down to the closest centimeter. Well --

Q Let me rephrase the question.

A Could have been nearest five centimeters, context matters.

Q Um-hmm. So in a paper, if you see a measured value of 15 centimeters, that paper is telling you a measurement -- withdrawn. Let me rephrase.

You're reading a scientific paper and it reports a measurement value of 12 centimeters, then the reasonable inference is that it is reporting a value to the closest centimeter, correct?

A I could turn it around and say, if it was a table of values and every value is an even number, then I might wonder if they measured to the nearest two centimeters.

Q Okay. And if you see in a paper that a measured value was reported as 12.0 centimeters, would it be reasonable to conclude that the paper is reporting a value down to the nearest tenth of a centimeter?
A Not if, for example, it was sitting in a table of values which included 11.0, 15.0, 19.0, but never included anything that didn't end in a .0. Context matters, I think, in this type of question.
Q So in that table, you wouldn't -- your conclusion would be, hey, everything ends in zero, they're just rounding to the nearest centimeter, your conclusion wouldn't be, hey, they're reporting a .0 because they want to tell us that they measured that extra tenth of a centimeter?
A To be honest, if it's a well written paper, I should know without having to make those guesses.
Q Looking at this example here in your, you know, on Page 31. We talked before that

Px4 needs four bits to -- be to represent it, correct?
A In this scenario, yes, with P as a variable, four as a constant, yes.
Q If you left shift Px4 in your example on Page 31, does this increase the number of possible values?
A Do you mean the binary representation that -- such as the one we discussed earlier?
Q Correct. The four bits, you take the four bits that you used, right --
A Okay.
Q -- for the Px4, and you left shift it, does that increase the number of possible values?
A Without doing anything else? No, it doesn't.
Q So let me ask you a question about -- let me ask you a question about Walker. So if you could turn to Walker, please.
A I'm on it, yeah.
Q Okay. And if you look at Table 2.

A Yeah. Sure.
Q Okay. You see in the first row (pred0)w0, Walker uses 16 bits, correct?
A In the --
Q Table 2.
A Yeah. In Table 2 of Walker, Walker chooses to use 16 bits at this point.
Q Okay. So the -- for the variable (pred0)w0, Walker uses bit depth of 16 bits, correct?
A Walker chooses to use -- yeah, for the -- call it variable or term -- (pred0)w0, yes.
Q So the result of the values of (pred0)w0 are 16-bit numbers, correct?
A Sorry. Say that again.
Q In Walker Table 2, the value of the variable (pred0)w0 are 16 bits, correct?
A The term (pred0)w0 is stored or represented using 16 bits at this point in Walker's Table 2.
Q Why does Walker use 16 bits instead of 8

bits?

A So w0, when we're predicting a block in H.264, w0 -- when we're predicting -- w0 is constant for the slice, as I recall. So slice is a set of macroblocks. So when we're predicting a block in H.264, w0 doesn't change. It's constant for the block; it's constant for the slice.

I have to speculate as to why Walker chose these numbers. I would speculate that Walker is considering, "Well, I'll use the same circuit for the next slice," which can have a different constant w0. So it's kind of analogous to -- you asked me earlier, you know, I gave the example Px4 where 4 was constant. Does Px4 have 10 possible values? Yes. Does Px5 have 10 possible values? Yes, but I'm now using a different constant.

So Walker -- and I explained this in around Paragraphs 105 to 106. Walker is choosing, I think, to use more bits than are needed to represent (pred0)w0, which is perfectly okay to do. If we need eight bits to represent (pred0)w0 in an implementation, I might chose to use or register more bits than that. For example, I can use the same pair of registers or the same circuitry when I decode a different slice that's got a different constant.

Q I want you to look at Walker Figure 5.
Do you see Walker Figure 5?

A Yes.

Q What are the boxes with numbers 520 and 580?

A So Walker describes Figure 5 starting at Paragraph 34 of Walker. The box 520 is a best-matching macroblock, and the box 580 is another best matching macroblock. So 510 is -- sorry. I'm just thinking aloud here. Previous reference picture 575 is a subsequent reference picture, so each of these is a best-matching macroblock, according to Walker, in two separate reference pictures.

Q What is a macroblock?
A Macroblock -- H.264 defines a macroblock. I don't have the standard in front of me. But my recollection is that it is a 16-by-16 region of luma pics -- luma samples along with -- for color source material along with a region of chroma samples, blue chroma samples and red chroma samples. And those regions, in many implementations, 8-by-8 samples.
So macroblock, one way of looking at it in H.264 -- this is my high-level explanation, not the way the standard defines it -- is it's the data that comprises a 16-by-16 region in a frame or video.
Now, I think -- I might be stepping a little bit out of the box here, but I think Walker here is using the term "macroblock" slightly loosely or it's slightly different way from H.264.
In H.264 a macroblock is always aligned to a 16-by-16 pixel grid, as I recall.

Whereas if you look at Figure 5 of Walker, the positions of these best-matching regions are not necessarily aligned to the 16-by-16 grid. So personally my opinion is that in H.264 terminology, it might be more accurate to say these are 16-by-16 matching regions.

That's a long answer, but I wanted to try and be precise. If I wanted to be more precise, I would take you through the standard just to back up what I just said.

Q So in H.264 a macroblock is a 16-by-16 group of pixels that is a line on 16-pixel boundaries?

A If you like, it's the data representing the -- that would ultimately be displayed as 16-by-16 groups of pixels. And I'm working from memory here. I don't have the standard in front of me. But that, as I recall, is the way the H.264 Standard uses the term "macroblock."

Q And you think -- and so Walker is just using the term a little more loosely just to refer to a group of 16-by-16 pixels, not necessarily aligned on those 16-pixel boundaries, right?

A Well, so in the description of Figure 5, Walker Paragraph 34, there's a description of a current picture 505 made up of 5-times-5 macroblocks, and you can see a grid there. And walker describes these as macroblocks. And that would be broadly consistent with the way H.264 uses the term "macroblock." And then Walker also describes the boxes you asked me about, 520 and 580, as best-matching macroblocks.

Personally, if I was describing or summarizing or trying to explain the operation of an H.264 process, compatible or compliant with H.264, I would probably call these "regions" rather than "macroblocks." But they're 16-by-16 regions.

Q Are there half pixels in Walker -- if you turn to Walker Figure 9, please.

A Sure.

Q You see Figure 9?
A Yes.
Q Does Walker Figure 9 show half pixels?
A So Walker Figure 9 is described in Walker at Paragraph 114. And it says, Figure 9 is an illustration of an example of half-pixel interpolation for use in motion compensation. Integer pixels are depicted as circles labeled as uppercase letters -- I'm paraphrasing -- the interpolated or half pixels, 920, are depicted as squares labeled with lowercase letters.
So Walker Figure 9 is depicting integer pixel positions capital A, B, C and so on and also sub-pixel positions, which Walker describes as half pixels. I would call them probably sub-pixel positions labeled with lowercase letters.
Q Are the half pixels in Walker Figure 9 interpolated?
A Walker in Paragraph 114 describes the half pixel positions as interpolated, yes --

sorry. Sorry. Yes -- sorry. Maybe you're going to ask me this. You go ahead.

Q How does Walker interpolate the half-pixel values in Figure 9?

A Walker, Paragraph 114 -- this is what I was just about to say -- says that half-pixel interpolation can be carried out with a bilinear filter such as, for example, a two-tap FIR filter with particular weights.

Q So then Walker in that paragraph would take a reference block and then use that with an FIR filter to come up with the half pixels shown in Figure 9?

A I think that's broadly consistent with what Walker -- what Walker is saying is that there are integer pixel positions illustrated, uppercase letters, and there are interpolated pixel positions illustrated with lowercase letters, and those interpolations -- yeah, it goes on to give an example where an interpolated pixel can be calculated as the average of two integer pixels, and I think that's what you're talking about.

So the integer pixels are from a reference block of pixels. A sub-pixel positions, such as lowercase A, Walker describes as being interpolated from -- between neighboring integer pixel positions.

MR. LIANG: We've been going about an hour. Let's take a break.

MR. VERBONCOEUR: Sure.

A Could I just finish my answer? Sorry. It's just -- I'm just reading -- just to fully answer your question, Walker does happen to describe here that some of the sub-pixel positions, such as lowercase D, are interpolated between other sub-pixel locations. Some are interpolated from integer pixels; some are not, according to Walker.

Done.

MR. LIANG: All right. So let's take a break.

(Whereupon, a recess was taken
from 4:22 PM until 4:37 PM.)
Q So, Dr. Richardson, I'm handing you what has been marked Exhibit 1019.
(Whereupon, Amazon Order for
"Coding Video: A Practical Guide
to HEVC and Beyond, Richardson,
Iain E." was marked as Exhibit
1019 for identification as of
this date.)
Q Now, the first page of Exhibit 1019 is an Amazon order form. But if you skip past that, a receipt, if you skip past that and look at the rest of Exhibit 1019.
A Okay.
Q You recognize this as a book that you wrote?
A It looks like a scan or a photocopy of some pages from a book that I wrote, yeah.
Q Okay. And if you flip through Exhibit 1019 and review. Can you let me know if this looks like an accurate scan of

certain pages from your book?
A Yeah. It looks consistent with certain pages from my book, yeah. Just a number of pages. I'm not sure. And that's my coding video book, which I think was published in 2024.
Q So as far as you can tell, this looks like a true and accurate copy of pages from your book Coding Video?
A I don't have any reason to disagree with that.
(Whereupon, "The H.264 Advanced Video Compression Standard, 2nd Edition, Iain E. Richardson" was marked as Exhibit 1020 for identification as of this date.)
Q So I'm handing you what's been marked as Exhibit 1020. Is it correct that your book, H.264 Advanced Video Compression Standard, Second Edition, is offered for sale electronically?
A Yes. I believe it is, yes.

Q And was your book, H.264 Advanced Video Compression Standard, Second Edition, published in August 2011?
A I think -- yeah, sir, I think my book, The H.264 Advanced Video Compression Standard, second edition, I think it was published in -- the book was published in 2010.
Q Okay. And Exhibit 1020 does reflect what you're saying earlier that the publisher does offer a version of your book on sale digitally?
A Yes.
Q Now, I'd like to take a look at -- actually, let me ask: Have you ever heard of John L Hennessy and David A Patterson?
A Not sure.
Q Well, have you ever heard of a computer architecture book called Hennessy and Patterson?
A Not sure.
Q So if we back up and just talk about

binary calculations, was the concept of keeping higher precision intermediate values a known method for reducing rounding errors before 2011?
A So for example, Paragraph 93 of my second declaration, I'm talking about the Karczewicz 2 reference, and there I'm explaining that in -- Karczewicz 2 suggests that certain interpolated values could be maintained at a high precision, and my recollection is a higher precision than, for example, the H.264 subsample interpolation process, and that there were certain advantages to that. And Karczewicz 2, I understand, to have been published in 2009.
Q Would it surprise you if there are, in addition, other references that teach the idea of keeping higher precision intermediate values to reduce rounding errors?
A It wouldn't necessarily surprise me. I think it's a -- yeah, it's a concept that was -- well, what I described happening in

Karczewicz 2 is happening in 2009. So, yeah, it wouldn't necessarily surprise me.

Q So I'm handing you what's been marked as Exhibit 1021.

(Whereupon, Textbook by Iain E. Richardson was marked as Exhibit 1021 for identification as of this date.)

Q And so Exhibit 1021 is a textbook. And if you turn to page --

MR. VERBONCOEUR: Counsel, you may clear this up with your questions, but I'll just lodge an objection for now that it doesn't appear there's any title or date or other information associated with the pages that have just been handed out.

Q Have you ever done any assembly programming before?

A Yes.

Q Have you ever done it on the Intel CPU architecture?

A I can't remember.
Q Would you agree that the Intel CPU architecture is a -- is also commonly known as the X86 architecture?
A I think there are sort of multiple generations of the Intel CPU architecture, but X86, I think, is a sort of shorthand for those generations. I'm familiar with that.
Q And is it correct that X86 is the most common PC CPU architecture in the world?
A I don't know.
Q Could we turn to Exhibit 1012, which is the --
A This one?
Q Correct.
Okay. So I'd like to turn to --
MR. LIANG: Can we go off the record for a second?
MR. VERBONCOEUR: Sure.
(Whereupon, a recess was taken from 4:48 PM until 4:53 PM.)
Q Okay. So could we turn to Exhibit 1012.

A   Okay.
Q   I'd like to direct you to the pages on the bottom, a stamped Page 000187.
A   Okay.
Q   Okay. If you could look and just read to yourself this page. It's titled Section 6.4.2.1, Generating Interpolated Sub-pixels, on stamped Page 187 of Exhibit 1012.
     Let me know when you're ready for questions.
A   Okay. Go ahead.
Q   Does this page, 187, appear to you to be a page from your book titled H.264 Advanced Video Compression Standard?
A   So as I said earlier, I don't recognize it as either a photocopy or a scan of that book or an e-book that was bought from the publisher because they look different in terms of -- yeah, the e-book versions that I have seen. All that said, I don't see anything on this particular page that is --

appears to be inconsistent with my 2010 book.
Q Okay. And if we could turn to stamped page 225.
A Okay.
Q If you could review stamped page 225. And let me know when you're ready for questions.
A Okay.
Q Does Page 225 of Exhibit 1012 look consistent with a page from your book?
A Yeah, again -- again, with the same proviso I gave a moment ago, I don't see anything here that I recall to be inconsistent with my 2010 book.
Q Okay. If we can turn to Page 194 of this, Exhibit 1012, go to stamped-Page 194.
A Yes.
Q And you look at --
A I'm sorry. Sorry. I was looking at the top.
Q Yeah, if you looked at stamped-Page 194 to 195.

A   Okay.
Q   Do Pages 194 to 195 look consistent to you with corresponding pages from your book H.264 Advanced Video Compression Standard?
A   Yeah, I think we might have already had this discussion. I think the answer is, yes, I don't see -- again, same provisos, but I don't see anything that I recall to be inconsistent with my 2010 book.
Q   If we turn to Page 183, stamped-Page 183.
A   Okay.
Q   And you review that through Page 185.
A   Okay.
Q   Do Pages 183 through 185 of Exhibit 1012 appear consistent to you with corresponding pages from your book, The H.264 Advanced Video Compression Standard?
A   Yeah. Same proviso, same answer. And I will point out that I don't have a -- I don't have a copy of the book to compare it with. But I don't see anything that I recall stands

out as different.
Q Okay. If we turn the page to Page 187. If you could just review Page 187 to 188.
A Okay. Yes.
Q Do Pages 187 to 188 appear consistent to you with corresponding pages from your book, The H.264 Advance Video Compression Standard?
A I think you've already asked me this one, and I already said -- gave the answer I gave for these pages.
Q Which would be?
A Whatever I said, like, three minutes ago. You've already taken me to these pages, I think.
Q I see. So before I had asked you about Page 187, but I just want to make sure you've also reviewed Page 188, so --
A Okay. I have, and it would be a similar answer, yes.
Q Okay. And if we then turn to stamped-Page 205.
A Okay.

Q So reviewing -- if you review Page 205 of Exhibit 1012, does Page 205 appear to be a page that corresponds to a page from your book, The H.264 Advanced Video Compression Standard?

A Same answer as before for the other pages.

Q Okay. And if we turn to Page 224, stamped-Page 224 of Exhibit 1012.

Does Page 224 appear to consistent with the corresponding page from your book, The H.264 Advanced Video Compression Standard?

A Same answer as before.

Q And just for the record, can you state what your answer is?

A Sure. Stamped Page 224 of this exhibit, once again, it doesn't look like I would expect a photo copy, scanned copy or purchased e-book page to look like, but I -- and I don't have a one of those aforementioned versions of my book beside me to compare it to, but I don't see anything on this exhibit page that looks inconsistent -- that I remember to be inconsistent with my 2010 book.

Q   Have you ever written software programs before?

A   Yes.

Q   What kind of programming languages have you used to write software programs?

A   Going way back basic, pascal, C, C++, more than one type of assembly language. Sorry, just say the question again. Software program or did you say software program or just program.

Q   Software programming languages?

A   Some Python, some JavaScript. Some Java though not so much of those last three. I don't recall whether there are others.

Q   What are code branches?

A   In what context?

Q   The context of the C programming language?

A   Do you mean within a program or in terms

of, for example, version control.
Q Oh. So within a C program, within a C -- withdrawn. Let me rephrase. Within a software program written in the C programming language --
A Okay.
Q -- what are code branches?
A It says C has certain, certain operators and expressions, some of them cause program execution to go in and out of functions, and so forth and then you've got things, like, if I remember correctly, case statements or, but I'm not sure which of those might be termed code branches, it's kind of a more generic term.
Q Now, I'm sorry. I'm not sure if the transcript is clear, so I just wanted to ask you again, so you mentioned a few statements in C that can cause code branches. So what were those statements in C that caused code branches?
A That wasn't what I said.

Q Oh, okay.
A There are statements -- I'll try and put it slightly clearer. There are statements in C that affect the execution flow or the order in which operations are carried out. Whether one could potentially call those code branches, but code branches sounds to me like a more generic term.
Q Do "if statements" cause code branches?
A Well, code branches is a somewhat generic term. An "if statement" in C language is or causes conditional execution, so the lines of code following an "if statement" may or may not be executed depending on the result of the "if statement."
Q So therefore "if statements" cause code branches because they create conditional portions of the code?
A "If statements" affect or -- "if statements" typically cause -- can cause conditional execution of portions of code. I

didn't call them code branches, you did.
Q Okay. Can you identify any programming statements in the C programming language that cause code branches?
A Okay. What do you mean by code branches?
Q Well, does that term mean anything to you in the context of software programming language?
A One could use it as a fairly generic term for something relating to the flow of execution. One can also use it to describe subsets of a larger program of some diversion control, so a bit of context would be helpful.
Where as if I talk about an "if statement" in C it has a particular meaning, if I talk about a "do while statement" in C, that has a particular meaning.
Q But discussing code branches in the context of this IPR doesn't have any particular meaning to you?

MR. VERBONCOEUR: Object to the form of the question.

A That's not at all what I said. That's not at all what I said, point me to the context and I'll talk about it.

Q Okay. I'm just going ask does an "if statement" in -- would you agree or disagree that an "if statement" in the C programming language causes code branches?

A I don't recall whether I've put it that way in the past. If I was, you know, I'm trying to be precised today. I would use -- if you asked me to describe -- explain the characteristics of an "if statement" in the C programming language I would probably say something like I've already said, that an "if statement" can affect the sequence of operations or the flow of operations. For example, a block of code may or may not be executed depending on the result of the "if statement." So that's a relatively precise statement in my view.

Q You would agree though that a POSITA would be aware of significant computational cost from adding code branches and would therefore avoid using them?
A In what context?
Q I'm just asking you if you agree or disagree with the statement that a POSITA working a video coding would be aware of the significant computational cost from adding code branches that would have persuaded a POSITA from using them?
MR. VERBONCOEUR: I would object to the form of the question.
A I wouldn't agree with that without context. For example, I can think of a counter example.
Q What's the counter example?
A If I'm writing, I don't know a shell script or a script that runs once per day and a code branch makes my job slightly easier when I'm writing, and testing that script and the difference in execution time between

using a code branch, not adding a code branch whatever you want to call it, adding conditional execution or not adding conditional execution, and that difference is one second and I run that once a day, I don't really care.

Q But for a video codec you would agree that a POSITA would not use code branches because they add significant computational cost?

MR. VERBONCOEUR: Object to the form of the question.

A I don't think I could write a video codec even a very simple one without using conditional execution. I don't think I could.

Q Would you agree that it's always important to have minimum computational complexity for all video codec applications?

MR. VERBONCOEUR: Object to the form of the question.

A So if you read my book, you will,

somewhere rather, see a discussion of performance, I think it's in this book and I probably explain in my book and I think a POSITA would be aware of this, that if, for example, wants to maximize compression efficiency one might chose to do that at the expense of increasing computational complexity.

Q Would you agree that those of ordinary skill in the art would understand that bit shifting operations could be accomplished by other methods such as applying a scaling factor through multiplication or division?

A I think a person of ordinary skill in the art would understand that in order to achieve the same result as, for example, a left shift by two binary places, one could achieve the same numerical result by multiplying by a factor of four. I think that's an example of what you were just asking.

Q So left shifting is mathematically

equivalent to multiplications by powers of two, correct?

A Binary left shifting -- left shifting of binary representation is, hang on, yeah, depends what the binary number is representing. So a binary representation of a decimal number, for example, then left shifting by a number of bit positions is mathematically equivalent to multiplying by a power of two.

Q So for shifting end bits to the left, then that's the same as multiplying by a scaling factor of two to the N?

A What does the N bits represent.

Q So if you have a number, a binary number, you left shift it end bits, then that's the same as multiplying by a scaling factor of two to the N?

A What is my binary number? I mean what's it representing.

Q Why do you have to know that?

A Well, I suppose if it's a binary number to me implies that it is representing a number, but if it's just a binary screen then yeah, I was just trying to make sure that I wasn't being imprecise in my answer to be honest. So if, for example, we have a decimal value and if I represent that as a binary number, and I left shift that binary number, that would in most context that I'm aware of be equivalent to, mathematically equivalent to multiplying it by a power of two.

Q   Would you agree that bit shifting a binary number to the right is mathematically equivalent to dividing by a factor?

A   What factor?

Q   Well, would you agree that bit shifting a binary number to the right by one bit, is that mathematically equivalent to dividing that number by two?

A   I think I have to play certain constraints now. So, for example, a binary number represented in twos complement form.

Yeah, so a binary number that is representing a negative number in two's compliment form if that is, and I think I got this -- is the right way around it that is arithmetically right shifted by one or more bit positions, that is mathematically equivalent to dividing the equivalent decimal number or whatever representation we have by a power of two with a rounding operation.

Q So computers in a CPU when it executes a multiplying operation, what portion of the CPU typically performs that operation?

A I'm familiar with sort of typical CPU architectures where that would be done something called an arithmetic logic unit, ALU.

Q What steps would an ALU use to multiply the number five with the number four?

A It depends on the ALU.

Q Can you give me an example way that an ALU would multiply the number five with the number four?

A I learned a few ways when I was a student and I used a few ways since then. I've used very specific ways in certain architectures. My recollection is that there are a lot of different hardware constructs, or if we can call them hardware algorithms, but for multiplication. A lot of different ones, I think people are still inventing new ones or proposing new ones.
Q In those ways that you learned as a student, did they involve shifts and adds?
A I can't remember. That was a while ago. I'm aware of lot of different ways of multiplying. I designed, for example, more than one transform implementation that involved multiplication and I recall using different methodologies.
Q Why are there so many ways that people look into implementing multiplication on an ALU?
A There are lots of ALUs, you mention the X86 architecture, how many different

iterations have there been of the X86 architecture, are they the same, no. Does each architecture do things in different ways, yes. Do more recent architectures, for example, have provisions for array multiplications, I think they do, compared to older versions of X86 architecture, and so on and so forth. So the applications change, the capabilities of the CPUs change, the number of logic gates that might be practical or available change. The constraints such as parallelization, threading, pipelining, execution, speed, applications, all of these things change over time.

Q Multiplication is a relatively simple operation in ALU right?

A Why do you say that.

Q Well, you would agree that multiplication is far simpler to perform in an ALU then say left shifting, right?

A Seriously?

Q I don't know?

A No, no. I hope that was a trick question.
Q Do you know if any ALUs might replace multiplication with left shifting if the left shifting is --
A What do you mean by, sorry, sorry.
Q Are you aware of any ALUs that might see a multiplication operation and then if -- and then replace that with a left shift operation instead as a shortcut?
A What do you mean by an ALU seeing a left, seeing something, I don't understand.
Q Are you aware of any ALUs that would replace multiplication by a power of two with a left shift as a computational shortcut?
A I just don't know.
Q Are you aware of any compilers replacing multiplication by a power of two with left shifting?
A I haven't designed a compiler before, so yeah, I just don't know.
Q So I'm handing you what's been marked as

Exhibit 1022.

(Whereupon, Pages from a textbook, Hennessy and Patterson Computer Architecture was marked as Exhibit 1022 for identification as of this date.)

Q Have you ever seen -- so Exhibit 1022 is a, you know, some pages from the Hennessy and Patterson Computer Architecture book.

Are you familiar with that textbook at all, have you ever heard of it?

A I don't recall. I think I already said that.

MR. VERBONCOEUR: I have the same objection to this exhibit pending further questions I lodged against the others for the untitled, undated exhibit.

Q So if you can go to Page 214 of this exhibit?

A Okay.

Q And see this highlighted text, it says:

"Rounding sounds simple enough, but to round accurately requires hardware to include extra bits in a calculation. The preceding examples, we were vague on the number of bits that intermediate representation can occupy, but clearly if every intermediate result had to be truncated to the exact number of digits there would be no opportunity to round. IEEE 754 therefore always keep two extra bits on the right during intermediate additions called garden round respectively."

Do you see that?

A Yes.

Q Actually, I was thinking about turning also to Page 181. So if you could turn to Page 181 of this.

You see how this Page 181 is titled faster multiplication?

A Sure.

Q In the highlighted portion it says:
"Summary, multiplication is accomplished by simple shift and add hardware derived from paper and pencil method learned in grammar school. Compilers even used shift instructions for multiplications by power of two."
Do you see that?
A Yeah. Absolutely.
Q Do you have any reason to doubt that compilers would use shift instructions for multiplications by power of two?
A What's the date of this reference? And what's the context of this chapter?
Q Well, feel free to review the reference. I'm just asking if you have any reason to doubt that statement.
MR. VERBONCOEUR: Sorry, Dr. Richardson, I'll make the same objection. This appears to be incomplete and modified.
By "this," I'm referring to the

exhibit. It doesn't have a label for me, but it's the one that's currently subject to questioning.
A Yeah. What's this chapter about, Chapter 3?
Q It's about faster multiplication, this page.
A In what context?
Q In computer architecture. It's a computer architecture textbook.
A It's talking about MIPs.
Q Do you know what MIPs is?
A Yeah. I kind of remember what it means. It's like a specific architecture, it's quite old.
Yeah. So what's the context of this chapter or this section of the chapter?
Q You can read the reference.
A Well, no, I can't, because if I go back, I'm still in 3.4, and then suddenly it shifts to 1.2. So, no, I can't read it.
Q Okay. Well, I'm just asking if you have

any reason to dispute that statement we just read?

A I don't know what the statement is talking about. I mean, I don't know what the scope is of this statement.

Does it mean -- are you suggesting this is in every single instance of multiplication? I don't agree, if that's the case. And which compilers are we talking about, and what's the date of this reference? You haven't answered any of those questions.

Q Do you believe that some compilers could replace multiplication by a power of two?

A Do I believe it?

Q Yeah. Do you have any understanding one way or the other?

A I've never designed a compiler.

Q Okay.

A To be honest, I haven't spent a lot of time on compilers in my career. I spent a reasonable amount of time on multiplication. And I disagree that all multipliers work the

same way in digital hardware. I mean, I can point you to some of my publications and things that I've built, I built a distributed arithmetic array multiplier. It ended up in several chip sets. It used distributed arithmetic. It didn't use shift and add. I built it.
Q Now, if you can put that exhibit aside.
In binary arithmetic, how do you tell if a number is a power of two?
A What's the "you" in this context? What is the context?
Q I'm just asking for you right now, are you aware of how you would look at a binary number to figure out if it's a power of two?
A So the binary representation of a decimal number, if that decimal number is a power of two, then the most straightforward binary representation of a positive -- if it's a positive decimal number, the most straightforward representation I would probably see in that number, that there is a

single one in a most significant bit position, followed by zeros thereafter.

And so examples would be a single binary one, that would represent decimal one, in, you know, one common notation. Single binary two represents decimal two that would be -- sorry. Single binary number one and zero can represent decimal number two and so on.

Q So if you have a number eight represented as 1000, and you subtract one from it, what do you get?

A I don't understand the question.

Q So if you have a binary number eight represented as 1000. Are you with me so far?

A Oh, I'm sorry. I think that -- yeah. I'm with you. I thought you put an extra zero in, but that's my mistake. Carry on.

Q If you have a binary number of eight represented as 1000, you subtract one from that, what's the result?

A So if I take the decimal number eight, positive eight, if I represent that as a binary number one followed by three zeros, and I now consider that binary quantity one followed by three zeros, if I subtract one from that quantity, I end up with a binary number 111. Of course, I can have zeros on the left-hand, but they don't change anything.

Q If you have the binary number four represented as 0100, you subtract one from it, what's the result?

A So if I take decimal four represented in binary using four bits as 0100, subtract one from that binary number, I get binary 11, I can put bits in the left -- zero bits in left-hand side, but they don't change the -- they don't change the magnitude or the value.

Q So subtracting one from the number that's a power of two will set the single one in that binary number to zero, and then flip the subsequent bits on the right side to one, correct?

A You had like a sequence of events in

your question, which I don't necessarily agree with.

Q So I'm going to give you this blank notepad.

Do you have a pen with you?

A Not on me. No.

Thank you. I have a pen.

Q So if you take the number four as a binary representation of 100.

A If I take -- can I just suggest -- are you asking me to take the binary number 100 as a representation of decimal four?

Q Correct.

A And I'm going to write down four to the base ten and I'm going to write down on the right-hand side -- what do you want me to write down?

Q 0100.

A I'll write a small two to show that it's a binary representation.

Q If you do a bit wise and with the binary representation of three, which is 11, 0011.

A Which one? Which of those two?
Q Okay. So if you -- we talked about before, right, the decimal number three corresponds to a binary number of 0011, right?
A It can be represented using four bits as a binary number 0011.
Q So if you do a bit wise and of those two numbers, what's the result?
A If I and binary 0100 with a binary 0011 --
MR. VERBONCOEUR: I'll object to the scope on this line of questioning.
A I get binary 0000.
Q If we do the same exercise with the numbers eight and seven, what would be the result?
A So I take a decimal eight, if I represent it using four bits as one followed by three zeros, if I take decimal seven and I represent it as binary 0111, if I add those two together, I get the result 0000 in

binary.
Q So when a number is a power of two, if we call that number N, then performing the calculation N and N minus one, the result will always be zero, correct?
MR. VERBONCOEUR: I'll object to the form of the question.
A The result of the binary and will be a number -- a set of zeros, but and is something that's done with the binary digits, not with decimal numbers.
So you're asking me to convert the result of the and, which is like a logic result, and determine a decimal representation or what?
Q So when a binary number is a power of two, then performing -- and if we call that binary number N, then performing N bit wise and with N minus one, the result is always zero, correct?
A You're flipping in your question between binary and decimal. So I want to be clear of

what you're asking me.
Q So I'm asking about binary numbers, right, just binary calculations.
A You're asking me about arithmetic calculations using binary numbers and, sorry, but and, logical operations such as and with binary numbers?
Q Well, bit wise and.
A Okay. Yeah. You're asking me about arithmetic operations and bit wise operations. And then you're saying zero, and I don't know what domain we're in now.
So I've got the decimal domain, I've got a binary domain, I've got binary arithmetic operations, I've got bit wise operations, and then you're saying zero. What domain are you in when you say zero?
Q So in the calculations that you just performed on the piece of paper, which we will mark as Exhibit 1023, if you repeat those calculations for any power of two, the result is always zero, correct?

MR. VERBONCOEUR: Object to the form of the question.
A Who says the result is zero? You did. Did I agree to that?
Q Do you agree with it?
A The result is 0000 binary.
Q Okay. So then --
A You've jumped between three different domains here.
Q So would you agree that for an eight bit number, when a number N is power of two, performing N bit wise and with N minus one will always result in 0000000?
A If I take a decimal number, let's say the range 0 to 255, if I express that decimal number as a binary number, and I restrict myself to decimal numbers that are powers of two, if I take that decimal number minus one, or I can do minus one in either form, of course, if I subtract one, I get another number, which I can represent in binary. If I then do a logical operation bit wise and on

those two binary representations, I will get a series of zeros in binary.

MR. LIANG: Let's take a quick break.

(Whereupon, a recess was taken from 5:41 PM until 5:47 PM.)

(Whereupon, Handwritten piece of paper by Dr. Iain Richardson was marked as Exhibit 1023 for identification as of this date.)

MR. LIANG: So we'll pass the witness.

MR. VERBONCOEUR: Okay. With that in mind, I need a quick break to confirm with Eric.

Can we go off the record briefly.

(Whereupon, a recess was taken from 5:47 PM until 5:52 PM.)

EXAMINATION BY

MR. VERBONCOUER:

Q All right. Dr. Richardson, I just have a few questions for you on redirect. Okay?

A Okay.

Q The materials that are in front of you,

I believe that those include a Notice of Decision to Institute?
A Yes.
Q And we can use the notice for the 626 IPR. Do you have that?
A Yes.
Q Okay. I'd like to ask you about something that you were asked about earlier, and if you could please turn to Page 16 of that document. And I'm specifically looking at the top of Page 16, and then the two paragraphs, top of page seven -- sorry, bottom of Page 16, two paragraphs at the top of Page 17. Please review them and let me know when you're ready for questions.
A Okay.
Q So the board gave some opinions about the meaning of the term "prediction."
MR. LIANG: Objection to form, leading.
A Okay. I mean, there's sentences you asked me to review, the board is talking

about construring prediction, which I understand to be giving -- yeah. Consistent with giving opinions as to the meaning of prediction, is my general understanding.

Q Okay. I'd like to ask for your opinions about part of the '267 Patent, and rather than turn to the '267 Patent we can look at Page 15 of this Decision to Institute.

A Okay. I'm at Page 15.

Q And I'd like to get your view on the P1 and P2 shown here on Page 15 of the institution decision.

Do you recognize those equations from the '267 Patent?

A I think so, yes. It's talking -- yes. It's citing -- it's citing portions of the '267 Patent.

Q In your opinion, is P1 a prediction?

MR. LIANG: Objection to form.

A P1 in the '267 Patent, Column 3, Line 43, describes P1 as a prediction value.

Q What's your opinion about whether a

person of skill in the art would see P1 in the '267 Patent as a prediction?
MR. LIANG: Objection to form.
A Well, a person of ordinary skill reading Columns 13 and 14 of the '267 Patent would see P1 described as a prediction value, and then the reference to P1 in the equation that, I think the board has excerpted on Page 15 of the decision granting institution that we discussed.
Q Do you have an opinion of whether a person of ordinary skill in the art reading the '267 Patent would see P2 as a prediction?
MR. LIANG: Objection to form.
A In a similar way, P2 with the equation, which is -- expresses an equation in the '267 Patent, Column 14, Line 21, in the previous Column 13, around Line 44, P2 is described as a prediction value.
Q Now, I want to ask you about what happens if we just take parts of the equation out. So if I refer you to three, asterisk E,

subscript two, do you know what I'm referring to here on Page 15 of the institution decision?

A So that's part of an excerpted equation for P2, which I think is the same as the equation in the '267 Patent, Column 14, Line 21.

Q Do you have an opinion on whether a person of ordinary skill in the art would see three, asterisk E, subscript two as a prediction?

MR. LIANG: Objection to form.

A In my opinion, they wouldn't. And I explained this earlier with regard to other expressions in, for example, the Walker reference, three times E2 in this equation. I think a person of ordinary skill in the art would understand that three times E2 is a term, almost a term or an operator in the equation. It's not in itself a prediction value.

Q Now what I want to do is ask you about, I guess, a partial definition, so to speak, a prediction given at the bottom of Page 16 of the institution decision, and then it continues on the top of Page 17. Just let me know when you're there.

A Okay.

Q There's the text:

"So to determine whether to institute here, we only determine that the term prediction encompasses values used for prediction that are calculated by mathematical operations, including multiplying pixel values in reference blocks with weights."

Do you see that?

A Yes.

Q Looking at P1 and P2, do you think this definition of prediction includes P1 and P2?

MR. LIANG: Objection to the form.

A So P1 and P2, as expressed in the equations in the '267 Patent, Column 14, Lines around 18 to 22, each of these is an equation. Each of these is a prediction value, described as a prediction value. P1 is described as a prediction value. P1 is calculated in this equation as an equation. It's the mathematical operation or a set of mathematical operations which include multiplying pixel values, such as E1, with weights, such as normalized three in this example.

Q Now I want to ask you about 3*E2?

A Okay.

Q Do you think this 3*E2 meets the definition of "prediction" provided at the bottom of Page 16, top of Page 17, in the institution decision?

MR. LIANG: Objection to form.

A So as it appears in the equation for P2 at around Column 14, Line 21 or 22 of the '267 Patent, I don't think it does because it's not a value that's used for prediction.

MR. VERBONCOEUR: Okay. No further questions.

EXAMINATION BY
MR. LIANG:
BY MR. LIANG:
Q Dr. Richardson, at any point today during any of the breaks we've taken today, did you discuss with your counsel anything related to your declarations or this IPR that we've -- the IPR proceedings that we've been dealing with today?
A No.
MR. LIANG: Okay. So no further questions from me. But before we go off the record, I do want to state that one item, for the record, that came up in Dr. Richardson's testimony and that counsel discussed subsequently.
So Dr. Richardson testified this morning that he reviewed a post-hearing brief from the parallel ITC proceeding as part of his preparation for his deposition today.

Dr. Richardson is not admitted under the protective order in the ITC proceeding, and there are no public versions of the post-hearing briefs in the ITC proceeding.

We understand that Nokia's counsel is investigation the issue and will follow up in writing to explain how Dr. Richardson was able to access nonpublic post-hearing briefs. To the extent that Dr. Richardson relied on those materials at all for purposes of his opinions in this IPR proceeding, we request that Nokia provide a copy of those materials to us.

MR. VERBONCOEUR: And just for clarity of the record, we don't agree that Dr. Richardson had any access to nonpublic information. But as we discussed over break several times, we will follow up in writing just so counsel is able to verify that.

Also point out I think the parties have exchanged redactions for certain post-hearing briefs, but we can follow up in writing after investigation.

MR. LIANG: Okay. We're ready to proceed with the next deposition for the next IPR proceeding, which I believe is for the '321 Patent, but we're ready to proceed. We can go off the record.

(Whereupon, a recess was taken from 6:01 PM until 6:06 PM.)

COURT REPORTER: Do you all want a rough draft from today's deposition?

ALL: Yes.

(Whereupon, this examination was concluded at 6:07 PM.)

____

DR. IAIN RICHARDSON

Subscribed and sworn to
before me on this ____ day
of ____________, ___________.

____
Notary Public

I N D E X

WITNESS: DR. IAIN RICHARDSON

E X H I B I T S

	paper by Dr. Iain Richardson	
PREVIOIUSLY MARKED	DESCRIPTION	PAGE
Exhibit 1012	The H.264 Advanced Video Compression Standard, Second Edition, Iain E Richardson	64
Exhibit 1006	Karczewicz 2	115
Exhibit 1003	Dr. Freedman's Declaration	122

C E R T I F I C A T E

I, KIARA MILLER,
A Shorthand Reporter and Notary Public of the State of New York, do hereby certify:

That the witness whose examination is hereinbefore set forth, was duly sworn or affirmed by me, and the foregoing transcript is a true record of the testimony given by such witness.

I further certify that I am not related to any of the parties to this action by blood or marriage, and that I am in no way interested in the outcome of this matter.

Kiara Miller

KIARA MILLER

A

G

H

I