1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3 _____

4 AMAZON.COM, INC., AMAZON.COM

5 SERVICES, LLC,

6 Petitioner

7 v.

8 NOKIA TECHNOLOGIES OY,

9 Patent Owner

10 _____

11 Case Nos. IPR2024-00626; IPR2024-00627

12

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14 DEPOSITION OF IMMANUEL FREEDMAN, PH.D.

15 November 26, 2024

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20 Reported by:

21 Debra Stevens, Realtime Certified Reporter

22 JOB NO. 562425

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1 Whereupon,
2 I M M A N U E L F R E E D M A N,
3 having been first duly sworn/affirmed, was
4 examined and testified as follows:
5 EXAMINATION BY
6 MR. VERBONCOEUR:
7 Q. Good morning, Dr. Freedman.
8 A. Good morning.
9 Q. Are you able to hear me okay?
10 A. I can hear you fine.
11 Q. Have you been deposed before?
12 A. Yes.
13 Q. How many times have you been deposed
14 before?
15 A. North of ten times.
16 Q. How many times have you been deposed
17 before in a PTAB proceeding?
18 A. I would have to look up that
19 information to be sure, but it is probably more
20 than eight times.
21 Q. How did you prepare for today's
22 deposition?

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1 A. I read my declaration and the
2 supporting references.
3 Q. Did you meet with counsel in advance
4 of today's deposition?
5 A. Yes, I did.
6 Q. For how long did you meet with counsel
7 in advance of today's deposition?
8 A. Are you asking for preparation for the
9 deposition, or in general?
10 Q. Yes. For how long did you meet with
11 counsel to prepare for today's deposition?
12 A. I met with counsel on Sunday for about
13 four hours. I met with counsel yesterday also for
14 about four hours.
15 Q. Other than counsel, did you speak with
16 anyone else in preparation for today's deposition?
17 A. No.
18 Q. And other than counsel, did you speak
19 with anyone else while you were preparing the
20 declarations you provided in the IPRs relevant to
21 today's deposition?
22 A. Are you speaking about counsel being

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1 Jeffrey, or counsel being Jeffrey's law firm?
2 Q. Any lawyers representing Amazon is who
3 I am referring to as counsel.
4 A. I spoke with other members of
5 counsel's legal team during our conferences to
6 prepare the declarations.
7 Q. Other than all of the members of the
8 legal team who are attorneys, did you speak with
9 anyone else to prepare the declarations you
10 provided that are relevant to today's deposition?
11 A. No.
12 Q. You understand that you provided two
13 declarations that are relevant to what we are
14 calling the '267 Patent, one for each of the two
15 petitions we will discuss today?
16 A. Yes.
17 Q. How long did you spend preparing those
18 two declarations?
19 A. I cannot remember.
20 Q. Other than members of Amazon's legal
21 team, did you speak or work with anyone else in
22 preparing those declarations?

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1 A. No.
2 Q. Did you provide the first draft of
3 each of the two declarations you provided in the
4 IPRs?
5 A. The declarations were drafted
6 collaboratively. I do not recall who provided the
7 first draft. However, I make it a rule, that I
8 apply to every attorney I work with, that I will
9 only sign a document if I truly believe every word
10 in it.
11 Q. Are you familiar with someone named
12 Dr. Dan Schonfeld?
13 A. Never heard of him.
14 Q. Are you familiar with someone named
15 Gary Sullivan?
16 A. That name certainly rings a bell. I
17 seem to think that is a person well known in image
18 coding.
19 Q. Now I would like to transition and
20 talk about your background and experience in video
21 coding.
22 A. Okay.

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1 Q. I can provide you the CV that you
2 attached to the declaration if you wish. So if
3 you need that to answer any of my questions, just
4 let me know.
5 A. I believe it is also at the end of my
6 declaration, so I can refer to it directly. I do
7 not hold all the details in my head all the time.
8 Q. Why don't we do this, then. We can
9 just mark as an exhibit that declaration so that
10 we are all on the same page about what you are
11 referring to. For ease of the record, what I am
12 going to do, I am going to mark as Exhibit 1 your
13 declaration from the '626 IPR, but will you agree
14 that the CV that you provided is the same in both
15 of the two petitions?
16 A. That was certainly the intention.
17 (So marked for identification as
18 Exhibit 1.)
19 Q. I am passing over what we've marked as
20 Exhibit 1, which is your declaration from the '626
21 Petition. Dr. Freedman, I see that you already
22 have your own copy, so feel free to consult with

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1 whichever you prefer.
2 A. It's open in front of me. Thank you.
3 Yes, indeed. If I look, this does
4 indeed, at least superficially, appear to be the
5 declaration.
6 Q. If you will please turn with me to
7 page 170 of what has been marked Exhibit 1, can
8 you confirm that that is the beginning of your CV?
9 A. Not in my copy here but let me look at
10 the exhibit you have provided and let's see if
11 that is indeed the same.
12 Indeed, it does appear to be that
13 document.
14 Q. If there is any discrepancy between
15 the two as far as pagination, is it because the
16 declaration that you have in front of you, is that
17 for the '627 Petition?
18 A. Counsel, I believe we are discussing
19 '267.
20 Q. Sorry. There are two petitions that
21 we will discuss today. One is '626, the other is
22 '627, both of which pertain to the '267 Patent.

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1 A. Oh, you are speaking about the IPR
2 number.
3 Q. Yes. So, the declaration to which you
4 were just referring, can you check for me and see
5 if that was the '627 declaration as opposed to the
6 '626?
7 A. Yes. We are literally now on the same
8 page.
9 Q. Okay. Just so we don't have to
10 continue flopping between two different documents,
11 can you agree that, other than the particular
12 claim elements that are somewhat different between
13 the two declarations, the substance is largely
14 common between the two declarations?
15 A. I don't think we can agree that,
16 Counsel. We need to examine that question on a
17 case-by-case basis, paragraph by paragraph, should
18 there be any substantive differences, although the
19 intention is to describe similar information in
20 similar ways.
21 Q. We'll do this. We'll start with the
22 '626 declaration and then if, when I am asking you

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1 questions, your opinions are different with
2 respect to your '626 declaration, can you agree to
3 let me know that your answer would not be the same
4 across the two declarations?
5 A. If that, indeed, turns out to be the
6 case. I am only caveating this because I have not
7 made a rigorous comparison paragraph by paragraph
8 of the declarations.
9 Q. You wrote both declarations, though;
10 correct?
11 A. Yes. But I didn't display them on the
12 screen para by para and check everywhere was
13 identical.
14 Q. But the opinions would at least be
15 consistent between the two declarations?
16 A. Of course.
17 Q. Okay. Now I want to turn back to your
18 background. I believe you agreed -- correct me if
19 I am wrong -- it is the same CV information
20 provided in both declarations?
21 A. Of course.
22 Q. I happen to be looking at page 171 of

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1 the '626 declaration, but we would find similar
2 information in the '627 declaration?
3 A. Correct.
4 Q. I would like to ask you now about your
5 experience with a company called Media Logic
6 Systems. Do you see that on page 171 of
7 Exhibit 1?
8 A. Yes.
9 Q. What is Media Logic Systems?
10 A. Media Logic Systems was a subsidiary
11 of a company called Nisaba in the United Kingdom.
12 (Reporter interruption.)
13 THE WITNESS: N-I-S-A-B-A.
14 Q. While you were with Media Logic
15 Systems, it's correct that your job title was
16 Chief Systems Engineer?
17 A. Yes.
18 Q. Can you describe your job role at
19 Media Logic Systems as a Chief Systems Engineer?
20 A. I was required to design and develop a
21 novel live interactive television system which
22 served as a user interface for customer

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1 communication with human sales agents in
2 video-enabled call centers, implemented by
3 television and telephone, that was deployed to
4 50,000 subscribers of Telewest, UK.
5 Telewest is T-E-L-E-W-E-S-T, in the
6 United Kingdom.
7 I researched and developed tools and
8 encoder systems to optimize image quality and to
9 prescribe latency and bit rate for distributing
10 live video and audio streams encoded via low
11 latency methods including the MPEG-2 Simple
12 Profile At Main Level and the MPEG-4 Visual
13 Profile with background sprite coding, together
14 with H.263, which now has become known as H.264.
15 I investigated the feasibility of
16 wavelet-based software encoding schemes with
17 motion compensation and perceptual quantization
18 described by the MPEG Standards Committee
19 Interframe Wavelet Ad Hoc Group. I interfaced
20 video streams by ATM transport to Telewest
21 regional CATV head-ends that we switched via
22 Harmonic Narrowcast Gateways for distribution via

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1 video on demand or near video on demand systems to
2 customers' homes.
3 Q. I see you have read the entry here
4 from your CV. I would like to ask you for more
5 details if you are able to provide them about what
6 you described there.
7 A. Sure.
8 Q. iSeeTV that is listed here in your CV
9 on page 171 of Exhibit 1, is that a product name
10 or is it the name of the user interface?
11 A. It was a product name.
12 Q. In your role with Media Logic Systems,
13 was it to design iSeeTV the product, or to design
14 the user interface for iSeeTV?
15 A. The product is a type of user
16 interface.
17 Q. And can you describe what you mean by
18 user interface here? Are you discussing the
19 buttons the user sees on the screen, or is it an
20 interface like a video interface through which
21 customers can interact with agents?
22 A. So, it is not quite either. And there

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1 were two products, types of products, one, iSeeTV,
2 that relied on the cable television video
3 on-demand system, and a separate product called
4 iSeePC that tried to -- at least attempted to
5 achieve the same goal on a PC.
6 The reason why I say this is a user
7 interface is that it was truly novel. Focusing on
8 the television aspect of it first, the concept was
9 that current systems for interactive television
10 were immensely complicated technically and also
11 very difficult for people to use. So, the
12 following concept was developed of one-way video
13 and two-way audio.
14 So -- do you need more detail? I can
15 go on.
16 Q. Yes. What I am trying to figure out
17 is if, at the time you began working with Media
18 Logic Systems -- correct me if I am wrong, but it
19 seems to me from reading the CV entry, they had a
20 form of video on demand and then there was a
21 customer communication with human sales agents
22 aspect that you were working on, the way in which

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1 that communication was established?
2 A. Would you allow me to explain a little
3 more?
4 Q. Please. That is what we are here for.
5 A. So, Telewest is a cable TV provider in
6 the United Kingdom. I am not sure whether it
7 still exists. It was at that time. And they had
8 a video-on-demand system that you can request a
9 stream, it would be played to a consumer or a
10 subscriber.
11 So, the novelty here was that in order
12 to enable a two-way interaction with an individual
13 in a call center, whether it be a sales agent or a
14 health care advisor -- we did that as well -- they
15 would call the call center using a telephone,
16 speak with the agent on the telephone first. The
17 agent would ask some information from them and,
18 knowing the telephone number, would then display
19 on the caller's television screen a set of digits.
20 The subscriber would then read out the
21 set of digits, which would be used to initiate a
22 video-on-demand stream to the subscriber. So in

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1 that system, you have one-way video from the call
2 center but you maintain two-way interaction via
3 the telephone.
4 This is very low complexity
5 technology, relatively easily implemented and has
6 very low cognitive overhead for the subscriber.
7 Q. I see that. So, the audio is done
8 through the telephone, then a video stream is sent
9 to the subscriber's set-top box or whatever device
10 they had to display the digits, and they can use
11 that to sort of verify or authenticate such that
12 they could receive video-on-demand programming?
13 A. Yes. The video is live in the sense
14 that the agent at the other end has a live camera
15 and the video stream is live. So, they can ask a
16 question and receive a demonstration or an
17 explanation or purchase a product that they can
18 see.
19 Q. Okay. So not only was there video
20 sent to actually display numerical digits, there
21 was also video of the employee, or healthcare
22 advisor, whoever it is showing up on the

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1 subscriber's television?
2 A. Once the stream was initiated. That
3 is the television.
4 On the PC side of it, we attempted to
5 provide what you would call one-way
6 videoconferencing using the internet and a PC
7 platform. Now, there are challenges, of course,
8 with that, and that is why I talk about here low
9 latency methods and the necessary synchronization.
10 It is far from an easy task to achieve.
11 Q. So the first paragraph of the Media
12 Logic Systems entry in your CV in Exhibit 1 is
13 talking about the process of a user making a call,
14 initiating a stream and then seeing some employee
15 or health care advisor.
16 The second paragraph is talking about
17 a separate set of work?
18 A. Same concept, but based on video
19 coding and with an attempt to have the audio
20 stream be part of the -- be a composite
21 audio/video stream. In other words, eliminate the
22 telephone.

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1 Q. I understand. So in both cases you
2 have a user trying to communicate with an employee
3 or healthcare advisor or something of the sort,
4 and now you are trying to get them video and now
5 audio of the person helping them?
6 A. Yes. So you have the two-way audio
7 and the one-way video.
8 Q. And there is reference in the second
9 paragraph of the Media Logic Systems entry on page
10 171 of Exhibit 1 to MPEG-2?
11 A. Yes.
12 Q. Am I to understand that that's because
13 some of the video that was sent to the subscribers
14 was encoded in MPEG-2 compliance formats?
15 A. Regarding the cable television
16 implementation, at that time MPEG-2 was the
17 dominant format.
18 Q. There is also reference to MPEG-4
19 Visual Profile?
20 A. Yes.
21 Q. Where was MPEG-4 Visual Profile used
22 in this system?

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1 A. This was -- this was attempted to be
2 used in the implementation of iSeePC. The point
3 there was to have a lightweight, low latency video
4 codec and to use the available tools, such as
5 MPEG-4 and H.263+, to try and minimize the latency
6 and the bandwidth. If you recall, in that time
7 frame internet bandwidth was intensely limited.
8 Q. As far as the decoder in the scenario
9 we are talking about with the Media Logic Systems
10 work, is the decoder the set-top box at the user
11 premises?
12 A. We are talking about two different
13 systems here, Counsel. If we speak about the
14 cable television system, the decoder system would
15 be implemented in the television set-top box.
16 Q. Then you mentioned a PC-based system?
17 A. Yes.
18 Q. By PC, I am assuming you mean personal
19 computer?
20 A. Correct.
21 Q. In the personal computer-based system
22 when you were working at Media Logic Systems, the

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1 decoder would be the user's computer?
2 A. The decoder would be the user's
3 computer, yes.
4 Q. And the time when you were working
5 with Media Logic Systems, then the users'
6 computers would need to have MPEG-4 Visual Profile
7 compliant decoders?
8 A. That was the intention, yes.
9 Q. Likewise, if you were to use an H.263+
10 compliant stream, the user's computer would need
11 to have an H.263+ compliant decoder?
12 A. Yes.
13 Q. I would like to ask you about the
14 parenthetical in the entry in the CV for Media
15 Logic Systems. It says "H.263+, now known as
16 H.264." Do you see where I'm reading?
17 A. Yes.
18 Q. Can you explain what you mean by
19 "H.263+ now known as H.264"?
20 A. Okay. In the evolution of the MPEG
21 standards and under the auspices of the Joint
22 Committee, MPEG-2 was also known as H.262. This

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1 first evolution was a draft standard called H.263.
2 Then the draft standard was further augmented to
3 H.263+, and it was finally ratified as H.264.
4 Q. I want to make sure I have this right.
5 It is your testimony that H.263 was an evolution
6 of H.264 --
7 A. H.262.
8 Q. I apologize. I got the numbers
9 backwards. Sorry. I don't want to mess it up.
10 First you had H.262, which is also
11 known as MPEG-2?
12 A. Correct.
13 Q. Then, your testimony is, that evolved
14 into H.263?
15 A. Yes, as a draft standard.
16 Q. Then H.263 had further refinements
17 that eventually became known as H.264?
18 A. Eventually, yes, having passed through
19 a stage called H.263+. And at the time that this
20 system was designed, H.264 had not yet been fully
21 ratified.
22 Q. Okay. The reason I ask -- and correct

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1 me if I am wrong. My understanding is that H.264
2 was a separate initiative from H.263 by the Joint
3 Video Team which was formed as a consortium of ITU
4 and ISO members.
5 A. I am trying to recall the history
6 precisely, but H.264 adopted much of the content
7 of the H.263+ draft. As for the administrative
8 organization, I don't recall whether the same
9 committee members were involved or whether a new
10 committee was started. But the technical content,
11 much of the technical content was absorbed from
12 the H.263+ effort as a foundation for H.264, which
13 then evolved some more.
14 Q. Are you familiar with the term H.26L?
15 A. Yes, I am.
16 Q. What is H.26L?
17 A. I am trying to recall it, exactly what
18 it is. I have heard that term, and I can't
19 remember. It may have been intermediate between
20 H.264 and H.265, but my memory fails me in that
21 area.
22 Q. Would it help if I used the phrase

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1 H.26L, as in long term?
2 A. I still do not recall where it is
3 precisely on the spectrum. The standards evolved
4 from H.264 to H.265, and there is a new draft
5 standard coming along above H.265. And, yes, I
6 have heard the term H.26, but I cannot remember
7 where it fits in that spectrum.
8 Q. At the time you were working in video
9 coding in the late '90s and early 2000s, were you
10 familiar with any process called a Call For
11 Proposals for H.26L?
12 A. I don't recall a Call For Proposals
13 for H.26L, but Call For Proposals was a procedure.
14 Q. Are you familiar with Nokia's role in
15 that process?
16 A. I am sorry. I do not recall. There
17 were many organizations involved in that very
18 large committee.
19 (Reporter interruption.)
20 MR. VERBONCOEUR: We can take a couple
21 minute break.
22 (Recess.)

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1 BY MR. VERBONCOEUR:
2 Q. Welcome back, Dr. Freedman.
3 We were just discussing your CV in
4 Exhibit 1, in particular your experience with
5 Media Logic Systems. Now I would like to ask you
6 about the third paragraph of that entry.
7 A. Aha.
8 Q. There is reference in the third
9 paragraph on page 171 of Exhibit 1 to the MPEG
10 Standards Committee Interframe Wavelet Ad Hoc
11 Group. What is the MPEG Standards Committee
12 Interframe Wavelet Ad Hoc Group?
13 A. It was an ad hoc group studying the
14 usage of wavelet transforms for interframe coding.
15 Q. Do you recall which standardization
16 effort that ad hoc group was part of?
17 A. I strongly -- I strongly think it was
18 probably related to MPEG-4 or H.263+, but I do not
19 recall whether it was a standalone initiative or
20 whether it was directly tied to the development of
21 one of those standards.
22 Q. Can you explain what you were working

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1 on at the time when you -- quoting now from your
2 CV -- "investigated the feasibility of
3 wavelet-based software encoding schemes"?
4 A. Okay. So I think it is extremely
5 clear from the words, but I will spell it out in
6 detail.
7 So, one of the most prevalent video
8 encoding schemes is to use what is called
9 transform coding. In the MPEG-2 system, the
10 discrete cosine transform was used to transform a
11 stream of incoming pixel values, brightness and
12 color, luma and chroma, and on a block or macro
13 block basis transform this mathematically to a
14 form where frequency components were important.
15 Some of the less important frequency components
16 were then quantized away, to result in a more
17 compact representation.
18 So, the suggestion had been that
19 wavelet-based techniques -- wavelets are a
20 mathematical representation -- might provide
21 stronger compression or fewer artifacts. So, the
22 feasibility of using wavelets rather than discrete

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1 cosine transform was what -- is what is involved.
2 So, I worked specifically with
3 available software codecs, such as reference
4 codecs in the software. And I am trying to
5 remember the name of a highly configurable MPEG-4
6 codec that became available during that time. It
7 is on the tip of my tongue but, I'm sorry, I don't
8 remember its name.
9 Nonetheless, it had adjustable
10 parameters. And because it had adjustable
11 parameters, I could attempt to tune the system,
12 the group of pictures, the wavelet coefficients
13 and so on, and other system parameters in order to
14 achieve what might be acceptable video to the user
15 and, above all, to keep the latency low. We
16 learned that if the latency is too high, the
17 subscriber or user becomes irritated and will not
18 accept the -- will not accept such a system.
19 Q. I presume, because you are discussing
20 software-based encoding schemes, you are talking
21 about the encoding that is done on the call agent
22 or healthcare advisor side of things to compress

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1 video to send to a subscriber who is requesting
2 help?
3 A. Actually, both. Remember that this is
4 for iSeePC, so both can be considered in parallel.
5 So, the iSeePC software itself was essentially
6 mirrored on both sides of the system, the call
7 center and the user's PC. And what was needed
8 there was to effectively tune the loops in terms
9 of time and in terms of system parameters. A lot
10 of experimentation went into this to make it work.
11 Q. So for the iSeePC system, you had a
12 software-based encoder on the call center end and
13 then a software-based decoder on some application
14 that is running on the user's computer?
15 A. Yes.
16 Q. For the set-top box scenario where you
17 are using MPEG-2 compliant bitstreams, do you
18 recall whether the decoding by the user set-top
19 box was done in hardware or software?
20 A. I don't recall that and I don't want
21 to speculate.
22 Q. I see that you have Exhibit 1 still in

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1 front of you. If you could, please, turn to page
2 26 of Exhibit 1. Do you see the section beginning
3 on page 26 of your declaration that is titled
4 "Claim Construction" and then has a subsection
5 called "Precision"?
6 A. Yes.
7 Q. Are your opinions about the meaning of
8 the claim term "precision" the same for both the
9 '626 and the '627 IPR petitions?
10 A. Yes.
11 Q. I would like to ask you about a
12 sentence you have here on the declaration on pages
13 26 and 27 and ask you perhaps to clarify something
14 for me.
15 A. Okay.
16 Q. Reading from your declaration, in the
17 middle of a sentence, "a person of ordinary skill
18 in the art would have understood precision is
19 satisfied by but is not necessarily limited to a
20 number of bits to represent possible values."
21 Do you see where I read from, pages 26
22 to 27?

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1 A. Yes.
2 Q. When you say that precision is not
3 necessarily limited to a number of bits to
4 represent possible values, are there other
5 definitions of precision that you have in mind for
6 purposes of these opinions in these IPRs?
7 A. Not for purpose of the opinions of
8 these IPRs. However, it is normal to caveat
9 statements one makes.
10 Q. Okay. But we can say, for purposes of
11 your opinions in these IPRs, while it might be in
12 other contexts "precision" has other meanings, you
13 are relying on a number of bits needed to
14 represent possible values?
15 A. Yes.
16 Q. I would like to ask you about the
17 language "needed to represent possible values."
18 A. Okay.
19 Q. When I read that, I thought of two
20 possible meanings; perhaps you mean neither or
21 perhaps you mean one or both. I just want to get
22 clarity here.

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1 One meaning I thought of is the bits
2 that you must use to represent the possible
3 values. The other meaning I thought of is the
4 bits that you actually use to represent the
5 possible values. What did you have in mind when
6 you wrote "a number of bits needed to represent
7 possible values"?
8 A. I didn't quite mean either of the
9 statements you made, Counsel. It's a much simpler
10 consideration. So, for example, if I want to
11 represent the decimal number 5 in uncompressed
12 binary form, I can represent it in three bits,
13 101, in unsigned binary arithmetic.
14 Q. Perhaps I am missing something but I
15 still see that ambiguity. Are you saying, then,
16 that because you are representing it with 3 bits,
17 that is more precise than a number that you would
18 represent with 2 bits in uncompressed binary form?
19 A. Yes.
20 Q. Okay. So the greater a decimal number
21 is, according to your interpretation of the claim
22 term "precision," the more precise that number is?

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1 A. If we are speaking about non-negative
2 decimal numbers.
3 Q. Let's talk about negative decimal
4 numbers.
5 A. Okay.
6 Q. How does your interpretation of the
7 claim term "precision" apply to negative decimal
8 numbers?
9 A. Okay. It still relates to
10 uncompressed binary arithmetic. And the view that
11 I am taking is that the appropriate number of
12 bits, which might be -- might sometimes be the
13 smallest number of bits -- refers to a two's
14 complement representation of uncompressed binary
15 numbers.
16 Q. So applying your interpretation of
17 precision to a two's complement number, is it the
18 same? We just now have the first bit in the
19 series of bits tell us the sign?
20 A. No.
21 Q. How is the meaning of precision
22 different then for two's complement?

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1 A. For example, we have the range from
2 minus 127 to plus 128 in decimal, which often
3 corresponds to a range of pixel values, then plus
4 128 might be represented by all one's and minus
5 127 would be represented by the two's complement
6 of that.
7 Q. What I am trying to figure out here
8 from your answer, Dr. Freedman, is how the number
9 of bits needed to represent possible values
10 changes for a two's complement number?
11 A. Oh, it doesn't, and that is the point.
12 Q. So it seems that, then, your
13 interpretation of precision would apply to a two's
14 complement number and we would just look at the
15 greater...
16 A. Absolute magnitude.
17 Q. Sorry? What was that?
18 A. The greater absolute magnitude.
19 Q. Thank you.
20 So the greater the absolute magnitude,
21 then, the greater the precision of a number is for
22 negative decimal numbers?

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1 A. To be more precise, the greater the
2 absolute magnitude, the greater the number of bits
3 represented in uncompressed binary form;
4 therefore, the greater the required precision.
5 Q. Earlier in one of your answers you
6 used the term "range"?
7 A. Yes.
8 Q. Can you provide a definition for
9 range?
10 MR. LIANG: Objection to form.
11 A. What context are we speaking about
12 here, Counsel?
13 Q. Reading now from the transcript, which
14 I will acknowledge is a rough draft, you answered,
15 "For example, we have the range from minus 127 to
16 plus 128 in decimal."
17 What do you mean by "range" in that
18 answer?
19 A. Range is a mathematical term, and the
20 way that I am interpreting it here for the purpose
21 of discussing the '267 Patent is that the range
22 encompasses all whole numbers between the lowest

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1 value, minus 127, to the highest value, 128.
2 Q. As I understand your interpretation of
3 the term "precision" as it relates to the
4 magnitude of a number, the greater a given number
5 is, you will use in uncompressed binary form more
6 bits; therefore, you have more precision?
7 A. Well, apart from the statement about
8 the greater the number, to be caveated as greater
9 the absolute magnitude number, then the more bits
10 to represent it, the more precision.
11 Q. So if I were to correct my statement,
12 I would say your interpretation of the term
13 "precision" is that, as it relates to the absolute
14 magnitude of a number, the greater that absolute
15 magnitude of a number is, you will use more bits
16 in uncompressed binary form; therefore, you have
17 more precision?
18 A. Yes.
19 Q. There is an example that you provide
20 in your declaration in your discussion of the '267
21 Patent that I would like to ask you about. It is
22 on page 13.

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1 A. Speaking of the same declaration?
2 Q. Correct. Thank you for the
3 clarification. Still referring to Exhibit 1 which
4 is in front of you.
5 A. Okay.
6 Q. Are you at page 13 of Exhibit 1?
7 A. Yes.
8 Q. You give the example that "an
9 uncompressed variable having values that range
10 from 0 to 3 can be represented by a binary number
11 of 2 bits."
12 A. Yes.
13 Q. By "range" in that sentence on page 13
14 of your declaration, you are referring to integer
15 values 0, 1, 2 and 3?
16 A. Yes.
17 Q. And "precision," according to your
18 interpretation, is the fact that we represent the
19 range 0, 1, 2 and 3 with 2 bits?
20 A. Yes.
21 Q. Then on page 13, what you have done is
22 you multiply that range 0, 1, 2, 3 by 2 such that

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1 the range is now 0, 2, 4 and 6?
2 A. No, that's not the range, not in terms
3 of the interpretation that I am adopting.
4 Q. Can you -- sorry.
5 A. So, I understand what you are
6 thinking, Counsel. To be more precise, if we
7 perform a multiplication by 2, then the range
8 expands from 0, 1, 2 and 3 to 0, 1, 2, 3, 4, 5, 6
9 and 7.
10 Q. Can you explain how multiplying 0, 1,
11 2 and 3 --
12 A. I am sorry. Are we speaking
13 specifically about the example of representing 0
14 to 7 with 3 bits of precision, or are we speaking
15 about something else? Perhaps I didn't quite
16 understand your question, Counsel.
17 Q. Sorry. Thank you for letting me know
18 that you might not have understood it so we can be
19 sure we are on the same page.
20 I am looking here at page 13 of
21 Exhibit 1. There is the sentence, "For example,
22 an uncompressed variable having values that range

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1 from 0 to 3 can be represented by a binary number
2 of 2 bits." The next sentence says, "When
3 multiplied by 2," the results --
4 A. Where does it say? Oh, I see. You
5 are looking further up.
6 An uncompressed variable having values
7 that range from naught to 3 can be represented by
8 a binary number of 2 bits. When multiplied by 2,
9 the result could range from naught to 6 and thus
10 needs 3 bits of precision to represent the largest
11 possible value 6 in binary.
12 Yes, this is a correct statement.
13 Q. Okay. What I am trying to figure out
14 here is, what are the possible results that we
15 receive after multiplying 0, 1, 2, 3 by 2?
16 A. Counsel, you are discussing a
17 different representation of numbers. While I see
18 where you are coming from with this -- and perhaps
19 we consider this to be an implementation
20 question -- if I have a variable that ranges from
21 naught to 3 and I multiply it by 2 and I need
22 3 bits of precision to represent the largest

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1 number 6, then in my opinion 3 bits are
2 appropriate to represent in uncompressed binary
3 format all the values from 0 to 6, including the
4 specific values that result from multiplying the
5 values naught, 1, 2 and 3 by 2.
6 Q. Right. What I want to do now is go
7 through the math of your example here. So, I
8 think we agreed earlier that in your example
9 sentence, with an uncompressed variable having
10 values that range from 0 to 3, the possible values
11 in that range are 0, 1, 2 and 3?
12 A. That is a correct statement.
13 Q. Using all the different possible
14 arrangements of 2 bits, we are able to represent
15 those four possible values?
16 A. Yes.
17 Q. Now we'll take those four possible
18 values and we will multiply each by 2.
19 A. Yes.
20 Q. Now we have 0, I think we agree that
21 is a possible result?
22 A. Yes.

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1 Q. 2?
2 A. Yes.
3 Q. 4?
4 A. Yes.
5 Q. And 6?
6 A. Yes.
7 Q. So we have four possible values, 0, 2,
8 4 and 6?
9 A. While I understand the thrust of your
10 comments, Counsel, I believe that you are hinting
11 at a completely different representation. And
12 this is where we have our differences because, in
13 my view, the fact that we have 0, 2, 4 and 6 as
14 results does not detract from the fact that in
15 uncompressed binary format the value 6 should be
16 represented by 3 bits. And in my opinion, it
17 would be appropriate to represent all of those
18 values in the entire range from 0 to 6 by 3 bits
19 in order to practically encompass the full range.
20 And what you are discussing, Counsel,
21 is a different representation, a different
22 implementation that would not normally be

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1 considered to be uncompressed binary format.
2 Q. I think I understand your answer. Let
3 me see if we are on the same page.
4 So, what you are saying is that it
5 would be appropriate to use 3 bits to represent
6 the possible values 0, 2, 4 and 6 because that's
7 what's typically done. Now, we could imagine a
8 world where we say, instead, we'll use just
9 2 bits, and then each of the four possibilities
10 then maps on to 0, 2, 4 and 6?
11 A. However, the catch in your statement,
12 Counsel, is the term "map." And that type of
13 mapping introduces additional complexity.
14 Sometimes an index has to be maintained to
15 maintain such mappings. A POSITA would not
16 normally be motivated to do that. The simplest
17 thing to do is to stick to the prevalent
18 implementation of taking 3 bits for all of it.
19 Q. If we had a scenario where we had two
20 possible values in a system, 0 or 10, would you
21 agree that one possible implementation would be to
22 use 1 bit to essentially flag whether we have that

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1 0 or 10 value?
2 A. You are speaking about a different
3 kind of quantity, Counsel. The context of the
4 '267 Patent, and in particular the context of what
5 is being discussed here, relates to pixel values;
6 and 8-bit signed pixel values typically range,
7 over all the values, from minus 127 to plus 128,
8 or in some types of systems unsigned pixel values
9 range over the whole range of all the whole
10 numbers from 0 to 255.
11 So, while you are speaking about a
12 theoretical possibility that might apply to
13 different types of systems and other types of
14 variables, regarding this context of pixel values
15 and the '267 Patent, that interpretation, in my
16 opinion, is untenable.
17 Q. Okay. I think we agree that in a
18 typical system you may have pixel values that
19 range from something like 0 to 255 or minus 127 to
20 128 depending on whether we are including negative
21 values.
22 A. That would be quite typical.

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1 Q. Using an 8-bit register?
2 A. That would be a common implementation.
3 Q. Now, if we take one of those pixel
4 values and we multiply it by 2, we no longer have
5 the full range of those possible values; our
6 possible values are only even numbers at this
7 point expressed in decimal form. Would you agree
8 with that?
9 A. Counsel, I am not quite understanding
10 the relevance of your question. Please could you
11 repeat your question so I understand it more
12 clearly?
13 Q. Yes.
14 So, we were just talking about the
15 range of possible values for a given pixel?
16 A. Yes.
17 Q. Now I am saying, imagine that we
18 multiply whatever value that happens to be along
19 that range by the number 2. Mathematically, you
20 would agree that the possible results of that
21 operation are only the even numbers within our
22 range?

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1 A. Counsel, you are repeating the same --
2 attempting to repeat the discussion and I believe
3 I have already answered your question.
4 If we take, let us say, numbers in the
5 range naught to 255 and multiply them by 2, to
6 maintain precision and accuracy we need to
7 increase the precision by an appropriate amount
8 and in an appropriate implementation to cover the
9 whole range. Otherwise, we will have problems
10 such as overflow.
11 Q. If you assume that we are limited in
12 the size of our registers, we are going to have
13 overflow problems?
14 A. There are practical implementations,
15 which I think are not relevant to the disclosure
16 of this patent, as to how such systems can be
17 practically implemented. They are not very
18 complex.
19 There are -- when there are systems
20 that require high precision, higher accuracy, such
21 as perhaps a 4K video system compared to, say,
22 surveillance camera footage, the additional

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1 precision may be required. And there are
2 practical implementations that can be made even on
3 systems with 8-bit registers or, more commonly,
4 systems that have 16-bit registers, or even now
5 64-bit registers in the modern era.
6 Q. Are you familiar with the concept of
7 entropy coding?
8 A. Counsel, while I understand the
9 statement you are making, please, could you
10 clarify the relevance to the disclosure of the
11 '267 Patent, which focuses entirely on the early
12 part of the encoding or decoding process before
13 any attempts at what you have described as entropy
14 coding are made.
15 While I understand perhaps -- maybe I
16 should not presume to understand your thrust.
17 Nonetheless, the disclosure of the '267 Patent
18 focuses on motion compensation, integer sub-pixel
19 positions, uncompressed binary information that is
20 at an earlier stage in the process of video
21 encoding than entropy coding.
22 Q. Would a person of ordinary skill in

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1 the art understand that an entropy coding
2 component would be part of a common video
3 architecture for an encoder or decoder at the time
4 of the '267 Patent?
5 A. It could be. It doesn't have to be.
6 And even, if I recall rightly -- and it is only
7 from memory; I do not have the standard in front
8 of me -- in the H.264 standard there is a bypass
9 coding that bypasses the entropy coding.
10 Q. Let's look at page 81 of Exhibit 1 in
11 your declaration.
12 A. Before we go there, Counsel, just a
13 minute or two?
14 MR. VERBONCOEUR: A quick break then.
15 (Recess.)
16 BY MR. VERBONCOEUR:
17 Q. Welcome back, Dr. Freedman.
18 I directed you to page 81 of
19 Exhibit 1. Now I would like to read to you a
20 sentence that spans across pages 81 to 82. That
21 is in reference to what we have called the
22 Karczewicz ground.

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1 "The similarities of Karczewicz-I's
2 and Karczewicz-II's architecture would have
3 suggested to a person of skill in the art to
4 implement techniques taught by Karczewicz-I and
5 techniques taught by Karczewicz-II using that
6 common architecture."
7 That sentence ends on page 82 of your
8 declaration. Do you see that?
9 A. Yes.
10 Q. Now, if we go back to page 81, we see
11 what I believe to be the reference to a common
12 architecture you made. Can you confirm that for
13 me?
14 A. Yes.
15 Q. At the top of the page 81 of Exhibit 1
16 there are two figures, one of which is from one of
17 the Karczewicz references and the other is from
18 the other Karczewicz reference.
19 A. Yes.
20 Q. We know that these two figures are
21 describing encoding processes because that is what
22 the captions say but also because we see transform

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1 units and quantization units?
2 A. Yes.
3 Q. Isn't it correct, Dr. Freedman, that
4 in all hybrid-based encoding processes we'd expect
5 to see a transform unit and a quantization unit?
6 A. That's a very general statement,
7 Counsel, and it doesn't refer to any particular
8 standard. It is not mandatory to have a transform
9 unit and it's not mandatory to have a quantization
10 unit. And if one wanted to encode images in some
11 other manner and was willing to accept the
12 resulting overheads, one could dispense with both.
13 Q. Are you aware of any lossy compression
14 system in use today that doesn't use transform and
15 quantization in a hybrid-based encoding process?
16 A. I am glad that you pointed out the
17 term "lossy." Off the top of my head, I cannot
18 think of one.
19 Q. And then this encoder architecture in
20 the two Karczewicz references also has an entropy
21 coding unit. Do you see that in the bottom of
22 each of the two figures displayed at the top of

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1 page 81 of Exhibit 1?
2 A. Yes, I see that.
3 Q. The entropy coding unit is what acts
4 right before the bitstream is produced in each
5 case?
6 A. That appears correct.
7 Q. What is entropy coding?
8 A. Entropy coding. Okay. Counsel, I
9 want to again ask, what is the specific relevance
10 of this to the disclosure and claims of the '267
11 Patent?
12 Q. Doctor, I am not the witness and so I
13 can't tell you what I believe to be the relevance
14 or not relevance in a way that is sort of me
15 testifying. You are the one offering opinions in
16 this case. My role is to ask you questions.
17 If you don't think it is relevant, you
18 can explain to me why you don't think it is.
19 Right now the question is just, what is entropy
20 coding?
21 A. I understand. I would like to first
22 say that the disclosure '267 Patent focuses on the

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1 area of the motion estimation unit and the motion
2 compensation unit, which is present in both
3 figures at the top of page 81, and that is the
4 part that is being disclosed and being claimed in
5 the '267 Patent.
6 Completely separate from the
7 discussion of the claims of the '267 Patent, there
8 are downstream processes such as entropy coding.
9 An entropy coding system is a system where what is
10 typically an uncompressed binary format stream is
11 encoded in such a way as to attempt to reduce the
12 amount of unnecessary information stored in the
13 final bitstream.
14 In other words, it's an attempt to
15 reach an ideal level of compression, which is
16 often measured by the Shannon entropy, which is a
17 measure of disorder in the bitstream.
18 Q. Earlier I asked you a question about a
19 system where we had two possible values in a
20 bitstream, 0 and 10. If we were to entropy code
21 that bitstream, a more efficient or more
22 compressed way of representing the values that are

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1 possible in that bitstream would be to use 1 bit.
2 That would essentially tell us whether we have 0
3 or 10?
4 A. Again, Counsel, let me repeat that in
5 terms of the relevance and the context of the
6 disclosure of the '267 Patent and the claims in
7 that patent in suit, which is what we are
8 attempting to discuss today, attempting to assist
9 the judge in reaching decision, that is really
10 outside the scope of the claims of the '267 Patent
11 according to my understanding.
12 Q. I appreciate your view that entropy
13 coding is not something within the scope of the
14 claims of the '267 Patent. You would at least
15 agree with me that a person of ordinary skill in
16 the art would know what entropy coding is?
17 A. It would be typical for a person of
18 ordinary skill in the art to know what entropy
19 coding is.
20 Q. Now going back to my example, what I
21 am looking for is not whether you think entropy
22 coding is relevant to the scope of the claim of

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1 the '267 Patent or whether it is required. I am
2 just trying to figure out the math behind this.
3 If we had a bitstream that had two
4 possible values, 0 and 10 for all values in that
5 bitstream, if we took an entropy coding process,
6 we could use 1 bit to represent whether we had
7 either 0 or 10 in each case for every variable in
8 that bitstream. Do you agree?
9 A. Let's refer back to the architecture.
10 So, if one had an entropy coding system much
11 earlier in the downstream process and if one had
12 what is essentially a binary logical variable, 0
13 and 10 essentially representing a binary logical
14 variable, one could represent it in fewer bits.
15 Nonetheless, the disclosure and claims
16 of the '267 Patent refer to a much earlier process
17 where we have uncompressed binary formats and
18 where we are focusing on pixel levels that are --
19 and predictions that are whole integers, whole
20 number integers.
21 Q. You agree, though, that the '267
22 Patent doesn't require that predictions be whole

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1 integers?
2 A. I think you are conflating more than
3 one -- more than one consideration here, Counsel.
4 Are you speaking about the concept of predictions
5 and whether predictions relate to whole integers,
6 or not?
7 Q. Doctor, you used the phrase
8 predictions that are whole integers. What did you
9 mean by that phrase?
10 A. I mean predictions that, for example,
11 encompass integer values within a certain range.
12 I am not speaking about pixel positions, which can
13 be, for example, half, quarter or eighth pixel
14 positions, but the representation of predicted
15 values or of pixel values in a form that can be
16 understood by these encoders such as 0 to 255 or 0
17 to 1024 or some other set of whole numbers.
18 Q. A convention in video coding is that
19 we use whole integer values between 0 and 255 or
20 negative 127 and 128, for example, for 8 bits to
21 represent pixel values. But we could just as
22 easily have a step size different than an integer

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1 value between each possible arrangement of those
2 bits?
3 MR. LIANG: Objection to form.
4 A. Counsel, you are repeating the same
5 discussion that we had earlier on sets of possible
6 values and ranges. And I believe I already
7 answered your question very clearly about the use
8 of uncompressed binary format -- and the key there
9 is "uncompressed" and the key there is "binary" --
10 uncompressed binary format to represent the range
11 that is all the integer values from the lowest to
12 the highest of those integers.
13 Q. Your Ph.D., Doctor, was in physics?
14 A. Yes.
15 Q. Do you believe that the term
16 "precision" has a different meaning in the context
17 of physics than it does in the context of the '267
18 Patent?
19 A. Counsel, that is a truly vague
20 question because all these things are context
21 sensitive. You spoke about physics. Physics is a
22 truly enormous field encompassing many, many

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1 technological disciplines from the very smallest
2 entities in existence to the very largest.
3 So, "precision" is a context-sensitive
4 term. To illustrate from other fields, the term
5 "precision" could, for instance, refer to a
6 precision machining tool. Or in linguistics, it
7 could refer to the use of precise language to
8 describe a subject such as we are trying to do
9 today.
10 So, there is not one unique meaning of
11 precision; it is always context sensitive. And we
12 have been discussing precision within the context
13 of the disclosure and claims of the '267 Patent.
14 Q. I would like to use an analogy here.
15 If you think this is too simplistic, let me know
16 and we can use something else. But in our
17 currency system in the United States we have
18 dollars, quarters, dimes, nickels and cents. The
19 smallest expressible amount of currency we have
20 with actual coins is 1 cent.
21 Do you understand all that?
22 A. Within a financial system that focuses

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1 on denominations of physical coins. Of course,
2 our United States financial system often
3 encompasses fractions of those to determine
4 exchange rates and to perform broker account
5 activities.
6 Q. Exactly. That is actually what I want
7 to explore. So in a system that can't address
8 fractions of physical coins and we are limited to
9 the coins themselves, the smallest expressible
10 unit is 1 cent?
11 A. At this time in the United States.
12 However, in earlier eras it was possible to
13 actually physically cut the coin to represent
14 smaller denominations. This is something we no
15 longer do.
16 Q. So if we are in a system where we
17 don't cut coins, the smallest unit we can
18 represent is 1 cent. You agree with that?
19 A. Within the constraints of the system
20 that you mentioned.
21 Q. And what that means is that I can
22 express 1 one-hundredth of a dollar?

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1 A. Yes.
2 Q. And imagine that I gave you 1 dollar
3 and 1 cent. One way of writing that would be
4 1.01?
5 A. In our current decimal system.
6 Q. If I took away the 1 cent, have I
7 changed the precision of the amount of money I
8 have given you if we assume a system that can
9 represent 1 one-hundredth of 1 dollar as the
10 smallest unit?
11 MR. LIANG: Objection to form.
12 A. So, I understand the statement you are
13 making, Counsel. And I would normally represent
14 that number, 1 dollar and 1 cent minus 1 cent --
15 if I were, say, for example, writing a check, I
16 could represent it as 1 and 00 over a hundred
17 dollars.
18 Q. If we imagined a world in which we cut
19 our pennies into 10th's, we would now essentially
20 add a decimal point to the end of our
21 representations. So, I could give you 1.001
22 dollars rather than just 1.01 dollars?

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1 A. In that hypothetical world, which to
2 me seems to be irrelevant to the context of the
3 '267 Patent.
4 Q. And if I took away the one-tenth of 1
5 cent, I have not changed the precision of the
6 remaining dollar?
7 MR. LIANG: Objection to form.
8 A. Counsel, while I see where you are
9 going, it is entirely reasonable for me to
10 represent that at the same precision, a precision
11 I choose to represent it at, as 1 dollar and 000
12 over 1,000 dollars.
13 Q. Now I think we are getting to the crux
14 of the matter. But if I gave you
15 1 million dollars --
16 A. Yes, please.
17 Q. Unfortunately, I don't have the
18 million dollars to give you. But if I were to
19 give you 1 million dollars and I gave you no 10ths
20 of a penny, does that change the precision of the
21 amount of money I have given you? Have I given
22 you a greater precision of money because I have

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1 given you a greater number of dollars?
2 A. It is a question of representation
3 again and the choice of representation. In the
4 representation we have been discussing, this
5 number can be represented as 1 million and 000
6 over 1,000 dollars. In that system of
7 representation, the required precision may have
8 increased beyond 1 dollar because I need now to
9 represent all the whole number dollars from 0 to
10 1 million with more decimals, more decimal digits.
11 So, I can represent that as
12 1,000,000.000 over 1,000 dollars. And that does,
13 indeed, require a greater precision to represent.
14 Q. Now going back to a video coding
15 scenario, the pixel values that are higher on our
16 range -- let's assume no negative numbers. Let's
17 assume just positive pixel values. Are we on the
18 same page there?
19 A. Yes.
20 Q. Let's assume a range of possible
21 values from 0 to 255, 8-bits, if you will, of
22 possibilities.

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1 A. Okay.
2 Q. It will always be the case that the
3 value 255 is going to be more precise than the
4 value 1?
5 MR. LIANG: Objection to form.
6 A. This is not true, Counsel, because you
7 are again essentially asking the question you have
8 asked many times before, and it relates to the
9 representation.
10 In the representation we have been
11 speaking about, 1 -- and knowing that the range is
12 0 to 255 unsigned -- 1 is represented by an 8-bit
13 number in which 7 bits are zeros and 1 bit is 1;
14 and 255 is represented by a binary number in which
15 all 8 bits are set to 1.
16 Q. So, in that context your position
17 would be, in that representation the precisions
18 are the same?
19 A. Yes.
20 Q. Okay.
21 A. Given that range.
22 Q. If we assume a range of 0 to 255, then

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1 all values within that range have the same
2 possible precision?
3 A. Depending on the range and in this
4 representation.
5 Q. Now, if we multiply any number within
6 that range, if the result exceeds 255, then we
7 either have overflow or, under your
8 interpretation, we must increase the precision by
9 using more bits?
10 A. That would seem to be true.
11 MR. VERBONCOEUR: Let's take a quick
12 break.
13 (Recess.)
14 BY MR. VERBONCOEUR:
15 Q. Welcome back, Dr. Freedman.
16 Are you familiar with the concept of
17 fidelity in video coding?
18 A. It's definitely a concept I have heard
19 of.
20 Q. What is fidelity in video coding?
21 A. Ah, well, if anyone knew, it would be
22 a very valuable piece of intellectual property.

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1 However, fidelity is represented by a number of
2 different approaches. Unfortunately, in video no
3 one, even the video experts group, has been able
4 to precisely capture the meaning of fidelity.
5 Q. When experts in video coding use the
6 phrase "higher fidelity," what are they referring
7 to?
8 A. They typically refer to encoding of
9 video in a way that is less lossy; that is, less
10 approximation is made to the pixel values in the
11 original raw video stream in ways that matter to
12 the context of use.
13 Q. Are you familiar with the H.265
14 standard?
15 A. I am reasonably cognizant of it.
16 However, I do not have that standard in front of
17 me and it is a very complex standard of many
18 hundreds of pages. And --
19 Q. Are you familiar -- I apologize.
20 A. It is also not particularly relevant
21 to the disclosure, the '267 Patent. That
22 discloses H.264, but I don't perceive it as

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1 explicitly disclosing H.265, which was ratified
2 far after its priority date.
3 Q. Have you read the Preliminary Patent
4 Owner Response that was filed by Nokia?
5 A. I may have done. I don't recall it.
6 Q. Let me know if this doesn't ring a
7 bell and we can move on. But are you familiar
8 with Nokia's contention that the inventors of the
9 '267 Patent were working on H.265 standardization
10 and proposed the techniques claimed in the '267
11 Patent to the H.265 standard?
12 A. If I had read that, I have no memory
13 of reading that. It truly doesn't ring a bell
14 with me.
15 Q. Are you familiar with the acronym
16 HEVC?
17 A. Yes. You are referring to HEVC, high
18 efficiency video coding.
19 Q. Correct. Let me know if you need me
20 to introduce the '267 Patent as an exhibit. You
21 perhaps have brought it?
22 A. I do, indeed, have an unmarked copy of

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1 that patent in front of me.
2 MR. VERBONCOEUR: I will go ahead and
3 introduce that as an exhibit. Let's mark
4 Dr. Freedman's copy.
5 (So marked for identification as
6 Exhibit 2.)
7 Q. Dr. Freedman, what has been marked
8 Exhibit 2 is your copy of the '267 Patent.
9 A. Yes.
10 Q. If we look at the priority date of the
11 '267 Patent, I will direct you to column 1.
12 A. Sorry. So, there is a date that it
13 was filed. Counsel, my understanding is that
14 priority dates require a legal determination which
15 is not appropriate for me to make in this context.
16 Q. How about if we do it this way. If
17 you look at column 1 of the '267 Patent, which
18 will be several pages in past the figures --
19 A. Yes.
20 Q. You see there is a subsection called,
21 "Cross-reference to related applications"?
22 A. Yes, Counsel, I see it.

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1 Q. If you go all the way to the very
2 earliest date, you will see January 7, 2011 at the
3 bottom of that section.
4 A. Yes. I see that page.
5 Q. Do you agree that H.264 was published
6 in May of 2003?
7 A. I have no idea, Counsel. To determine
8 that, I would have to see a copy or perform an
9 internet search for the earliest revision of that
10 standard, and I am not going to agree to that
11 information without some verification.
12 Q. Do you have some sense of when H.264
13 was published in its first final form?
14 A. I don't want -- I don't want to make a
15 guess, Counsel. Such information has to be -- has
16 to be verified before I will agree to it.
17 Q. To verify that, we'll introduce
18 another exhibit.
19 MR. VERBONCOEUR: We'll mark this
20 Exhibit 3.
21 (So marked for identification as
22 Exhibit 3.)

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1 Q. What's been marked as Exhibit 3 is an
2 IEEE paper called "Overview of the H.264/AVC Video
3 Coding Standard." Do you see the title?
4 A. I see the title.
5 (Brief interruption due to noise
6 condition.)
7 MR. VERBONCOEUR: Let's break for a
8 second.
9 (Pause.)
10 Q. So, we are looking at Exhibit 3, which
11 has been marked "Overview of the H.264/AVC Video
12 Coding Standard"?
13 A. Yes.
14 Q. If you look below the title of
15 Exhibit 3, there are some names. Thomas Weigand,
16 Gary Sullivan, Gisle Bjøntegaard and Ajay Luthra?
17 A. Yes.
18 Q. Do you recognize those names?
19 A. I recognize the first two names.
20 Q. Do you recognize Thomas Weigand and
21 Gary Sullivan as co-chairs of the Joint Video Team
22 that developed H.264?

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1 A. I don't recall. It was just too long
2 ago. But the names are familiar to me.
3 Q. I will direct you to a paragraph in
4 the second column of the first page. It is the
5 second full paragraph. In particular, the last
6 sentence of that second full paragraph.
7 It says, "In December of 2001 VCEG and
8 The Moving Picture Expert Group, MPEG, formed a
9 Joint Video Team with the charter to finalize the
10 draft new video coding standard for formal
11 approval submission as H.264/AVC in March 2003."
12 A. I am sorry. I am not finding it.
13 What was the location?
14 Q. It is the last sentence of the second
15 full paragraph on the second column of the first
16 page.
17 A. Oh, I see where it is. "In
18 December 2001..."
19 I see it.
20 Q. I should ask, do you recognize this
21 paper, "Overview of the H.264 Video Coding
22 Standard"?

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1 A. I believe I may have seen it before,
2 if it is the same paper I have seen before. Let
3 me see if it is indeed even in my binder here. It
4 might be.
5 It does not appear to be.
6 Nonetheless, this is a document I have previously
7 seen in conjunction with video coding.
8 Q. If you look at the last sentence of
9 the second full paragraph in the second column of
10 the first page of Exhibit 3, there is reference to
11 the finalization of the new video coding standard
12 for formal approval submission as H.264/AVC in
13 March 2003. Does that year ring a bell for you?
14 A. Well, all the years ring bells. One
15 should understand that submission for approval is
16 not the same as ratification or publication, and
17 so I would essentially need to see that that
18 standard was actually ratified and actually
19 published in an appropriate year.
20 This is a publication -- and, Counsel,
21 it is not within the scope of my deposition nor is
22 it appropriate for me as an expert to opine on

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1 what is essentially a legal determination of
2 priority.
3 Q. This is not about priority, Doctor.
4 The question is just, when was H.264 introduced?
5 A. Presumably sometime after March 2003.
6 It would have been approved after submission for
7 approval. The question is precisely when.
8 Q. Let's go to page 6 of your declaration
9 that we had marked as Exhibit 1, I believe.
10 A. Okay. Page 6. Yes.
11 Q. There is a sentence, the second full
12 sentence from your declaration, that says, "In
13 2003, the H.264 standard, also known as Advanced
14 Video Coding (AVC) was introduced."
15 A. Yes, it says that.
16 Q. Is it correct that the H.264 standard
17 was introduced in 2003?
18 A. If I wrote it there, I would have
19 verified it.
20 Q. So now let's go back to the '267
21 Patent which we have marked Exhibit 2.
22 A. Yes.

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1 Q. We are looking at column 1 now, so
2 about 15 pages into the document, past the
3 figures.
4 A. I see it.
5 Q. I am not asking you for a legal
6 determination of priority date, but you can agree
7 with me that the earliest date listed in the
8 section "Cross-Reference to Related Applications"
9 is January 7, 2011?
10 A. The earliest of the list of dates that
11 are mentioned under "Cross-Reference to Related
12 Applications" is January 7, 2011.
13 Q. If you go to page 24 of your
14 declaration marked Exhibit 1, please, there is a
15 sentence on page 24 of Exhibit 1 where you write,
16 "For purposes of this declaration, I have analyzed
17 obviousness as of January 7, 2011."
18 A. Correct.
19 Q. So for purposes of your opinions, we
20 are looking at the '267 Patent as having a date of
21 January 7, 2011?
22 A. For that purpose.

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1 Q. Do you know when the standardization
2 efforts for H.265 started?
3 A. Not offhand, Counsel. And it would be
4 typical for me to look up the information on the
5 internet. There are draft standards and there are
6 working papers that were published, and I do not
7 recall the precise dates and would indeed have to
8 look them up.
9 Many of the deliberations of the MPEG
10 committee were published in the sense that they
11 became available to the public. And as for the
12 implication of that, it is not appropriate for me
13 to opine on that implication.
14 Q. I would like to go back to page 6 of
15 your declaration, please, marked Exhibit 1. There
16 is a figure displayed on page 6. Feel free to
17 correct this if it is not correct, but your
18 declaration described it as "the model of a
19 typical general video encoder as illustrated
20 below. This fundamental model has been used by
21 major video encoding standards since the 1990's."
22 A. It is a statement about typical

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1 encoders and a hybrid model that has been widely
2 used since the 1990's by major video encoding
3 standards. It is not prescriptive that it must be
4 used; however, it is widely used.
5 Q. It's your opinion that a person of
6 skill in the art would look at this figure and
7 appreciate this as a notoriously well-known model
8 for a general video encoder?
9 A. I would object to the word "notorious"
10 because I think it is a very good type of encoder.
11 Nonetheless, it would be quite familiar to a
12 person of ordinary skill in the art.
13 Q. I will ask the question without the
14 word "notorious." How about we say it is your
15 opinion that a person of skill in the art would
16 find the general video encoder model depicted on
17 page 6 of your declaration marked as Exhibit 1
18 quite familiar?
19 A. Yes.
20 Q. I would like to talk now about the
21 Karczewicz references on which you rely. You are
22 familiar that you have what we have been calling

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1 or haven't yet called the Walker Ground and then
2 you have the Karczewicz Ground?
3 A. Yes. It is in my declaration.
4 Q. Now what I would like to do is
5 introduce the Karczewicz references on which you
6 rely as exhibits. Do you have those in your
7 binder?
8 A. Yes, I do. I will have to see which
9 tab it is.
10 Okay. I see them.
11 Q. I will hand you a copy as well
12 because, given they are both called Karczewicz, I
13 want to be sure we have the two of them lined up
14 so we know which is which.
15 MR. VERBONCOEUR: If we can mark as
16 Exhibit 4 the Karczewicz reference that is
17 Publication No. 2011/0007799.
18 (So marked for identification as
19 Exhibit 4.)
20 Q. Doctor, in your declaration you refer
21 to what has been marked Exhibit 4 as Karczewicz-I?
22 A. That would appear to be true.

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1 MR. VERBONCOEUR: Now I will mark the
2 second Karczewicz exhibit. The second
3 Karczewicz exhibit, which we'll mark
4 Exhibit 5, is Publication No. 2009/0257499.
5 (So marked for identification as
6 Exhibit 5.)
7 THE WITNESS: Okay. I see it.
8 Q. What has been marked Exhibit 5 you
9 have been calling Karczewicz-II?
10 A. Apparently.
11 Q. So I would like you to put Exhibits 4
12 and 5 side by side, 4 being Karczewicz-I,
13 Exhibit 5 being Karczewicz-II.
14 A. Do you mean literally physically side
15 by side?
16 Q. It may be easier for you to answer the
17 questions. You are not required to put them
18 physically adjacent to one another if you prefer
19 not to.
20 A. Okay. They are adjacent.
21 Q. Let's see if we can agree on basic
22 facts about Karczewicz-I and Karczewicz-II.

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1 First, the inventors, Marta Karczewicz, Peisong
2 Chen and Yan Ye, are common between Karczewicz-I
3 and Karczewicz-II?
4 A. That statement appears correct.
5 Q. Not only are Karczewicz-I and
6 Karczewicz-II invented by the same inventors, both
7 Karczewicz-I and Karczewicz-II are assigned to
8 Qualcomm Incorporated?
9 A. That appears correct.
10 Q. Just to be sure I have it right --
11 feel free to consult your declaration -- is it
12 your opinion a person of ordinary skill in the art
13 would have seen Karczewicz-I and would have been
14 motivated to modify Karczewicz-I based on
15 Karczewicz-II?
16 A. I believe that, to answer your
17 question with greater precision -- sorry to use
18 that term -- a person of ordinary skill in the art
19 would be motivated to combine the disclosures of
20 Karczewicz-I, which I like to call K-I and
21 Karczewicz-II, which I like to call K-II.
22 Q. I think what I am asking here is what,

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1 in your view, is the person of ordinary skill in
2 the art starting with. Are they starting with
3 Karczewicz-I, or are they starting with
4 Karczewicz-II?
5 A. Well, from the standpoint of a person
6 of ordinary skill in the art, I would propose that
7 they are starting from the simpler starting point,
8 which appears to be K-I.
9 Q. Why do you refer to Karczewicz-I as
10 the simpler starting point?
11 A. Because if I recall rightly, it
12 focuses primarily on weighted predictions. And
13 although it does mention sub-pixel values, its
14 approach to the predictions for motion
15 compensation is of relatively -- relatively simple
16 form. While the disclosure of K-II provides
17 additional refinement to sub-pixel values from
18 sophisticated interpolation schemes.
19 Q. Thank you.
20 I would like to go back to the covers
21 of Exhibits 4 and 5 and ask you a couple more
22 questions about them.

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1 Are you familiar with Marta
2 Karczewicz?
3 A. I do not know that person.
4 Q. What about Peisong Chen?
5 A. Not someone I know personally.
6 Q. Have you heard of Peisong Chen before?
7 A. I don't recall. There are many people
8 whose last name is Chen, and I do not recall
9 whether Peisong Chen is someone that I have met.
10 Q. I want to make sure I ask the first
11 set of questions the right way. Have you heard of
12 Marta Karczewicz before this case?
13 A. I don't recall.
14 Q. Are you aware of Marta Karczewicz's
15 reputation in the video coding community?
16 A. I really don't recall. It's a very
17 large community with many individuals.
18 Q. What about Yan Ye? Have you heard of
19 Yan Ye before?
20 A. That name does not ring a bell, but
21 let me repeat my statement that the video and the
22 image coding community is very large indeed, and I

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1 don't recall -- I don't recall their names
2 offhand.
3 Q. Do you know whether Marta Karczewicz
4 is a person of ordinary skill in the art in video
5 coding as of the time of '267 Patent?
6 A. I have no basis for that
7 determination.
8 Q. The same question for Peisong Chen and
9 Yan Ye. Do you have any knowledge as to whether
10 they were people of skill in the art as of the
11 time of '267 Patent?
12 A. I have no basis to make that
13 determination on being persons of ordinary skill
14 in the art. I have opined on the level of a
15 person of ordinary skill in the art in my
16 declaration in terms of their experience and
17 educational background and their training.
18 So, I don't know what their
19 educational background, experience or training is,
20 and the only information we have in front of us is
21 that they are named as inventors on a pair of
22 patent application publications.

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1 Q. Now what I would like to do is look at
2 the publication dates. So, for Karczewicz-I you
3 agree that the publication date listed -- and this
4 is Exhibit 4 -- is January 13, 2011?
5 A. I see that there.
6 Q. In Karczewicz-II, Exhibit 5, the
7 publication date is October 15, 2009.
8 A. I see that.
9 Q. The application for Karczewicz-I,
10 marked Exhibit 4, was filed on July 9, 2009?
11 A. I see that date.
12 Q. The earliest application for
13 Karczewicz-II listed under "Related U.S.
14 Application Data" on Exhibit 5 is May 30, 2008?
15 A. And it would not be appropriate for me
16 to opine on priority. But I do see the date
17 listed.
18 Q. I am not asking you to opine on
19 priority, but can we at least agree that Marta
20 Karczewicz, Yan Ye and Peisong Chen were aware of
21 the application that was filed on May 30, 2008, as
22 listed here on Exhibit 5 of Karczewicz-II?

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1 A. I don't think I can agree to that,
2 Counsel, because you asked whether these
3 individuals were aware of it and I do not know
4 what the intellectual property practices of
5 Qualcomm are. I am sorry to say that there are
6 organizations that will file patent applications
7 that may never have been reviewed or notified to
8 their inventors, from documents they have in their
9 possession.
10 So, I cannot tell you whether those
11 people actually even knew the patent application
12 was being filed.
13 Q. Okay. Now I will ask you the same
14 question for Karczewicz-I, marked Exhibit 4.
15 There is this application that was filed on
16 July 9, 2009. Do you have an opinion as to
17 whether Marta Karczewicz, Peisong Chen and Yan Ye
18 knew about the substance of Karczewicz-I as of
19 that July 9, 2009 date?
20 A. That is a question I cannot answer.
21 My belief is that this is, on the face of it, a
22 patent application publication in which these

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1 individuals have been named. And while I would
2 hope they were aware of the contents and that they
3 had communicated with counsel, I have no
4 information as to whether that actually took
5 place.
6 MR. VERBONCOEUR: We can put those
7 aside for now. Now I would like to introduce
8 another exhibit we can mark as Exhibit 6.
9 (So marked for identification as
10 Exhibit 6.)
11 Q. What has been marked Exhibit 6 is
12 Publication No. 2003/0112864. Do you see that,
13 Doctor?
14 A. I see that number, yes.
15 Q. Do you see there is a publication date
16 listed on Exhibit 6 of June 19, 2003?
17 A. I see that publication date.
18 Q. Where Exhibit 6 lists inventors, there
19 is someone named Marta Karczewicz listed alongside
20 Antti Olli Hallapuro?
21 A. I see that.
22 Q. Does this give you enough information,

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1 Doctor, to agree with me that Marta Karczewicz
2 listed on Exhibit 6 is the same Marta Karczewicz
3 we saw on Exhibits 4 and 5?
4 A. I don't have that information,
5 Counsel. To me, it is a highly probable
6 proposition, but I have no means of verifying the
7 true identity of the inventor, nor do I know who
8 the assignee, if any, of this patent application
9 publication is.
10 Q. So you don't know one way or the other
11 whether Marta Karczewicz had been working on video
12 coding since at least this period of time listed
13 here on Exhibit 6?
14 A. I don't have any information about
15 that.
16 Q. Exhibit 6, you agree, is about
17 sub-pixel interpolation?
18 A. Well, Counsel, it is a document that
19 appears not to -- I do not recall this document
20 being opined on in my declaration. Let me look to
21 see, from the list of materials that were
22 referenced, whether indeed this document appears

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1 in the list.
2 This document does not appear in the
3 list which is on page 182 of the declaration,
4 titled "Appendix 2, Materials Considered in the
5 Preparation of this Declaration." Therefore, I
6 will assume that it wasn't considered and if I
7 make any statements about this patent application
8 publication, Counsel, it's outside the scope of my
9 declaration and would be effectively a new
10 opinion.
11 Q. So you don't have opinions on this
12 document, you didn't consider it, so we can put it
13 aside. I would like you to verify that before we
14 put it aside.
15 A. I have no opinion about the contents
16 of this document.
17 Q. Thank you.
18 I would like to get more into the
19 weeds on your Karczewicz-I and Karczewicz-II
20 opinions. If we could, please, turn to page 90 of
21 your declaration.
22 A. Okay.

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1 Q. Doctor, we are on page 90 of your
2 declaration, which has been marked Exhibit 1. Do
3 you recognize this section as going through the
4 three different motion vector scenarios where, in
5 your view, a person of skill in the art would have
6 been motivated to combine -- well, to modify
7 Karczewicz-I based on Karczewicz-II?
8 A. I believe that extends from paragraph
9 151 to at least paragraph 163.
10 Q. Yes. And starting with paragraph 151
11 on page 90 of your declaration through paragraph
12 163, there is scenario 1, scenario 2 and scenario
13 3?
14 A. I see that.
15 Q. I would like to ask you about these
16 scenarios and then ask you some questions sort of
17 keeping all three scenarios in mind. Let's start
18 with scenario 1 on page 90 of your decoration.
19 If I understand this right, this is
20 talking about a scenario where a person of skill
21 in the art would have been motivated to modify
22 Karczewicz-I based on Karczewicz-II when they were

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1 looking at a first motion vector that points to a
2 half-pixel position and then a second motion
3 vector that points to an integer pixel position?
4 A. It would seem that that is true.
5 Q. You agree with me that in video
6 coding, when we are talking about two-dimensional
7 image frames, motion vectors can have two
8 components, a vertical component and horizontal
9 component?
10 A. It depends again on the context. In
11 the context of H.262 or H.264, where there are
12 simply two reference frames for bi-directional
13 prediction, those are the possibilities. It is
14 not universally true for all possible video
15 codecs.
16 Q. Okay. But let's just use H.264 as an
17 example that I think we'd agree that a person of
18 skill in the art at the time of the '267 Patent
19 would have been familiar with.
20 A. Okay.
21 Q. In that context and from the
22 perspective of a person of skill in the art at the

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1 time of the '267 Patent thinking about, for
2 example, H.264, they would appreciate that a
3 motion vector can have two components, one to
4 represent horizontal movement, one to represent
5 vertical movement?
6 A. It's a question of representation and
7 how the pixels are indexed. One possible
8 representation is a row/column representation such
9 as you mentioned.
10 Q. So you agree a person of skill in the
11 art of the '267 Patent would appreciate that a
12 common way to represent motion vectors for pixels
13 on a grid is to have a horizontal component and
14 then a comma and then a vertical component?
15 A. That's a common scenario.
16 Q. So, I want to ask about the first and
17 second motion vectors you mention in paragraph 151
18 on page 90. When you say, "A first motion vector
19 points to a half-pixel position," are you saying
20 that either the horizontal or vertical position is
21 half-pixel, or both are half-pixel?
22 A. One needs to look at this with respect

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1 to an appropriate diagram. I believe there may
2 have been an appropriate diagram in one of the
3 Karczewicz references or perhaps within my
4 declaration.
5 Yes. We have a diagram, Figure 4B
6 from K-II, just below -- well, rather, below
7 paragraph 144 and above paragraph 145.
8 Q. Just for clarity of the record, you
9 are looking at page 87 of your declaration marked
10 as Exhibit 1, and we are now looking at Figure 4B
11 from Karczewicz-II?
12 A. That's right.
13 Q. On page 87 of Exhibit 1, your
14 declaration, you added what is shown in red?
15 There are red rectangles interposed on the figure
16 there; that is your addition?
17 A. Yes. The color scheme is my addition.
18 Q. Now going back to the question I asked
19 about paragraph 151, does this figure here on page
20 87 of your declaration help clear up whether, when
21 you reference a first motion vector points to a
22 half-pixel position, are you talking about one

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1 component of that motion vector, or does it have
2 to be both?
3 A. It can be one component. So, in
4 Figure 4B we have "b" and "h" as our pixel
5 positions.
6 Q. Okay. So going back to paragraph 151,
7 we are talking about now the discussion in
8 Karczewicz-II. Your position is scenario 1 would
9 occur when the first motion vector points to a
10 half-pixel position, but that could be either the
11 horizontal or vertical component?
12 A. It could be either the horizontal or
13 the vertical component. I would have to think
14 whether it's possible for it to be both
15 components.
16 Q. What about for the second motion
17 vector in paragraph 151? Is that referring to an
18 integer position for one of the components, or
19 both?
20 A. That is certainly referring to an
21 integer position for both.
22 Q. So the second motion vector needs to

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1 point to an integer pixel position for both
2 components; the first, you are not sure whether it
3 can point to half-pixel positions for both
4 components but at minimum it needs to point to a
5 half-pixel position for one component?
6 A. Correct.
7 Q. Then let's go to scenario 2, please,
8 page 94 of Exhibit 1, your declaration.
9 A. I see it.
10 Q. Now, in scenario 2 we have the first
11 motion vector pointing to a center-pixel position.
12 What do you mean by "center-pixel position"? Is
13 that in reference to Figure 4B from Karczewicz-II?
14 A. It is a reference to Figure 4B, and it
15 clarifies my answer to your previous question.
16 Q. Okay.
17 A. If we go back to Figure 4B, because it
18 is abundantly clear now within the context of that
19 disclosure, that "j" is what they are calling a
20 center-pixel position and not what has been called
21 a half-pixel position.
22 Q. So, scenario 1, from page 90 of your

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1 declaration, is talking about where the first
2 motion vector points to one component that is at
3 half-pixel position. Now scenario 2, the first
4 motion vector has to point to a half-pixel
5 position for both components?
6 A. This appears correct.
7 Q. Then also in scenario 2, the second
8 motion vector now doesn't point to an integer
9 pixel position; it points to a half-pixel
10 position?
11 A. So, "b" and "h" and "ee" and "hh" do
12 appear to be these half-pixel positions.
13 Q. So basically what's happened is, from
14 scenario 1 to scenario 2, the first motion vector,
15 rather than point to just one half-pixel position,
16 now are pointing to a half, half, both components
17 at half-pixel; then the second motion vector no
18 longer points to an integer pixel position but
19 points to the -- the motion vector has one
20 component that is a half-pixel?
21 A. Counsel, I would remind you that
22 half/half is a quarter. But I am going to

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1 interpret the statement as meaning that a
2 center-pixel has a half a pixel in the horizontal
3 and a half pixel in the vertical.
4 Q. Right. Let me clarify that. I don't
5 mean half by half, which would be quarter. I mean
6 one half, comma, one half. Are we on the same
7 page there?
8 A. We are now on the same page.
9 Q. Let's go to scenario 3, page 98 of
10 your declaration.
11 A. I see it.
12 Q. Scenario 3 is both motion vectors
13 point to half-pixel positions.
14 A. I see it.
15 Q. This is discussing the scenario where
16 one component of each of the motion vectors points
17 to a half-pixel position and the other component
18 of each of the motion vectors points to an integer
19 pixel position?
20 A. No.
21 Q. Can you explain, please, scenario 3?
22 A. Scenario 3 is precisely explained in

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1 paragraph 163. Both motion vectors point to
2 half-pixel positions.
3 Q. And is that both components of both
4 motion vectors point to a half-pixel, or that just
5 one component of each motion vector points to
6 half-pixel?
7 A. It is clear that the disclosure here
8 refers to both motion vectors having one component
9 that is half-pixel.
10 Q. Now that, at least for me, we cleared
11 that up, I would like to ask you some questions
12 about how a person of skill in the art would go
13 about modifying Karczewicz-I in light of your view
14 on Karczewicz-II.
15 A. Okay.
16 Q. Karczewicz-I, I think we agree,
17 discloses a process for bi-prediction?
18 A. I believe that to be correct.
19 Q. And in Karczewicz-I, there is a
20 default weighted prediction process where both the
21 first and second predictions are weighted equally.
22 There is a default weighted prediction process in

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1 Karczewicz-I where both the first and second
2 predictions are weighted equally?
3 A. They have equal values for the weight.
4 Q. While we are on this point, the
5 difference between Walker, on which you rely for
6 Ground 1, and Karczewicz-I, on which you rely for
7 Ground 2, is that Walker discusses explicitly
8 signalling different weights for the first and
9 second predictions?
10 A. Walker certainly discloses that.
11 Although I believe we did not rely on it, I seem
12 to recall some such disclosure also in
13 Karczewicz-I.
14 Let me look at the patent briefly to
15 see if there is any such disclosure. As I say, I
16 don't recall us relying on it. I am actually
17 looking at --
18 Q. Karczewicz-I is marked Exhibit 4.
19 A. This would explain my surprise at
20 looking at Exhibit 5.
21 Now, while it is certainly true that
22 K-I discloses implicit and explicit weighted

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1 prediction with different weights in paragraph 621
2 and 622 at least, and also I think paragraph --
3 some other paragraphs, including 64 and 69 -- I
4 believe we did not explicitly rely on this
5 information in drafting the declaration.
6 Q. So when you are discussing Walker, you
7 are relying on the weighted prediction process,
8 but for purposes of your Karczewicz ground, you
9 are not relying on the weighted prediction
10 process; you are relying on the default weighted
11 prediction process?
12 A. Predominantly relying on the default.
13 But since we have disclosed that we are -- that we
14 are using those references, there may be, so to
15 speak, an implicit disclosure to the effect that
16 anything that was disclosed by K-I or K-II can in
17 principle be referred to.
18 Q. Does it make a difference for purposes
19 of your opinions in Karczewicz whether
20 Karczewicz-I is looking at a default weighted
21 prediction scenario versus an explicit weighted
22 prediction scenario when a person of skill in the

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1 art is seeking to combine or modify Karczewicz-I
2 in view of Karczewicz-II?
3 A. I don't think it really makes much
4 difference.
5 Q. Now I would like to go back to the
6 scenarios 1 through 3. Your view is that a person
7 of skill in the art looking at Karczewicz-I would
8 have been inspired by Karczewicz-II to make some
9 changes. I would like to talk about what those
10 changes are.
11 A. Sure.
12 Q. Are you envisioning a person of skill
13 in the art implementing Karczewicz-I in a
14 software-based encoder, hardware-based encoder, or
15 both?
16 A. I think it's agnostic.
17 Q. How would the process of modifying
18 Karczewicz-I work? This is something I didn't
19 quite track reading the declaration so I wanted to
20 ask you a few questions on this.
21 We have these different motion vector
22 scenarios, so how would the person of skill in the

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1 art change Karczewicz-I -- I am trying to think of
2 how to ask this.
3 What modifications would need to be
4 made to Karczewicz-I to account for these
5 different possibilities of the three different
6 motion vector scenarios you identify?
7 A. Karczewicz-II, among other things,
8 focuses on improving the accuracy of the
9 predictions. An example here is given in
10 paragraph 162 in my declaration, in which a higher
11 level of precision than was envisioned in K-I was
12 applied to perform the averaging process.
13 Q. In paragraph 162, we are talking about
14 scenario 2?
15 A. I think so, yes.
16 Q. How would a person of skill in the art
17 change an encoder or decoder to know which
18 scenario they were in as it relates to an entire
19 block of bi-predicted pixels?
20 A. You seem to be asking two different
21 questions, Counsel. Probably the simplest
22 discussion is from the standpoint of a

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1 software-based encoder since additional steps are
2 required to translate software or firmware into an
3 embedded system with hardware.
4 So, focusing on the simplest approach,
5 it would essentially be a change of mathematical
6 formula and it might require an implementation
7 that uses a cast to a more precise data type, or
8 it might involve more than one element of an 8-bit
9 data type. It could be two separate variables or
10 they could be in an array. There may be some
11 other implementations that I can't think of
12 offhand.
13 Q. You used the phrase "cast to a more
14 precise data type." What do you mean by that?
15 A. Okay. That is a term of art in
16 computer science when, say, a value of an 8-bit --
17 an unsigned 8-bit number is copied to bits, lowest
18 or highest, of, for example, a 16-bit register or
19 a 16-bit number.
20 Q. The reason I am thinking through this,
21 Doctor, I am not a computer scientist so I am
22 trying to be sure I actually understand what this

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1 means. And I apologize; this might be simple for
2 you. But can you explain what you mean by the
3 value of an unsigned 8-bit number is copied to
4 bits?
5 A. Okay. This is actually not a trivial
6 question at all because it represents a practical
7 implementation. But if we go back to the simple
8 representation that we have in terms of
9 uncompressed binary numbers, then let us say we
10 represent in 8-bit form decimal number 255 by all
11 8 bits as set to 1 in the 8-bit representation.
12 Then in one representation this can be
13 cast to a 16-bit binary number by copying the
14 variable with all bits set to 1 for 8 bits to the
15 8 least significant bits of the 16-bit variable or
16 16-bit register.
17 Q. I see. So one possibility for the
18 different scenarios you have identified in your
19 declaration is that you would cast to a more
20 precise data, and by that you mean you could copy
21 the bits to a greater size register and then just
22 assign those bits as the least significant bits of

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1 that register?
2 A. It depends on what abstraction one is
3 using. When one talks about registers, one often
4 talks about practical hardware, embedded
5 programming and so on. If we stick to the
6 simplest scenario in software when one has modern
7 languages and compilers available, this is
8 sometimes called casting or promotion, where I
9 basically say something like "integer star two
10 16-bit variable is equal to integer star one 8-bit
11 variable."
12 That's a statement of FORTRAN. There
13 are similar statements in C and other widely
14 implemented languages.
15 Q. If we are looking at the person of
16 skill in the art who is reading Karczewicz-I and
17 has now been inspired by Karczewicz-II to change
18 Karczewicz-I, I guess what I am trying to figure
19 out is, for any given motion vector, we don't know
20 what that motion vector is going to be. It could
21 be that it fits into one of the three scenarios or
22 it could be that it doesn't; there are some

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1 possibilities --
2 A. I believe that within the H.264
3 standard, those three scenarios are a complete
4 representation. There is nowhere else for them to
5 fit in that scenario. And it is a very simple
6 thing to do.
7 So if, for example, one were to
8 implement this in C, which is a language that was
9 widely used at the time both for software and
10 firmware, it would be a simple statement like
11 double 16-bit variable equals 8-bit variable where
12 the 8-bit variable had probably been declared in
13 single position.
14 Q. And that modification you say would
15 apply to each of the three scenarios you --
16 A. Sorry. I wish to correct myself. I
17 seem to recall that "double" referred to floating
18 point numbers and I don't mean to imply that here.
19 It's just a simple change of data type.
20 Q. And that change of data type you are
21 referring to would apply to the three scenarios
22 you identified?

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1 A. Yes.
2 Q. The reason I am asking the question,
3 in part, is sometimes you might have a first
4 motion vector that points to an integer position
5 and then a second motion vector that points to an
6 integer position, and that wouldn't be any of your
7 three scenarios?
8 A. This is an interesting point.
9 I had thought that this was a complete
10 set of scenarios, and both motion vectors pointing
11 to whole pixel positions is certainly -- is
12 certainly a valid scenario.
13 Q. When the person of skill in the art,
14 under your view of things, has modified
15 Karczewicz-I in light of Karczewicz-II, what are
16 they doing for the scenario where the first and
17 second motion vectors point to integer positions?
18 A. Very probably in all these
19 circumstances, if we consider disclosure of K-II,
20 they are very probably still seeking higher
21 precision to be maintained during the
22 calculations. So, very probably this change of

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1 data type, this cast, could efficiently be made
2 for all of them. And I believe that a person of
3 ordinary skill in the art would be motivated to do
4 so because the apparent simplicity of just casting
5 the data types once and applying it to all those
6 four scenarios.
7 Q. Then I would like to introduce a fifth
8 scenario, if we are up to five, which would be
9 what about when the first motion vector points to
10 a center-pixel position like we discussed earlier
11 but the second motion vector points to an integer
12 pixel position?
13 A. I still think that it would be
14 convenient and simple to maintain the higher
15 position throughout the sequence of calculations
16 by performing that cast, a very easy
17 implementation; the first prediction and the
18 second prediction both cast to a higher precision
19 one time and the appropriate formula applied for
20 all of them.
21 Q. Do you think that it matters to the
22 way a person of skill in the art would have

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1 approached this problem that Karczewicz-II
2 describes shifting by different amounts depending
3 on the scenario one is in?
4 A. It's a tiny -- a tiny change. It
5 might be that the amount by which it is shifted
6 can be decided with a switch statement, for
7 example, in C or an "if" statement. The various
8 cases can be listed, as I said -- for example,
9 there is cases of a switch statement in C -- and
10 the appropriate shift read off.
11 Q. So under your opinion, a person of
12 skill in the art would have taken Karczewicz-I,
13 would have looked at Karczewicz-II and then they
14 could have mapped out all the different possible
15 motion vector scenarios and then, depending on
16 which scenario they were in, they would shift
17 different amounts --
18 A. To me, it's a few lines of code. It's
19 the kind of activity -- well, you know, I can't
20 speak for what other people's productivity level
21 are, but I would be surprised if it takes me over
22 a day to implement.

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1 Q. And that is in software?
2 A. That is in software.
3 Q. How would that be implemented in
4 hardware, the scenario where the person of skill
5 in the art takes all the different motion vector
6 possibilities, identifies the different amounts by
7 which to shift and then implements that in the
8 hardware system?
9 A. Counsel, I am not really qualified to
10 opine about hardware. I may be able to speak
11 about firmware, which represents the software that
12 makes the hardware work. As you see from my CV, I
13 have done some work on set-top boxes as an
14 embedded system engineer, but I am not qualified
15 to speak about the internals of any piece of
16 hardware.
17 Q. I think you agree with me that in some
18 scenarios one can run what we would call a
19 software encoder where all the processes are done
20 in software?
21 A. Correct.
22 Q. Then in other scenarios, one can run

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1 what is called a hardware accelerated encoder
2 where many of the calculations are passed on in
3 hardware?
4 A. In a certain scenario.
5 Q. In that scenario, a person of skill in
6 the art would appreciate the typical way in which
7 bi-prediction and sub-pixel interpolation would be
8 done would be through hardware?
9 A. It's a definite possibility because of
10 the speed requirement. However, one is now
11 speaking about intricacy of specific chips, one is
12 speaking about the balance of software -- firmware
13 to provide inputs to those chips and calculations
14 performed on those chips.
15 Since this is such a context-sensitive
16 and implementation-sensitive issue, that has not
17 been opined on in my declaration. I don't want to
18 offer any definite opinion as to what a POSITA
19 would do.
20 Q. Going back to the discussion we had --
21 and I'm not asking you now about hardware but just
22 the approach that a person of skill might take to

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1 a software encoder.
2 It seems that one approach would be
3 the shift by the same amount, regardless of the
4 motion vector scenario one finds themselves in.
5 But given that Karczewicz-II teaches different
6 shifts, your opinion is that a person of skill
7 would map out all of the possible motion vector
8 scenarios and shift differently for each case?
9 A. If a person of ordinary skill in the
10 art intended to implement K-II's disclosure, I
11 would opine that it is an easy matter for them to
12 do so.
13 Q. I am getting into the "do so how" part
14 of the question. When a person of skill in the
15 art changes Karczewicz-I based on Karczewicz-II,
16 it is your opinion that they would shift
17 differently for each particular bi-prediction for
18 each block of pixels depending on which of the
19 various possible motion vector scenarios they
20 found themselves in?
21 A. To me, this is a very small piece of
22 code. Such software codecs, as you may be aware,

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1 have a very large number of lines of code to
2 implement them in software only. To me, this
3 seems like a very small addition.
4 Q. But is it your opinion that the person
5 of skill in the art looking at Karczewicz-I, being
6 inspired by Karczewicz-II, would not have the same
7 shifts for all of the possible motion vector
8 scenarios that could happen?
9 A. Let us look at the disclosure of
10 Karczewicz-II to make sure that that is indeed
11 what K-II discloses because I do not want to agree
12 to something that K-II discloses unless K-II
13 actually discloses it.
14 I also think that this is in my
15 declaration. It may be a simpler place to look.
16 I see some bit shifts of 6 to the
17 right, 1 to the right. It's, to me, perfectly
18 reasonable, if we say that that is indeed the
19 disclosure of Karczewicz, to implement it. It
20 would represent no barrier of complexity to have a
21 switch statement that simply tests the
22 interpolation scenario and provides the

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1 appropriate shift.
2 Q. Now what I would like to do is kind of
3 change topics a little bit --
4 A. Counsel, it is coming up to 12 noon.
5 Would it be better for us to adjourn for lunch
6 before you start a new series of questions?
7 Q. I will defer to you. To be --
8 MR. VERBONCOEUR: Off the record.
9 (Discussion held off the record.)
10 (Recess.)
11 BY MR. VERBONCOEUR:
12 Q. Welcome back, Dr. Freedman.
13 A. Yes.
14 Q. At any point during the deposition and
15 at any breaks that we took, did you discuss the
16 substance of your testimony with counsel?
17 A. No, not at all.
18 Q. Thank you.
19 Do you know someone named Iain
20 Richardson?
21 A. I don't know him personally but I know
22 of him.

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1 Q. How do you know of Iain Richardson?
2 A. He wrote a book which is now in a
3 second edition that describes some video coding
4 techniques.
5 Q. Do you cite to that book by Iain
6 Richardson in your declaration?
7 A. I don't recall whether there are any
8 citations. It might have been one of the
9 references. Let us see.
10 Exhibit 1012. As I say, there are two
11 editions. It was most likely the earlier edition.
12 Q. Before working on these IPR petitions,
13 were you familiar with Professor Richardson's
14 book?
15 A. I had certainly read it. It is a book
16 that is commonly cited. Of course, to make any
17 rational determination, it's best to have a deep
18 knowledge of or to consult the standard itself
19 because the standard is determinative.
20 Q. When you say Dr. Richardson's book is
21 commonly cited, what are you referring to?
22 A. I am saying that there are many -- his

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1 book has many citations. It's a well-known book.
2 Q. Earlier we were talking about H.265
3 and you agreed with me that that is also known by
4 the acronym HEVC?
5 A. Correct.
6 Q. Are you familiar with HEVC Main 10
7 Profile?
8 A. I recall those names. However, I do
9 not have a copy of the standard in front of me and
10 I do not offhand recall the precise
11 characteristics of that profile.
12 Q. Are you familiar with the concept of a
13 right shift?
14 A. In the context of the '267 Patent, I
15 believe you are speaking about a right shift of a
16 certain number of bits.
17 Q. Yes. Do you know what a logical and
18 an arithmetic right shift is?
19 A. Yes, I do, and this relates to how the
20 shift is performed and whether logical operations
21 such as and/or or X/or at a bit level are used to
22 effect that shift.

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1 Q. For purposes of your opinions about
2 the '267 Patent, does it matter whether we are
3 talking about logical or arithmetic right shifts?
4 A. We are speaking about a conceptual
5 right shift that effectively -- we are speaking
6 about conceptual left shifts and right shifts
7 which relate to multiplication by positive or
8 negative powers of 2 in an uncompressed binary
9 representation. How that shift is effected is not
10 material to the discussion.
11 Q. In both the arithmetic and logical
12 right-shift scenarios, a right shift has the
13 effect of multiplying a number by a power of 2?
14 A. I simply -- I think I recall that to
15 be true. However, I would have to go away and
16 look up to be 100 percent sure.
17 Q. I apologize. I actually may have said
18 that backwards. Let me rephrase that.
19 In both the arithmetic and logical
20 right shift scenarios, a right shift has the
21 effect of dividing a number by the power of 2?
22 A. That's a clearer statement.

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1 Q. Just to be clear for the record --
2 A. And for the record, when I say
3 multiplying by a negative power of 2, it is the
4 same as dividing by a power of 2.
5 Q. So I think we can agree the effect of
6 a logical or arithmetic right shift is to divide
7 by a power of 2 or multiply by a negative power of
8 2?
9 A. Correct.
10 Q. And then the effect of a logical or
11 arithmetic left shift is to multiply by a power of
12 2?
13 A. Yes.
14 Q. When one is right shifting, they can
15 figure out what power of 2 the number at issue is
16 being divided by by looking at the number of bits
17 they are right-shifting by?
18 A. Yes.
19 Q. And so the way you would figure out
20 the division operation to do is you would say 2 to
21 the nth power or n is the number of bits in that
22 particular right shift?

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1 A. Well, 2 to the minus n.
2 Q. Yes. If you put it as multiplication,
3 you would multiply by 2 to the minus n where n is
4 the number of bits shifted to the right.
5 Alternatively, you could divide by 2 to the n
6 where n is the number that's been shifted --
7 A. In terms of practical implementation,
8 I can't think of anybody who would implement that
9 by a division operation.
10 Q. So let's just talk about
11 multiplication. In terms of the way you are
12 putting it, if you want to figure out what you are
13 multiplying by for a right shift, you would do 2
14 to the negative n where n is the number of bits
15 right-shifted?
16 A. Correct.
17 Q. Likewise, for a left shift, you would
18 multiply by 2 to the n where n is the number of
19 bits left-shifted?
20 A. Yes.
21 Q. In going back to our earlier
22 discussion, you could look at this mathematically

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1 where, if you right-shift by a certain number of
2 bits, you are dividing the number or multiplying
3 by a negative power, which has the effect in your
4 view of reducing its precision?
5 A. In that representation.
6 Q. And then for a left shift, you are now
7 multiplying by a positive power of 2, and that has
8 the effect of increasing its precision?
9 A. Ah, but we need to be very careful
10 about -- I see where you are going with this.
11 We need to be very careful about the
12 representation. So, for example, if the
13 representation, let us say, has been cast to a
14 certain number of bits, one should be careful to
15 properly count how many bits are needed to
16 represent the result in that operation.
17 Q. Let me explore that.
18 A. There are some tables in my
19 declaration that I believe were obtained from
20 either Walker or Karczewicz that explore that in
21 depth.
22 So, here is one for example. Table 5

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1 on page 93 of the first declaration.
2 Q. We are looking at Exhibit 1 at page
3 93. Where in the table are you --
4 A. Paragraph 154, the whole table. So,
5 operation r1 is integer pixel x, minimum value 0,
6 maximum value 255, register 8 bits unsigned.
7 Q. I see.
8 A. Next operation is shift left by 5.
9 The result is 32 times the integer pixel x. The
10 range is now 0 to 8160 and the required register
11 size is 13 bits unsigned.
12 MR. VERBONCOEUR: No further
13 questions. Thank you for your time, Doctor.
14 THE WITNESS: Also, Counsel, even
15 though you are opposing counsel, I thank you
16 for a pleasant and civil deposition.
17 MR. VERBONCOEUR: No problem.
18 MR. LIANG: I do have one redirect
19 question, Dr. Freedman.
20 EXAMINATION BY
21 MR. LIANG:
22 Q. If you could take a look at Exhibit 6?

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1 Do you have it in front of you?
2 A. I have Exhibit 6 in front of me.
3 Q. And if you could turn to your
4 declaration on page 182?
5 A. The first declaration?
6 Q. Yes. Your first declaration. There
7 it is.
8 A. Yes.
9 Q. What is on page 182 of your
10 declaration?
11 MR. VERBONCOEUR: Object to the form
12 of the question. And leading.
13 A. Quite a lot of things. But I would
14 describe it as Appendix 2, Materials Considered in
15 the Preparation of This Declaration. I am
16 assuming you are saying what is the title of that.
17 Q. Right. If you could review Exhibit
18 No. 1010 on page 182 of your declaration, let me
19 know after you are done reviewing that entry.
20 MR. VERBONCOEUR: Same objections.
21 A. The publication numbers appear to
22 match.

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1 Q. So does reviewing your Appendix 2
2 refresh your memory about Exhibit 1010?
3 A. Yes, it does. I clearly have -- I
4 clearly have seen this before, though I did not
5 recall it offhand during my deposition. I did not
6 memorize the entire document.
7 MR. LIANG: Okay. Thank you. No
8 further questions.
9 MR. VERBONCOEUR: Just a brief recross
10 on that.
11 FURTHER EXAMINATION BY
12 MR. VERBONCOEUR:
13 Q. Doctor, if we could please go back to
14 what is Exhibit 1010 as mentioned in your
15 declaration and what has been marked as Exhibit 6,
16 I believe it is?
17 A. Yes.
18 Q. Earlier I asked you about Exhibit 6.
19 Do you recall that?
20 A. Yes.
21 Q. One of the inventors listed on
22 Exhibit 6 is someone named Marta Karczewicz?

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1 A. Yes.
2 Q. I believe you mentioned your view that
3 it was highly probable that the inventor Marta
4 Karczewicz was the same person that is an inventor
5 on both of the Karczewicz references on which you
6 rely for your Ground 2?
7 A. That is a statement of probability,
8 not a determination. I don't have her in front of
9 me. I don't have her legal government ID so I
10 can't tell you.
11 Q. As part of your analysis in preparing
12 your opinions for these cases, did you consider
13 Marta Karczevicz's background and experiences in
14 video coding?
15 A. Counsel, you have asked me this
16 question before. I can only see the disclosure,
17 the patent in front of me. From this information,
18 I cannot fully evaluate her training, background
19 and experience. I don't have a CV for her and I
20 cannot immediately tell whether she does or does
21 not meet the requirements for a POSITA.
22 Q. Just to put a finer point on it, then,

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1 you don't have an opinion, one way or another,
2 about Marta Karczewicz's or any of the other
3 inventor's on the references we discussed today
4 levels of experience or skill?
5 A. No, I can't do so. There is a
6 definite criterion to be a POSITA expressed in my
7 declaration. It requires consideration of
8 education, training, background and experience,
9 which is usual. And since I don't have that
10 information, I can't make an opinion.
11 MR. VERBONCOEUR: No further
12 questions. Thank you.
13 [TIME NOTED: 12:58 p.m EST]
14
15 _____
IMMANUEL FREEDMAN, PH.D.
16
17 _____
Subscribed and sworn to
18
Before me this _____
19
Day of _____, 2024.
20
21
22 _____
Notary Public

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1 CERTIFICATION

2

3 I, DEBRA STEVENS, a Notary Public for and
4 within the State of New York, do hereby certify:
5 That the witness whose testimony as herein set
6 forth, was duly sworn by me; and that the within
7 transcript is a true record of the testimony given
8 by said witness.
9 I further certify that I am not related to any
10 of the parties to this action by blood or
11 marriage, and that I am in no way interested in
12 the outcome of this matter.
13 IN WITNESS WHEREOF, I have hereunto set my
14 hand this 1st day of December, 2024.
15
16 Debra Stevens
17 DEBRA STEVENS, RPR-CRR
18
19 * * *
20
21
22

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