UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioner

v.

NOKIA TECHNOLOGIES OY,

Patent Owner

_____

Case Nos. IPR2024-00626; IPR2024-00627

DEPOSITION OF IMMANUEL FREEDMAN, PH.D.

November 26, 2024

9:00 a.m., EST (UTC-5)

Reported by:

Debra Stevens, Realtime Certified Reporter

JOB NO. 562425

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E X A M I N A T I O N S

E X H I B I T S

Whereupon,

I M M A N U E L F R E E D M A N,

having been first duly sworn/affirmed, was examined and testified as follows:

EXAMINATION BY

MR. VERBONCOEUR:

Q. Good morning, Dr. Freedman.

A. Good morning.

Q. Are you able to hear me okay?

A. I can hear you fine.

Q. Have you been deposed before?

A. Yes.

Q. How many times have you been deposed before?

A. North of ten times.

Q. How many times have you been deposed before in a PTAB proceeding?

A. I would have to look up that information to be sure, but it is probably more than eight times.

Q. How did you prepare for today's deposition?

A. I read my declaration and the supporting references.
Q. Did you meet with counsel in advance of today's deposition?
A. Yes, I did.
Q. For how long did you meet with counsel in advance of today's deposition?
A. Are you asking for preparation for the deposition, or in general?
Q. Yes. For how long did you meet with counsel to prepare for today's deposition?
A. I met with counsel on Sunday for about four hours. I met with counsel yesterday also for about four hours.
Q. Other than counsel, did you speak with anyone else in preparation for today's deposition?
A. No.
Q. And other than counsel, did you speak with anyone else while you were preparing the declarations you provided in the IPRs relevant to today's deposition?
A. Are you speaking about counsel being

Jeffrey, or counsel being Jeffrey's law firm?

Q. Any lawyers representing Amazon is who I am referring to as counsel.

A. I spoke with other members of counsel's legal team during our conferences to prepare the declarations.

Q. Other than all of the members of the legal team who are attorneys, did you speak with anyone else to prepare the declarations you provided that are relevant to today's deposition?

A. No.

Q. You understand that you provided two declarations that are relevant to what we are calling the '267 Patent, one for each of the two petitions we will discuss today?

A. Yes.

Q. How long did you spend preparing those two declarations?

A. I cannot remember.

Q. Other than members of Amazon's legal team, did you speak or work with anyone else in preparing those declarations?

A. No.

Q. Did you provide the first draft of each of the two declarations you provided in the IPRs?

A. The declarations were drafted collaboratively. I do not recall who provided the first draft. However, I make it a rule, that I apply to every attorney I work with, that I will only sign a document if I truly believe every word in it.

Q. Are you familiar with someone named Dr. Dan Schonfeld?

A. Never heard of him.

Q. Are you familiar with someone named Gary Sullivan?

A. That name certainly rings a bell. I seem to think that is a person well known in image coding.

Q. Now I would like to transition and talk about your background and experience in video coding.

A. Okay.

Q. I can provide you the CV that you attached to the declaration if you wish. So if you need that to answer any of my questions, just let me know.

A. I believe it is also at the end of my declaration, so I can refer to it directly. I do not hold all the details in my head all the time.

Q. Why don't we do this, then. We can just mark as an exhibit that declaration so that we are all on the same page about what you are referring to. For ease of the record, what I am going to do, I am going to mark as Exhibit 1 your declaration from the '626 IPR, but will you agree that the CV that you provided is the same in both of the two petitions?

A. That was certainly the intention.

(So marked for identification as Exhibit 1.)

Q. I am passing over what we've marked as Exhibit 1, which is your declaration from the '626 Petition. Dr. Freedman, I see that you already have your own copy, so feel free to consult with

whichever you prefer.

A. It's open in front of me. Thank you.

Yes, indeed. If I look, this does indeed, at least superficially, appear to be the declaration.

Q. If you will please turn with me to page 170 of what has been marked Exhibit 1, can you confirm that that is the beginning of your CV?

A. Not in my copy here but let me look at the exhibit you have provided and let's see if that is indeed the same.

Indeed, it does appear to be that document.

Q. If there is any discrepancy between the two as far as pagination, is it because the declaration that you have in front of you, is that for the '627 Petition?

A. Counsel, I believe we are discussing '267.

Q. Sorry. There are two petitions that we will discuss today. One is '626, the other is '627, both of which pertain to the '267 Patent.

A. Oh, you are speaking about the IPR number.

Q. Yes. So, the declaration to which you were just referring, can you check for me and see if that was the '627 declaration as opposed to the '626?

A. Yes. We are literally now on the same page.

Q. Okay. Just so we don't have to continue flopping between two different documents, can you agree that, other than the particular claim elements that are somewhat different between the two declarations, the substance is largely common between the two declarations?

A. I don't think we can agree that, Counsel. We need to examine that question on a case-by-case basis, paragraph by paragraph, should there be any substantive differences, although the intention is to describe similar information in similar ways.

Q. We'll do this. We'll start with the '626 declaration and then if, when I am asking you

questions, your opinions are different with respect to your '626 declaration, can you agree to let me know that your answer would not be the same across the two declarations?

A. If that, indeed, turns out to be the case. I am only caveating this because I have not made a rigorous comparison paragraph by paragraph of the declarations.

Q. You wrote both declarations, though; correct?

A. Yes. But I didn't display them on the screen para by para and check everywhere was identical.

Q. But the opinions would at least be consistent between the two declarations?

A. Of course.

Q. Okay. Now I want to turn back to your background. I believe you agreed -- correct me if I am wrong -- it is the same CV information provided in both declarations?

A. Of course.

Q. I happen to be looking at page 171 of

the '626 declaration, but we would find similar information in the '627 declaration?

A. Correct.

Q. I would like to ask you now about your experience with a company called Media Logic Systems. Do you see that on page 171 of Exhibit 1?

A. Yes.

Q. What is Media Logic Systems?

A. Media Logic Systems was a subsidiary of a company called Nisaba in the United Kingdom.

(Reporter interruption.)

THE WITNESS: N-I-S-A-B-A.

Q. While you were with Media Logic Systems, it's correct that your job title was Chief Systems Engineer?

A. Yes.

Q. Can you describe your job role at Media Logic Systems as a Chief Systems Engineer?

A. I was required to design and develop a novel live interactive television system which served as a user interface for customer

communication with human sales agents in video-enabled call centers, implemented by television and telephone, that was deployed to 50,000 subscribers of Telewest, UK.

Telewest is T-E-L-E-W-E-S-T, in the United Kingdom.

I researched and developed tools and encoder systems to optimize image quality and to prescribe latency and bit rate for distributing live video and audio streams encoded via low latency methods including the MPEG-2 Simple Profile At Main Level and the MPEG-4 Visual Profile with background sprite coding, together with H.263, which now has become known as H.264.

I investigated the feasibility of wavelet-based software encoding schemes with motion compensation and perceptual quantization described by the MPEG Standards Committee Interframe Wavelet Ad Hoc Group. I interfaced video streams by ATM transport to Telewest regional CATV head-ends that we switched via Harmonic Narrowcast Gateways for distribution via

video on demand or near video on demand systems to customers' homes.

Q. I see you have read the entry here from your CV. I would like to ask you for more details if you are able to provide them about what you described there.

A. Sure.

Q. iSeeTV that is listed here in your CV on page 171 of Exhibit 1, is that a product name or is it the name of the user interface?

A. It was a product name.

Q. In your role with Media Logic Systems, was it to design iSeeTV the product, or to design the user interface for iSeeTV?

A. The product is a type of user interface.

Q. And can you describe what you mean by user interface here? Are you discussing the buttons the user sees on the screen, or is it an interface like a video interface through which customers can interact with agents?

A. So, it is not quite either. And there

were two products, types of products, one, iSeeTV, that relied on the cable television video on-demand system, and a separate product called iSeePC that tried to -- at least attempted to achieve the same goal on a PC.

The reason why I say this is a user interface is that it was truly novel. Focusing on the television aspect of it first, the concept was that current systems for interactive television were immensely complicated technically and also very difficult for people to use. So, the following concept was developed of one-way video and two-way audio.

So -- do you need more detail? I can go on.

Q. Yes. What I am trying to figure out is if, at the time you began working with Media Logic Systems -- correct me if I am wrong, but it seems to me from reading the CV entry, they had a form of video on demand and then there was a customer communication with human sales agents aspect that you were working on, the way in which

that communication was established?

A. Would you allow me to explain a little more?

Q. Please. That is what we are here for.

A. So, Telewest is a cable TV provider in the United Kingdom. I am not sure whether it still exists. It was at that time. And they had a video-on-demand system that you can request a stream, it would be played to a consumer or a subscriber.

So, the novelty here was that in order to enable a two-way interaction with an individual in a call center, whether it be a sales agent or a health care advisor -- we did that as well -- they would call the call center using a telephone, speak with the agent on the telephone first. The agent would ask some information from them and, knowing the telephone number, would then display on the caller's television screen a set of digits.

The subscriber would then read out the set of digits, which would be used to initiate a video-on-demand stream to the subscriber. So in

that system, you have one-way video from the call center but you maintain two-way interaction via the telephone.

This is very low complexity technology, relatively easily implemented and has very low cognitive overhead for the subscriber.

Q. I see that. So, the audio is done through the telephone, then a video stream is sent to the subscriber's set-top box or whatever device they had to display the digits, and they can use that to sort of verify or authenticate such that they could receive video-on-demand programming?

A. Yes. The video is live in the sense that the agent at the other end has a live camera and the video stream is live. So, they can ask a question and receive a demonstration or an explanation or purchase a product that they can see.

Q. Okay. So not only was there video sent to actually display numerical digits, there was also video of the employee, or healthcare advisor, whoever it is showing up on the

subscriber's television?

A. Once the stream was initiated. That is the television.

On the PC side of it, we attempted to provide what you would call one-way videoconferencing using the internet and a PC platform. Now, there are challenges, of course, with that, and that is why I talk about here low latency methods and the necessary synchronization. It is far from an easy task to achieve.

Q. So the first paragraph of the Media Logic Systems entry in your CV in Exhibit 1 is talking about the process of a user making a call, initiating a stream and then seeing some employee or health care advisor.

The second paragraph is talking about a separate set of work?

A. Same concept, but based on video coding and with an attempt to have the audio stream be part of the -- be a composite audio/video stream. In other words, eliminate the telephone.

Q. I understand. So in both cases you have a user trying to communicate with an employee or healthcare advisor or something of the sort, and now you are trying to get them video and now audio of the person helping them?

A. Yes. So you have the two-way audio and the one-way video.

Q. And there is reference in the second paragraph of the Media Logic Systems entry on page 171 of Exhibit 1 to MPEG-2?

A. Yes.

Q. Am I to understand that that's because some of the video that was sent to the subscribers was encoded in MPEG-2 compliance formats?

A. Regarding the cable television implementation, at that time MPEG-2 was the dominant format.

Q. There is also reference to MPEG-4 Visual Profile?

A. Yes.

Q. Where was MPEG-4 Visual Profile used in this system?

A. This was -- this was attempted to be used in the implementation of iSeePC. The point there was to have a lightweight, low latency video codec and to use the available tools, such as MPEG-4 and H.263+, to try and minimize the latency and the bandwidth. If you recall, in that time frame internet bandwidth was intensely limited.

Q. As far as the decoder in the scenario we are talking about with the Media Logic Systems work, is the decoder the set-top box at the user premises?

A. We are talking about two different systems here, Counsel. If we speak about the cable television system, the decoder system would be implemented in the television set-top box.

Q. Then you mentioned a PC-based system?

A. Yes.

Q. By PC, I am assuming you mean personal computer?

A. Correct.

Q. In the personal computer-based system when you were working at Media Logic Systems, the

decoder would be the user's computer?

A. The decoder would be the user's computer, yes.

Q. And the time when you were working with Media Logic Systems, then the users' computers would need to have MPEG-4 Visual Profile compliant decoders?

A. That was the intention, yes.

Q. Likewise, if you were to use an H.263+ compliant stream, the user's computer would need to have an H.263+ compliant decoder?

A. Yes.

Q. I would like to ask you about the parenthetical in the entry in the CV for Media Logic Systems. It says "H.263+, now known as H.264." Do you see where I'm reading?

A. Yes.

Q. Can you explain what you mean by "H.263+ now known as H.264"?

A. Okay. In the evolution of the MPEG standards and under the auspices of the Joint Committee, MPEG-2 was also known as H.262. This

first evolution was a draft standard called H.263. Then the draft standard was further augmented to H.263+, and it was finally ratified as H.264.

Q. I want to make sure I have this right. It is your testimony that H.263 was an evolution of H.264 --

A. H.262.

Q. I apologize. I got the numbers backwards. Sorry. I don't want to mess it up.

First you had H.262, which is also known as MPEG-2?

A. Correct.

Q. Then, your testimony is, that evolved into H.263?

A. Yes, as a draft standard.

Q. Then H.263 had further refinements that eventually became known as H.264?

A. Eventually, yes, having passed through a stage called H.263+. And at the time that this system was designed, H.264 had not yet been fully ratified.

Q. Okay. The reason I ask -- and correct

me if I am wrong. My understanding is that H.264 was a separate initiative from H.263 by the Joint Video Team which was formed as a consortium of ITU and ISO members.

A. I am trying to recall the history precisely, but H.264 adopted much of the content of the H.263+ draft. As for the administrative organization, I don't recall whether the same committee members were involved or whether a new committee was started. But the technical content, much of the technical content was absorbed from the H.263+ effort as a foundation for H.264, which then evolved some more.

Q. Are you familiar with the term H.26L?

A. Yes, I am.

Q. What is H.26L?

A. I am trying to recall it, exactly what it is. I have heard that term, and I can't remember. It may have been intermediate between H.264 and H.265, but my memory fails me in that area.

Q. Would it help if I used the phrase

H.26L, as in long term?

A. I still do not recall where it is precisely on the spectrum. The standards evolved from H.264 to H.265, and there is a new draft standard coming along above H.265. And, yes, I have heard the term H.26, but I cannot remember where it fits in that spectrum.

Q. At the time you were working in video coding in the late '90s and early 2000s, were you familiar with any process called a Call For Proposals for H.26L?

A. I don't recall a Call For Proposals for H.26L, but Call For Proposals was a procedure.

Q. Are you familiar with Nokia's role in that process?

A. I am sorry. I do not recall. There were many organizations involved in that very large committee.

(Reporter interruption.)

MR. VERBONCOEUR: We can take a couple minute break.

(Recess.)

BY MR. VERBONCOEUR:

Q. Welcome back, Dr. Freedman.

We were just discussing your CV in Exhibit 1, in particular your experience with Media Logic Systems. Now I would like to ask you about the third paragraph of that entry.

A. Aha.

Q. There is reference in the third paragraph on page 171 of Exhibit 1 to the MPEG Standards Committee Interframe Wavelet Ad Hoc Group. What is the MPEG Standards Committee Interframe Wavelet Ad Hoc Group?

A. It was an ad hoc group studying the usage of wavelet transforms for interframe coding.

Q. Do you recall which standardization effort that ad hoc group was part of?

A. I strongly -- I strongly think it was probably related to MPEG-4 or H.263+, but I do not recall whether it was a standalone initiative or whether it was directly tied to the development of one of those standards.

Q. Can you explain what you were working

on at the time when you -- quoting now from your CV -- "investigated the feasibility of wavelet-based software encoding schemes"?

A. Okay. So I think it is extremely clear from the words, but I will spell it out in detail.

So, one of the most prevalent video encoding schemes is to use what is called transform coding. In the MPEG-2 system, the discrete cosine transform was used to transform a stream of incoming pixel values, brightness and color, luma and chroma, and on a block or macro block basis transform this mathematically to a form where frequency components were important. Some of the less important frequency components were then quantized away, to result in a more compact representation.

So, the suggestion had been that wavelet-based techniques -- wavelets are a mathematical representation -- might provide stronger compression or fewer artifacts. So, the feasibility of using wavelets rather than discrete

cosine transform was what -- is what is involved.

So, I worked specifically with available software codecs, such as reference codecs in the software. And I am trying to remember the name of a highly configurable MPEG-4 codec that became available during that time. It is on the tip of my tongue but, I'm sorry, I don't remember its name.

Nonetheless, it had adjustable parameters. And because it had adjustable parameters, I could attempt to tune the system, the group of pictures, the wavelet coefficients and so on, and other system parameters in order to achieve what might be acceptable video to the user and, above all, to keep the latency low. We learned that if the latency is too high, the subscriber or user becomes irritated and will not accept the -- will not accept such a system.

Q. I presume, because you are discussing software-based encoding schemes, you are talking about the encoding that is done on the call agent or healthcare advisor side of things to compress

video to send to a subscriber who is requesting help?

A. Actually, both. Remember that this is for iSeePC, so both can be considered in parallel. So, the iSeePC software itself was essentially mirrored on both sides of the system, the call center and the user's PC. And what was needed there was to effectively tune the loops in terms of time and in terms of system parameters. A lot of experimentation went into this to make it work.

Q. So for the iSeePC system, you had a software-based encoder on the call center end and then a software-based decoder on some application that is running on the user's computer?

A. Yes.

Q. For the set-top box scenario where you are using MPEG-2 compliant bitstreams, do you recall whether the decoding by the user set-top box was done in hardware or software?

A. I don't recall that and I don't want to speculate.

Q. I see that you have Exhibit 1 still in

front of you. If you could, please, turn to page 26 of Exhibit 1. Do you see the section beginning on page 26 of your declaration that is titled "Claim Construction" and then has a subsection called "Precision"?

A. Yes.

Q. Are your opinions about the meaning of the claim term "precision" the same for both the '626 and the '627 IPR petitions?

A. Yes.

Q. I would like to ask you about a sentence you have here on the declaration on pages 26 and 27 and ask you perhaps to clarify something for me.

A. Okay.

Q. Reading from your declaration, in the middle of a sentence, "a person of ordinary skill in the art would have understood precision is satisfied by but is not necessarily limited to a number of bits to represent possible values."

Do you see where I read from, pages 26 to 27?

A. Yes.
Q. When you say that precision is not necessarily limited to a number of bits to represent possible values, are there other definitions of precision that you have in mind for purposes of these opinions in these IPRs?
A. Not for purpose of the opinions of these IPRs. However, it is normal to caveat statements one makes.
Q. Okay. But we can say, for purposes of your opinions in these IPRs, while it might be in other contexts "precision" has other meanings, you are relying on a number of bits needed to represent possible values?
A. Yes.
Q. I would like to ask you about the language "needed to represent possible values."
A. Okay.
Q. When I read that, I thought of two possible meanings; perhaps you mean neither or perhaps you mean one or both. I just want to get clarity here.

One meaning I thought of is the bits that you must use to represent the possible values. The other meaning I thought of is the bits that you actually use to represent the possible values. What did you have in mind when you wrote "a number of bits needed to represent possible values"?

A. I didn't quite mean either of the statements you made, Counsel. It's a much simpler consideration. So, for example, if I want to represent the decimal number 5 in uncompressed binary form, I can represent it in three bits, 101, in unsigned binary arithmetic.

Q. Perhaps I am missing something but I still see that ambiguity. Are you saying, then, that because you are representing it with 3 bits, that is more precise than a number that you would represent with 2 bits in uncompressed binary form?

A. Yes.

Q. Okay. So the greater a decimal number is, according to your interpretation of the claim term "precision," the more precise that number is?

A. If we are speaking about non-negative decimal numbers.
Q. Let's talk about negative decimal numbers.
A. Okay.
Q. How does your interpretation of the claim term "precision" apply to negative decimal numbers?
A. Okay. It still relates to uncompressed binary arithmetic. And the view that I am taking is that the appropriate number of bits, which might be -- might sometimes be the smallest number of bits -- refers to a two's complement representation of uncompressed binary numbers.
Q. So applying your interpretation of precision to a two's complement number, is it the same? We just now have the first bit in the series of bits tell us the sign?
A. No.
Q. How is the meaning of precision different then for two's complement?

A. For example, we have the range from minus 127 to plus 128 in decimal, which often corresponds to a range of pixel values, then plus 128 might be represented by all one's and minus 127 would be represented by the two's complement of that.

Q. What I am trying to figure out here from your answer, Dr. Freedman, is how the number of bits needed to represent possible values changes for a two's complement number?

A. Oh, it doesn't, and that is the point.

Q. So it seems that, then, your interpretation of precision would apply to a two's complement number and we would just look at the greater...

A. Absolute magnitude.

Q. Sorry? What was that?

A. The greater absolute magnitude.

Q. Thank you.

So the greater the absolute magnitude, then, the greater the precision of a number is for negative decimal numbers?

A. To be more precise, the greater the absolute magnitude, the greater the number of bits represented in uncompressed binary form; therefore, the greater the required precision.

Q. Earlier in one of your answers you used the term "range"?

A. Yes.

Q. Can you provide a definition for range?

MR. LIANG: Objection to form.

A. What context are we speaking about here, Counsel?

Q. Reading now from the transcript, which I will acknowledge is a rough draft, you answered, "For example, we have the range from minus 127 to plus 128 in decimal."

What do you mean by "range" in that answer?

A. Range is a mathematical term, and the way that I am interpreting it here for the purpose of discussing the '267 Patent is that the range encompasses all whole numbers between the lowest

value, minus 127, to the highest value, 128.

Q. As I understand your interpretation of the term "precision" as it relates to the magnitude of a number, the greater a given number is, you will use in uncompressed binary form more bits; therefore, you have more precision?

A. Well, apart from the statement about the greater the number, to be caveated as greater the absolute magnitude number, then the more bits to represent it, the more precision.

Q. So if I were to correct my statement, I would say your interpretation of the term "precision" is that, as it relates to the absolute magnitude of a number, the greater that absolute magnitude of a number is, you will use more bits in uncompressed binary form; therefore, you have more precision?

A. Yes.

Q. There is an example that you provide in your declaration in your discussion of the '267 Patent that I would like to ask you about. It is on page 13.

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

the range is now 0, 2, 4 and 6?

A. No, that's not the range, not in terms of the interpretation that I am adopting.

Q. Can you -- sorry.

A. So, I understand what you are thinking, Counsel. To be more precise, if we perform a multiplication by 2, then the range expands from 0, 1, 2 and 3 to 0, 1, 2, 3, 4, 5, 6 and 7.

Q. Can you explain how multiplying 0, 1, 2 and 3 --

A. I am sorry. Are we speaking specifically about the example of representing 0 to 7 with 3 bits of precision, or are we speaking about something else? Perhaps I didn't quite understand your question, Counsel.

Q. Sorry. Thank you for letting me know that you might not have understood it so we can be sure we are on the same page.

I am looking here at page 13 of Exhibit 1. There is the sentence, "For example, an uncompressed variable having values that range

from 0 to 3 can be represented by a binary number of 2 bits." The next sentence says, "When multiplied by 2," the results --

A. Where does it say? Oh, I see. You are looking further up.

An uncompressed variable having values that range from naught to 3 can be represented by a binary number of 2 bits. When multiplied by 2, the result could range from naught to 6 and thus needs 3 bits of precision to represent the largest possible value 6 in binary.

Yes, this is a correct statement.

Q. Okay. What I am trying to figure out here is, what are the possible results that we receive after multiplying 0, 1, 2, 3 by 2?

A. Counsel, you are discussing a different representation of numbers. While I see where you are coming from with this -- and perhaps we consider this to be an implementation question -- if I have a variable that ranges from naught to 3 and I multiply it by 2 and I need 3 bits of precision to represent the largest

number 6, then in my opinion 3 bits are appropriate to represent in uncompressed binary format all the values from 0 to 6, including the specific values that result from multiplying the values naught, 1, 2 and 3 by 2.

Q. Right. What I want to do now is go through the math of your example here. So, I think we agreed earlier that in your example sentence, with an uncompressed variable having values that range from 0 to 3, the possible values in that range are 0, 1, 2 and 3?

A. That is a correct statement.

Q. Using all the different possible arrangements of 2 bits, we are able to represent those four possible values?

A. Yes.

Q. Now we'll take those four possible values and we will multiply each by 2.

A. Yes.

Q. Now we have 0, I think we agree that is a possible result?

A. Yes.

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

considered to be uncompressed binary format.

Q. I think I understand your answer. Let me see if we are on the same page.

So, what you are saying is that it would be appropriate to use 3 bits to represent the possible values 0, 2, 4 and 6 because that's what's typically done. Now, we could imagine a world where we say, instead, we'll use just 2 bits, and then each of the four possibilities then maps on to 0, 2, 4 and 6?

A. However, the catch in your statement, Counsel, is the term "map." And that type of mapping introduces additional complexity. Sometimes an index has to be maintained to maintain such mappings. A POSITA would not normally be motivated to do that. The simplest thing to do is to stick to the prevalent implementation of taking 3 bits for all of it.

Q. If we had a scenario where we had two possible values in a system, 0 or 10, would you agree that one possible implementation would be to use 1 bit to essentially flag whether we have that

0 or 10 value?

A. You are speaking about a different kind of quantity, Counsel. The context of the '267 Patent, and in particular the context of what is being discussed here, relates to pixel values; and 8-bit signed pixel values typically range, over all the values, from minus 127 to plus 128, or in some types of systems unsigned pixel values range over the whole range of all the whole numbers from 0 to 255.

So, while you are speaking about a theoretical possibility that might apply to different types of systems and other types of variables, regarding this context of pixel values and the '267 Patent, that interpretation, in my opinion, is untenable.

Q. Okay. I think we agree that in a typical system you may have pixel values that range from something like 0 to 255 or minus 127 to 128 depending on whether we are including negative values.

A. That would be quite typical.

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

A. Counsel, you are repeating the same -- attempting to repeat the discussion and I believe I have already answered your question.

If we take, let us say, numbers in the range naught to 255 and multiply them by 2, to maintain precision and accuracy we need to increase the precision by an appropriate amount and in an appropriate implementation to cover the whole range. Otherwise, we will have problems such as overflow.

Q. If you assume that we are limited in the size of our registers, we are going to have overflow problems?

A. There are practical implementations, which I think are not relevant to the disclosure of this patent, as to how such systems can be practically implemented. They are not very complex.

There are -- when there are systems that require high precision, higher accuracy, such as perhaps a 4K video system compared to, say, surveillance camera footage, the additional

precision may be required. And there are practical implementations that can be made even on systems with 8-bit registers or, more commonly, systems that have 16-bit registers, or even now 64-bit registers in the modern era.

Q. Are you familiar with the concept of entropy coding?

A. Counsel, while I understand the statement you are making, please, could you clarify the relevance to the disclosure of the '267 Patent, which focuses entirely on the early part of the encoding or decoding process before any attempts at what you have described as entropy coding are made.

While I understand perhaps -- maybe I should not presume to understand your thrust. Nonetheless, the disclosure of the '267 Patent focuses on motion compensation, integer sub-pixel positions, uncompressed binary information that is at an earlier stage in the process of video encoding than entropy coding.

Q. Would a person of ordinary skill in

the art understand that an entropy coding component would be part of a common video architecture for an encoder or decoder at the time of the '267 Patent?

A. It could be. It doesn't have to be. And even, if I recall rightly -- and it is only from memory; I do not have the standard in front of me -- in the H.264 standard there is a bypass coding that bypasses the entropy coding.

Q. Let's look at page 81 of Exhibit 1 in your declaration.

A. Before we go there, Counsel, just a minute or two?

MR. VERBONCOEUR: A quick break then.

(Recess.)

BY MR. VERBONCOEUR:

Q. Welcome back, Dr. Freedman.

I directed you to page 81 of Exhibit 1. Now I would like to read to you a sentence that spans across pages 81 to 82. That is in reference to what we have called the Karczewicz ground.

"The similarities of Karczewicz-I's and Karczewicz-II's architecture would have suggested to a person of skill in the art to implement techniques taught by Karczewicz-I and techniques taught by Karczewicz-II using that common architecture."

That sentence ends on page 82 of your declaration. Do you see that?

A. Yes.

Q. Now, if we go back to page 81, we see what I believe to be the reference to a common architecture you made. Can you confirm that for me?

A. Yes.

Q. At the top of the page 81 of Exhibit 1 there are two figures, one of which is from one of the Karczewicz references and the other is from the other Karczewicz reference.

A. Yes.

Q. We know that these two figures are describing encoding processes because that is what the captions say but also because we see transform

units and quantization units?

A. Yes.

Q. Isn't it correct, Dr. Freedman, that in all hybrid-based encoding processes we'd expect to see a transform unit and a quantization unit?

A. That's a very general statement, Counsel, and it doesn't refer to any particular standard. It is not mandatory to have a transform unit and it's not mandatory to have a quantization unit. And if one wanted to encode images in some other manner and was willing to accept the resulting overheads, one could dispense with both.

Q. Are you aware of any lossy compression system in use today that doesn't use transform and quantization in a hybrid-based encoding process?

A. I am glad that you pointed out the term "lossy." Off the top of my head, I cannot think of one.

Q. And then this encoder architecture in the two Karczewicz references also has an entropy coding unit. Do you see that in the bottom of each of the two figures displayed at the top of

page 81 of Exhibit 1?

A. Yes, I see that.

Q. The entropy coding unit is what acts right before the bitstream is produced in each case?

A. That appears correct.

Q. What is entropy coding?

A. Entropy coding. Okay. Counsel, I want to again ask, what is the specific relevance of this to the disclosure and claims of the '267 Patent?

Q. Doctor, I am not the witness and so I can't tell you what I believe to be the relevance or not relevance in a way that is sort of me testifying. You are the one offering opinions in this case. My role is to ask you questions.

If you don't think it is relevant, you can explain to me why you don't think it is. Right now the question is just, what is entropy coding?

A. I understand. I would like to first say that the disclosure '267 Patent focuses on the

area of the motion estimation unit and the motion compensation unit, which is present in both figures at the top of page 81, and that is the part that is being disclosed and being claimed in the '267 Patent.

Completely separate from the discussion of the claims of the '267 Patent, there are downstream processes such as entropy coding. An entropy coding system is a system where what is typically an uncompressed binary format stream is encoded in such a way as to attempt to reduce the amount of unnecessary information stored in the final bitstream.

In other words, it's an attempt to reach an ideal level of compression, which is often measured by the Shannon entropy, which is a measure of disorder in the bitstream.

Q. Earlier I asked you a question about a system where we had two possible values in a bitstream, 0 and 10. If we were to entropy code that bitstream, a more efficient or more compressed way of representing the values that are

possible in that bitstream would be to use 1 bit. That would essentially tell us whether we have 0 or 10?

A. Again, Counsel, let me repeat that in terms of the relevance and the context of the disclosure of the '267 Patent and the claims in that patent in suit, which is what we are attempting to discuss today, attempting to assist the judge in reaching decision, that is really outside the scope of the claims of the '267 Patent according to my understanding.

Q. I appreciate your view that entropy coding is not something within the scope of the claims of the '267 Patent. You would at least agree with me that a person of ordinary skill in the art would know what entropy coding is?

A. It would be typical for a person of ordinary skill in the art to know what entropy coding is.

Q. Now going back to my example, what I am looking for is not whether you think entropy coding is relevant to the scope of the claim of

the '267 Patent or whether it is required. I am just trying to figure out the math behind this.

If we had a bitstream that had two possible values, 0 and 10 for all values in that bitstream, if we took an entropy coding process, we could use 1 bit to represent whether we had either 0 or 10 in each case for every variable in that bitstream. Do you agree?

A. Let's refer back to the architecture. So, if one had an entropy coding system much earlier in the downstream process and if one had what is essentially a binary logical variable, 0 and 10 essentially representing a binary logical variable, one could represent it in fewer bits.

Nonetheless, the disclosure and claims of the '267 Patent refer to a much earlier process where we have uncompressed binary formats and where we are focusing on pixel levels that are -- and predictions that are whole integers, whole number integers.

Q. You agree, though, that the '267 Patent doesn't require that predictions be whole

integers?

A. I think you are conflating more than one -- more than one consideration here, Counsel. Are you speaking about the concept of predictions and whether predictions relate to whole integers, or not?

Q. Doctor, you used the phrase predictions that are whole integers. What did you mean by that phrase?

A. I mean predictions that, for example, encompass integer values within a certain range. I am not speaking about pixel positions, which can be, for example, half, quarter or eighth pixel positions, but the representation of predicted values or of pixel values in a form that can be understood by these encoders such as 0 to 255 or 0 to 1024 or some other set of whole numbers.

Q. A convention in video coding is that we use whole integer values between 0 and 255 or negative 127 and 128, for example, for 8 bits to represent pixel values. But we could just as easily have a step size different than an integer

value between each possible arrangement of those bits?

MR. LIANG: Objection to form.

A. Counsel, you are repeating the same discussion that we had earlier on sets of possible values and ranges. And I believe I already answered your question very clearly about the use of uncompressed binary format -- and the key there is "uncompressed" and the key there is "binary" -- uncompressed binary format to represent the range that is all the integer values from the lowest to the highest of those integers.

Q. Your Ph.D., Doctor, was in physics?

A. Yes.

Q. Do you believe that the term "precision" has a different meaning in the context of physics than it does in the context of the '267 Patent?

A. Counsel, that is a truly vague question because all these things are context sensitive. You spoke about physics. Physics is a truly enormous field encompassing many, many

technological disciplines from the very smallest entities in existence to the very largest.

So, "precision" is a context-sensitive term. To illustrate from other fields, the term "precision" could, for instance, refer to a precision machining tool. Or in linguistics, it could refer to the use of precise language to describe a subject such as we are trying to do today.

So, there is not one unique meaning of precision; it is always context sensitive. And we have been discussing precision within the context of the disclosure and claims of the '267 Patent.

Q. I would like to use an analogy here. If you think this is too simplistic, let me know and we can use something else. But in our currency system in the United States we have dollars, quarters, dimes, nickels and cents. The smallest expressible amount of currency we have with actual coins is 1 cent.

Do you understand all that?

A. Within a financial system that focuses

on denominations of physical coins. Of course, our United States financial system often encompasses fractions of those to determine exchange rates and to perform broker account activities.

Q. Exactly. That is actually what I want to explore. So in a system that can't address fractions of physical coins and we are limited to the coins themselves, the smallest expressible unit is 1 cent?

A. At this time in the United States. However, in earlier eras it was possible to actually physically cut the coin to represent smaller denominations. This is something we no longer do.

Q. So if we are in a system where we don't cut coins, the smallest unit we can represent is 1 cent. You agree with that?

A. Within the constraints of the system that you mentioned.

Q. And what that means is that I can express 1 one-hundredth of a dollar?

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

A. In that hypothetical world, which to me seems to be irrelevant to the context of the '267 Patent.

Q. And if I took away the one-tenth of 1 cent, I have not changed the precision of the remaining dollar?

MR. LIANG: Objection to form.

A. Counsel, while I see where you are going, it is entirely reasonable for me to represent that at the same precision, a precision I choose to represent it at, as 1 dollar and 000 over 1,000 dollars.

Q. Now I think we are getting to the crux of the matter. But if I gave you 1 million dollars --

A. Yes, please.

Q. Unfortunately, I don't have the million dollars to give you. But if I were to give you 1 million dollars and I gave you no 10ths of a penny, does that change the precision of the amount of money I have given you? Have I given you a greater precision of money because I have

given you a greater number of dollars?

A. It is a question of representation again and the choice of representation. In the representation we have been discussing, this number can be represented as 1 million and 000 over 1,000 dollars. In that system of representation, the required precision may have increased beyond 1 dollar because I need now to represent all the whole number dollars from 0 to 1 million with more decimals, more decimal digits.

So, I can represent that as 1,000,000.000 over 1,000 dollars. And that does, indeed, require a greater precision to represent.

Q. Now going back to a video coding scenario, the pixel values that are higher on our range -- let's assume no negative numbers. Let's assume just positive pixel values. Are we on the same page there?

A. Yes.

Q. Let's assume a range of possible values from 0 to 255, 8-bits, if you will, of possibilities.

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

all values within that range have the same possible precision?

A. Depending on the range and in this representation.

Q. Now, if we multiply any number within that range, if the result exceeds 255, then we either have overflow or, under your interpretation, we must increase the precision by using more bits?

A. That would seem to be true.

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

(Recess.)

BY MR. VERBONCOEUR:

Q. Welcome back, Dr. Freedman.

Are you familiar with the concept of fidelity in video coding?

A. It's definitely a concept I have heard of.

Q. What is fidelity in video coding?

A. Ah, well, if anyone knew, it would be a very valuable piece of intellectual property.

However, fidelity is represented by a number of different approaches. Unfortunately, in video no one, even the video experts group, has been able to precisely capture the meaning of fidelity.

Q. When experts in video coding use the phrase "higher fidelity," what are they referring to?

A. They typically refer to encoding of video in a way that is less lossy; that is, less approximation is made to the pixel values in the original raw video stream in ways that matter to the context of use.

Q. Are you familiar with the H.265 standard?

A. I am reasonably cognizant of it. However, I do not have that standard in front of me and it is a very complex standard of many hundreds of pages. And --

Q. Are you familiar -- I apologize.

A. It is also not particularly relevant to the disclosure, the '267 Patent. That discloses H.264, but I don't perceive it as

explicitly disclosing H.265, which was ratified far after its priority date.

Q. Have you read the Preliminary Patent Owner Response that was filed by Nokia?

A. I may have done. I don't recall it.

Q. Let me know if this doesn't ring a bell and we can move on. But are you familiar with Nokia's contention that the inventors of the '267 Patent were working on H.265 standardization and proposed the techniques claimed in the '267 Patent to the H.265 standard?

A. If I had read that, I have no memory of reading that. It truly doesn't ring a bell with me.

Q. Are you familiar with the acronym HEVC?

A. Yes. You are referring to HEVC, high efficiency video coding.

Q. Correct. Let me know if you need me to introduce the '267 Patent as an exhibit. You perhaps have brought it?

A. I do, indeed, have an unmarked copy of

that patent in front of me.

MR. VERBONCOEUR: I will go ahead and introduce that as an exhibit. Let's mark Dr. Freedman's copy.

(So marked for identification as Exhibit 2.)

Q. Dr. Freedman, what has been marked Exhibit 2 is your copy of the '267 Patent.

A. Yes.

Q. If we look at the priority date of the '267 Patent, I will direct you to column 1.

A. Sorry. So, there is a date that it was filed. Counsel, my understanding is that priority dates require a legal determination which is not appropriate for me to make in this context.

Q. How about if we do it this way. If you look at column 1 of the '267 Patent, which will be several pages in past the figures --

A. Yes.

Q. You see there is a subsection called, "Cross-reference to related applications"?

A. Yes, Counsel, I see it.

Q. If you go all the way to the very earliest date, you will see January 7, 2011 at the bottom of that section.

A. Yes. I see that page.

Q. Do you agree that H.264 was published in May of 2003?

A. I have no idea, Counsel. To determine that, I would have to see a copy or perform an internet search for the earliest revision of that standard, and I am not going to agree to that information without some verification.

Q. Do you have some sense of when H.264 was published in its first final form?

A. I don't want -- I don't want to make a guess, Counsel. Such information has to be -- has to be verified before I will agree to it.

Q. To verify that, we'll introduce another exhibit.

MR. VERBONCOEUR: We'll mark this Exhibit 3.

(So marked for identification as Exhibit 3.)

Q. What's been marked as Exhibit 3 is an IEEE paper called "Overview of the H.264/AVC Video Coding Standard." Do you see the title?

A. I see the title.

(Brief interruption due to noise condition.)

MR. VERBONCOEUR: Let's break for a second.

(Pause.)

Q. So, we are looking at Exhibit 3, which has been marked "Overview of the H.264/AVC Video Coding Standard"?

A. Yes.

Q. If you look below the title of Exhibit 3, there are some names. Thomas Weigand, Gary Sullivan, Gisle Bjøntegaard and Ajay Luthra?

A. Yes.

Q. Do you recognize those names?

A. I recognize the first two names.

Q. Do you recognize Thomas Weigand and Gary Sullivan as co-chairs of the Joint Video Team that developed H.264?

A. I don't recall. It was just too long ago. But the names are familiar to me.

Q. I will direct you to a paragraph in the second column of the first page. It is the second full paragraph. In particular, the last sentence of that second full paragraph.

It says, "In December of 2001 VCEG and The Moving Picture Expert Group, MPEG, formed a Joint Video Team with the charter to finalize the draft new video coding standard for formal approval submission as H.264/AVC in March 2003."

A. I am sorry. I am not finding it. What was the location?

Q. It is the last sentence of the second full paragraph on the second column of the first page.

A. Oh, I see where it is. "In December 2001..."

I see it.

Q. I should ask, do you recognize this paper, "Overview of the H.264 Video Coding Standard"?

A. I believe I may have seen it before, if it is the same paper I have seen before. Let me see if it is indeed even in my binder here. It might be.

It does not appear to be. Nonetheless, this is a document I have previously seen in conjunction with video coding.

Q. If you look at the last sentence of the second full paragraph in the second column of the first page of Exhibit 3, there is reference to the finalization of the new video coding standard for formal approval submission as H.264/AVC in March 2003. Does that year ring a bell for you?

A. Well, all the years ring bells. One should understand that submission for approval is not the same as ratification or publication, and so I would essentially need to see that that standard was actually ratified and actually published in an appropriate year.

This is a publication -- and, Counsel, it is not within the scope of my deposition nor is it appropriate for me as an expert to opine on

what is essentially a legal determination of priority.

Q. This is not about priority, Doctor. The question is just, when was H.264 introduced?

A. Presumably sometime after March 2003. It would have been approved after submission for approval. The question is precisely when.

Q. Let's go to page 6 of your declaration that we had marked as Exhibit 1, I believe.

A. Okay. Page 6. Yes.

Q. There is a sentence, the second full sentence from your declaration, that says, "In 2003, the H.264 standard, also known as Advanced Video Coding (AVC) was introduced."

A. Yes, it says that.

Q. Is it correct that the H.264 standard was introduced in 2003?

A. If I wrote it there, I would have verified it.

Q. So now let's go back to the '267 Patent which we have marked Exhibit 2.

A. Yes.

Q. We are looking at column 1 now, so about 15 pages into the document, past the figures.

A. I see it.

Q. I am not asking you for a legal determination of priority date, but you can agree with me that the earliest date listed in the section "Cross-Reference to Related Applications" is January 7, 2011?

A. The earliest of the list of dates that are mentioned under "Cross-Reference to Related Applications" is January 7, 2011.

Q. If you go to page 24 of your declaration marked Exhibit 1, please, there is a sentence on page 24 of Exhibit 1 where you write, "For purposes of this declaration, I have analyzed obviousness as of January 7, 2011."

A. Correct.

Q. So for purposes of your opinions, we are looking at the '267 Patent as having a date of January 7, 2011?

A. For that purpose.

Q. Do you know when the standardization efforts for H.265 started?

A. Not offhand, Counsel. And it would be typical for me to look up the information on the internet. There are draft standards and there are working papers that were published, and I do not recall the precise dates and would indeed have to look them up.

Many of the deliberations of the MPEG committee were published in the sense that they became available to the public. And as for the implication of that, it is not appropriate for me to opine on that implication.

Q. I would like to go back to page 6 of your declaration, please, marked Exhibit 1. There is a figure displayed on page 6. Feel free to correct this if it is not correct, but your declaration described it as "the model of a typical general video encoder as illustrated below. This fundamental model has been used by major video encoding standards since the 1990's."

A. It is a statement about typical

encoders and a hybrid model that has been widely used since the 1990's by major video encoding standards. It is not prescriptive that it must be used; however, it is widely used.

Q. It's your opinion that a person of skill in the art would look at this figure and appreciate this as a notoriously well-known model for a general video encoder?

A. I would object to the word "notorious" because I think it is a very good type of encoder. Nonetheless, it would be quite familiar to a person of ordinary skill in the art.

Q. I will ask the question without the word "notorious." How about we say it is your opinion that a person of skill in the art would find the general video encoder model depicted on page 6 of your declaration marked as Exhibit 1 quite familiar?

A. Yes.

Q. I would like to talk now about the Karczewicz references on which you rely. You are familiar that you have what we have been calling

or haven't yet called the Walker Ground and then you have the Karczewicz Ground?

A. Yes. It is in my declaration.

Q. Now what I would like to do is introduce the Karczewicz references on which you rely as exhibits. Do you have those in your binder?

A. Yes, I do. I will have to see which tab it is.

Okay. I see them.

Q. I will hand you a copy as well because, given they are both called Karczewicz, I want to be sure we have the two of them lined up so we know which is which.

MR. VERBONCOEUR: If we can mark as Exhibit 4 the Karczewicz reference that is Publication No. 2011/0007799.

(So marked for identification as Exhibit 4.)

Q. Doctor, in your declaration you refer to what has been marked Exhibit 4 as Karczewicz-I?

A. That would appear to be true.

MR. VERBONCOEUR: Now I will mark the second Karczewicz exhibit. The second Karczewicz exhibit, which we'll mark Exhibit 5, is Publication No. 2009/0257499.

(So marked for identification as Exhibit 5.)

THE WITNESS: Okay. I see it.

Q. What has been marked Exhibit 5 you have been calling Karczewicz-II?

A. Apparently.

Q. So I would like you to put Exhibits 4 and 5 side by side, 4 being Karczewicz-I, Exhibit 5 being Karczewicz-II.

A. Do you mean literally physically side by side?

Q. It may be easier for you to answer the questions. You are not required to put them physically adjacent to one another if you prefer not to.

A. Okay. They are adjacent.

Q. Let's see if we can agree on basic facts about Karczewicz-I and Karczewicz-II.

First, the inventors, Marta Karczewicz, Peisong Chen and Yan Ye, are common between Karczewicz-I and Karczewicz-II?

A. That statement appears correct.

Q. Not only are Karczewicz-I and Karczewicz-II invented by the same inventors, both Karczewicz-I and Karczewicz-II are assigned to Qualcomm Incorporated?

A. That appears correct.

Q. Just to be sure I have it right -- feel free to consult your declaration -- is it your opinion a person of ordinary skill in the art would have seen Karczewicz-I and would have been motivated to modify Karczewicz-I based on Karczewicz-II?

A. I believe that, to answer your question with greater precision -- sorry to use that term -- a person of ordinary skill in the art would be motivated to combine the disclosures of Karczewicz-I, which I like to call K-I and Karczewicz-II, which I like to call K-II.

Q. I think what I am asking here is what,

in your view, is the person of ordinary skill in the art starting with. Are they starting with Karczewicz-I, or are they starting with Karczewicz-II?

A. Well, from the standpoint of a person of ordinary skill in the art, I would propose that they are starting from the simpler starting point, which appears to be K-I.

Q. Why do you refer to Karczewicz-I as the simpler starting point?

A. Because if I recall rightly, it focuses primarily on weighted predictions. And although it does mention sub-pixel values, its approach to the predictions for motion compensation is of relatively -- relatively simple form. While the disclosure of K-II provides additional refinement to sub-pixel values from sophisticated interpolation schemes.

Q. Thank you.

I would like to go back to the covers of Exhibits 4 and 5 and ask you a couple more questions about them.

Are you familiar with Marta Karczewicz?
A. I do not know that person.
Q. What about Peisong Chen?
A. Not someone I know personally.
Q. Have you heard of Peisong Chen before?
A. I don't recall. There are many people whose last name is Chen, and I do not recall whether Peisong Chen is someone that I have met.
Q. I want to make sure I ask the first set of questions the right way. Have you heard of Marta Karczewicz before this case?
A. I don't recall.
Q. Are you aware of Marta Karczewicz's reputation in the video coding community?
A. I really don't recall. It's a very large community with many individuals.
Q. What about Yan Ye? Have you heard of Yan Ye before?
A. That name does not ring a bell, but let me repeat my statement that the video and the image coding community is very large indeed, and I

don't recall -- I don't recall their names offhand.

Q. Do you know whether Marta Karczewicz is a person of ordinary skill in the art in video coding as of the time of '267 Patent?

A. I have no basis for that determination.

Q. The same question for Peisong Chen and Yan Ye. Do you have any knowledge as to whether they were people of skill in the art as of the time of '267 Patent?

A. I have no basis to make that determination on being persons of ordinary skill in the art. I have opined on the level of a person of ordinary skill in the art in my declaration in terms of their experience and educational background and their training.

So, I don't know what their educational background, experience or training is, and the only information we have in front of us is that they are named as inventors on a pair of patent application publications.

Q. Now what I would like to do is look at the publication dates. So, for Karczewicz-I you agree that the publication date listed -- and this is Exhibit 4 -- is January 13, 2011?

A. I see that there.

Q. In Karczewicz-II, Exhibit 5, the publication date is October 15, 2009.

A. I see that.

Q. The application for Karczewicz-I, marked Exhibit 4, was filed on July 9, 2009?

A. I see that date.

Q. The earliest application for Karczewicz-II listed under "Related U.S. Application Data" on Exhibit 5 is May 30, 2008?

A. And it would not be appropriate for me to opine on priority. But I do see the date listed.

Q. I am not asking you to opine on priority, but can we at least agree that Marta Karczewicz, Yan Ye and Peisong Chen were aware of the application that was filed on May 30, 2008, as listed here on Exhibit 5 of Karczewicz-II?

A. I don't think I can agree to that, Counsel, because you asked whether these individuals were aware of it and I do not know what the intellectual property practices of Qualcomm are. I am sorry to say that there are organizations that will file patent applications that may never have been reviewed or notified to their inventors, from documents they have in their possession.

So, I cannot tell you whether those people actually even knew the patent application was being filed.

Q. Okay. Now I will ask you the same question for Karczewicz-I, marked Exhibit 4. There is this application that was filed on July 9, 2009. Do you have an opinion as to whether Marta Karczewicz, Peisong Chen and Yan Ye knew about the substance of Karczewicz-I as of that July 9, 2009 date?

A. That is a question I cannot answer. My belief is that this is, on the face of it, a patent application publication in which these

individuals have been named. And while I would hope they were aware of the contents and that they had communicated with counsel, I have no information as to whether that actually took place.

MR. VERBONCOEUR: We can put those aside for now. Now I would like to introduce another exhibit we can mark as Exhibit 6.

(So marked for identification as Exhibit 6.)

Q. What has been marked Exhibit 6 is Publication No. 2003/0112864. Do you see that, Doctor?

A. I see that number, yes.

Q. Do you see there is a publication date listed on Exhibit 6 of June 19, 2003?

A. I see that publication date.

Q. Where Exhibit 6 lists inventors, there is someone named Marta Karczewicz listed alongside Antti Olli Hallapuro?

A. I see that.

Q. Does this give you enough information,

Doctor, to agree with me that Marta Karczewicz listed on Exhibit 6 is the same Marta Karczewicz we saw on Exhibits 4 and 5?

A. I don't have that information, Counsel. To me, it is a highly probable proposition, but I have no means of verifying the true identity of the inventor, nor do I know who the assignee, if any, of this patent application publication is.

Q. So you don't know one way or the other whether Marta Karczewicz had been working on video coding since at least this period of time listed here on Exhibit 6?

A. I don't have any information about that.

Q. Exhibit 6, you agree, is about sub-pixel interpolation?

A. Well, Counsel, it is a document that appears not to -- I do not recall this document being opined on in my declaration. Let me look to see, from the list of materials that were referenced, whether indeed this document appears

in the list.

This document does not appear in the list which is on page 182 of the declaration, titled "Appendix 2, Materials Considered in the Preparation of this Declaration." Therefore, I will assume that it wasn't considered and if I make any statements about this patent application publication, Counsel, it's outside the scope of my declaration and would be effectively a new opinion.

Q. So you don't have opinions on this document, you didn't consider it, so we can put it aside. I would like you to verify that before we put it aside.

A. I have no opinion about the contents of this document.

Q. Thank you.

I would like to get more into the weeds on your Karczewicz-I and Karczewicz-II opinions. If we could, please, turn to page 90 of your declaration.

A. Okay.

Q. Doctor, we are on page 90 of your declaration, which has been marked Exhibit 1. Do you recognize this section as going through the three different motion vector scenarios where, in your view, a person of skill in the art would have been motivated to combine -- well, to modify Karczewicz-I based on Karczewicz-II?

A. I believe that extends from paragraph 151 to at least paragraph 163.

Q. Yes. And starting with paragraph 151 on page 90 of your declaration through paragraph 163, there is scenario 1, scenario 2 and scenario 3?

A. I see that.

Q. I would like to ask you about these scenarios and then ask you some questions sort of keeping all three scenarios in mind. Let's start with scenario 1 on page 90 of your decoration.

If I understand this right, this is talking about a scenario where a person of skill in the art would have been motivated to modify Karczewicz-I based on Karczewicz-II when they were

looking at a first motion vector that points to a half-pixel position and then a second motion vector that points to an integer pixel position?

A. It would seem that that is true.

Q. You agree with me that in video coding, when we are talking about two-dimensional image frames, motion vectors can have two components, a vertical component and horizontal component?

A. It depends again on the context. In the context of H.262 or H.264, where there are simply two reference frames for bi-directional prediction, those are the possibilities. It is not universally true for all possible video codecs.

Q. Okay. But let's just use H.264 as an example that I think we'd agree that a person of skill in the art at the time of the '267 Patent would have been familiar with.

A. Okay.

Q. In that context and from the perspective of a person of skill in the art at the

time of the '267 Patent thinking about, for example, H.264, they would appreciate that a motion vector can have two components, one to represent horizontal movement, one to represent vertical movement?

A. It's a question of representation and how the pixels are indexed. One possible representation is a row/column representation such as you mentioned.

Q. So you agree a person of skill in the art of the '267 Patent would appreciate that a common way to represent motion vectors for pixels on a grid is to have a horizontal component and then a comma and then a vertical component?

A. That's a common scenario.

Q. So, I want to ask about the first and second motion vectors you mention in paragraph 151 on page 90. When you say, "A first motion vector points to a half-pixel position," are you saying that either the horizontal or vertical position is half-pixel, or both are half-pixel?

A. One needs to look at this with respect

to an appropriate diagram. I believe there may have been an appropriate diagram in one of the Karczewicz references or perhaps within my declaration.

Yes. We have a diagram, Figure 4B from K-II, just below -- well, rather, below paragraph 144 and above paragraph 145.

Q. Just for clarity of the record, you are looking at page 87 of your declaration marked as Exhibit 1, and we are now looking at Figure 4B from Karczewicz-II?

A. That's right.

Q. On page 87 of Exhibit 1, your declaration, you added what is shown in red? There are red rectangles interposed on the figure there; that is your addition?

A. Yes. The color scheme is my addition.

Q. Now going back to the question I asked about paragraph 151, does this figure here on page 87 of your declaration help clear up whether, when you reference a first motion vector points to a half-pixel position, are you talking about one

component of that motion vector, or does it have to be both?

A. It can be one component. So, in Figure 4B we have "b" and "h" as our pixel positions.

Q. Okay. So going back to paragraph 151, we are talking about now the discussion in Karczewicz-II. Your position is scenario 1 would occur when the first motion vector points to a half-pixel position, but that could be either the horizontal or vertical component?

A. It could be either the horizontal or the vertical component. I would have to think whether it's possible for it to be both components.

Q. What about for the second motion vector in paragraph 151? Is that referring to an integer position for one of the components, or both?

A. That is certainly referring to an integer position for both.

Q. So the second motion vector needs to

point to an integer pixel position for both components; the first, you are not sure whether it can point to half-pixel positions for both components but at minimum it needs to point to a half-pixel position for one component?

A. Correct.

Q. Then let's go to scenario 2, please, page 94 of Exhibit 1, your declaration.

A. I see it.

Q. Now, in scenario 2 we have the first motion vector pointing to a center-pixel position. What do you mean by "center-pixel position"? Is that in reference to Figure 4B from Karczewicz-II?

A. It is a reference to Figure 4B, and it clarifies my answer to your previous question.

Q. Okay.

A. If we go back to Figure 4B, because it is abundantly clear now within the context of that disclosure, that "j" is what they are calling a center-pixel position and not what has been called a half-pixel position.

Q. So, scenario 1, from page 90 of your

declaration, is talking about where the first motion vector points to one component that is at half-pixel position. Now scenario 2, the first motion vector has to point to a half-pixel position for both components?

A. This appears correct.

Q. Then also in scenario 2, the second motion vector now doesn't point to an integer pixel position; it points to a half-pixel position?

A. So, "b" and "h" and "ee" and "hh" do appear to be these half-pixel positions.

Q. So basically what's happened is, from scenario 1 to scenario 2, the first motion vector, rather than point to just one half-pixel position, now are pointing to a half, half, both components at half-pixel; then the second motion vector no longer points to an integer pixel position but points to the -- the motion vector has one component that is a half-pixel?

A. Counsel, I would remind you that half/half is a quarter. But I am going to

interpret the statement as meaning that a center-pixel has a half a pixel in the horizontal and a half pixel in the vertical.

Q. Right. Let me clarify that. I don't mean half by half, which would be quarter. I mean one half, comma, one half. Are we on the same page there?

A. We are now on the same page.

Q. Let's go to scenario 3, page 98 of your declaration.

A. I see it.

Q. Scenario 3 is both motion vectors point to half-pixel positions.

A. I see it.

Q. This is discussing the scenario where one component of each of the motion vectors points to a half-pixel position and the other component of each of the motion vectors points to an integer pixel position?

A. No.

Q. Can you explain, please, scenario 3?

A. Scenario 3 is precisely explained in

paragraph 163. Both motion vectors point to half-pixel positions.

Q. And is that both components of both motion vectors point to a half-pixel, or that just one component of each motion vector points to half-pixel?

A. It is clear that the disclosure here refers to both motion vectors having one component that is half-pixel.

Q. Now that, at least for me, we cleared that up, I would like to ask you some questions about how a person of skill in the art would go about modifying Karczewicz-I in light of your view on Karczewicz-II.

A. Okay.

Q. Karczewicz-I, I think we agree, discloses a process for bi-prediction?

A. I believe that to be correct.

Q. And in Karczewicz-I, there is a default weighted prediction process where both the first and second predictions are weighted equally. There is a default weighted prediction process in

Karczewicz-I where both the first and second predictions are weighted equally?

A. They have equal values for the weight.

Q. While we are on this point, the difference between Walker, on which you rely for Ground 1, and Karczewicz-I, on which you rely for Ground 2, is that Walker discusses explicitly signalling different weights for the first and second predictions?

A. Walker certainly discloses that. Although I believe we did not rely on it, I seem to recall some such disclosure also in Karczewicz-I.

Let me look at the patent briefly to see if there is any such disclosure. As I say, I don't recall us relying on it. I am actually looking at --

Q. Karczewicz-I is marked Exhibit 4.

A. This would explain my surprise at looking at Exhibit 5.

Now, while it is certainly true that K-I discloses implicit and explicit weighted

prediction with different weights in paragraph 621 and 622 at least, and also I think paragraph -- some other paragraphs, including 64 and 69 -- I believe we did not explicitly rely on this information in drafting the declaration.

Q. So when you are discussing Walker, you are relying on the weighted prediction process, but for purposes of your Karczewicz ground, you are not relying on the weighted prediction process; you are relying on the default weighted prediction process?

A. Predominantly relying on the default. But since we have disclosed that we are -- that we are using those references, there may be, so to speak, an implicit disclosure to the effect that anything that was disclosed by K-I or K-II can in principle be referred to.

Q. Does it make a difference for purposes of your opinions in Karczewicz whether Karczewicz-I is looking at a default weighted prediction scenario versus an explicit weighted prediction scenario when a person of skill in the

art is seeking to combine or modify Karczewicz-I in view of Karczewicz-II?

A. I don't think it really makes much difference.

Q. Now I would like to go back to the scenarios 1 through 3. Your view is that a person of skill in the art looking at Karczewicz-I would have been inspired by Karczewicz-II to make some changes. I would like to talk about what those changes are.

A. Sure.

Q. Are you envisioning a person of skill in the art implementing Karczewicz-I in a software-based encoder, hardware-based encoder, or both?

A. I think it's agnostic.

Q. How would the process of modifying Karczewicz-I work? This is something I didn't quite track reading the declaration so I wanted to ask you a few questions on this.

We have these different motion vector scenarios, so how would the person of skill in the

art change Karczewicz-I -- I am trying to think of how to ask this.

What modifications would need to be made to Karczewicz-I to account for these different possibilities of the three different motion vector scenarios you identify?

A. Karczewicz-II, among other things, focuses on improving the accuracy of the predictions. An example here is given in paragraph 162 in my declaration, in which a higher level of precision than was envisioned in K-I was applied to perform the averaging process.

Q. In paragraph 162, we are talking about scenario 2?

A. I think so, yes.

Q. How would a person of skill in the art change an encoder or decoder to know which scenario they were in as it relates to an entire block of bi-predicted pixels?

A. You seem to be asking two different questions, Counsel. Probably the simplest discussion is from the standpoint of a

software-based encoder since additional steps are required to translate software or firmware into an embedded system with hardware.

So, focusing on the simplest approach, it would essentially be a change of mathematical formula and it might require an implementation that uses a cast to a more precise data type, or it might involve more than one element of an 8-bit data type. It could be two separate variables or they could be in an array. There may be some other implementations that I can't think of offhand.

Q. You used the phrase "cast to a more precise data type." What do you mean by that?

A. Okay. That is a term of art in computer science when, say, a value of an 8-bit -- an unsigned 8-bit number is copied to bits, lowest or highest, of, for example, a 16-bit register or a 16-bit number.

Q. The reason I am thinking through this, Doctor, I am not a computer scientist so I am trying to be sure I actually understand what this

means. And I apologize; this might be simple for you. But can you explain what you mean by the value of an unsigned 8-bit number is copied to bits?

A. Okay. This is actually not a trivial question at all because it represents a practical implementation. But if we go back to the simple representation that we have in terms of uncompressed binary numbers, then let us say we represent in 8-bit form decimal number 255 by all 8 bits as set to 1 in the 8-bit representation.

Then in one representation this can be cast to a 16-bit binary number by copying the variable with all bits set to 1 for 8 bits to the 8 least significant bits of the 16-bit variable or 16-bit register.

Q. I see. So one possibility for the different scenarios you have identified in your declaration is that you would cast to a more precise data, and by that you mean you could copy the bits to a greater size register and then just assign those bits as the least significant bits of

that register?

A. It depends on what abstraction one is using. When one talks about registers, one often talks about practical hardware, embedded programming and so on. If we stick to the simplest scenario in software when one has modern languages and compilers available, this is sometimes called casting or promotion, where I basically say something like "integer star two 16-bit variable is equal to integer star one 8-bit variable."

That's a statement of FORTRAN. There are similar statements in C and other widely implemented languages.

Q. If we are looking at the person of skill in the art who is reading Karczewicz-I and has now been inspired by Karczewicz-II to change Karczewicz-I, I guess what I am trying to figure out is, for any given motion vector, we don't know what that motion vector is going to be. It could be that it fits into one of the three scenarios or it could be that it doesn't; there are some

possibilities --

A. I believe that within the H.264 standard, those three scenarios are a complete representation. There is nowhere else for them to fit in that scenario. And it is a very simple thing to do.

So if, for example, one were to implement this in C, which is a language that was widely used at the time both for software and firmware, it would be a simple statement like double 16-bit variable equals 8-bit variable where the 8-bit variable had probably been declared in single position.

Q. And that modification you say would apply to each of the three scenarios you --

A. Sorry. I wish to correct myself. I seem to recall that "double" referred to floating point numbers and I don't mean to imply that here. It's just a simple change of data type.

Q. And that change of data type you are referring to would apply to the three scenarios you identified?

A. Yes.

Q. The reason I am asking the question, in part, is sometimes you might have a first motion vector that points to an integer position and then a second motion vector that points to an integer position, and that wouldn't be any of your three scenarios?

A. This is an interesting point.

I had thought that this was a complete set of scenarios, and both motion vectors pointing to whole pixel positions is certainly -- is certainly a valid scenario.

Q. When the person of skill in the art, under your view of things, has modified Karczewicz-I in light of Karczewicz-II, what are they doing for the scenario where the first and second motion vectors point to integer positions?

A. Very probably in all these circumstances, if we consider disclosure of K-II, they are very probably still seeking higher precision to be maintained during the calculations. So, very probably this change of

data type, this cast, could efficiently be made for all of them. And I believe that a person of ordinary skill in the art would be motivated to do so because the apparent simplicity of just casting the data types once and applying it to all those four scenarios.

Q. Then I would like to introduce a fifth scenario, if we are up to five, which would be what about when the first motion vector points to a center-pixel position like we discussed earlier but the second motion vector points to an integer pixel position?

A. I still think that it would be convenient and simple to maintain the higher position throughout the sequence of calculations by performing that cast, a very easy implementation; the first prediction and the second prediction both cast to a higher precision one time and the appropriate formula applied for all of them.

Q. Do you think that it matters to the way a person of skill in the art would have

approached this problem that Karczewicz-II describes shifting by different amounts depending on the scenario one is in?

A. It's a tiny -- a tiny change. It might be that the amount by which it is shifted can be decided with a switch statement, for example, in C or an "if" statement. The various cases can be listed, as I said -- for example, there is cases of a switch statement in C -- and the appropriate shift read off.

Q. So under your opinion, a person of skill in the art would have taken Karczewicz-I, would have looked at Karczewicz-II and then they could have mapped out all the different possible motion vector scenarios and then, depending on which scenario they were in, they would shift different amounts --

A. To me, it's a few lines of code. It's the kind of activity -- well, you know, I can't speak for what other people's productivity level are, but I would be surprised if it takes me over a day to implement.

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

what is called a hardware accelerated encoder where many of the calculations are passed on in hardware?

A. In a certain scenario.

Q. In that scenario, a person of skill in the art would appreciate the typical way in which bi-prediction and sub-pixel interpolation would be done would be through hardware?

A. It's a definite possibility because of the speed requirement. However, one is now speaking about intricacy of specific chips, one is speaking about the balance of software -- firmware to provide inputs to those chips and calculations performed on those chips.

Since this is such a context-sensitive and implementation-sensitive issue, that has not been opined on in my declaration. I don't want to offer any definite opinion as to what a POSITA would do.

Q. Going back to the discussion we had -- and I'm not asking you now about hardware but just the approach that a person of skill might take to

a software encoder.

It seems that one approach would be the shift by the same amount, regardless of the motion vector scenario one finds themselves in. But given that Karczewicz-II teaches different shifts, your opinion is that a person of skill would map out all of the possible motion vector scenarios and shift differently for each case?

A. If a person of ordinary skill in the art intended to implement K-II's disclosure, I would opine that it is an easy matter for them to do so.

Q. I am getting into the "do so how" part of the question. When a person of skill in the art changes Karczewicz-I based on Karczewicz-II, it is your opinion that they would shift differently for each particular bi-prediction for each block of pixels depending on which of the various possible motion vector scenarios they found themselves in?

A. To me, this is a very small piece of code. Such software codecs, as you may be aware,

have a very large number of lines of code to implement them in software only. To me, this seems like a very small addition.

Q. But is it your opinion that the person of skill in the art looking at Karczewicz-I, being inspired by Karczewicz-II, would not have the same shifts for all of the possible motion vector scenarios that could happen?

A. Let us look at the disclosure of Karczewicz-II to make sure that that is indeed what K-II discloses because I do not want to agree to something that K-II discloses unless K-II actually discloses it.

I also think that this is in my declaration. It may be a simpler place to look.

I see some bit shifts of 6 to the right, 1 to the right. It's, to me, perfectly reasonable, if we say that that is indeed the disclosure of Karczewicz, to implement it. It would represent no barrier of complexity to have a switch statement that simply tests the interpolation scenario and provides the

appropriate shift.

Q. Now what I would like to do is kind of change topics a little bit --

A. Counsel, it is coming up to 12 noon. Would it be better for us to adjourn for lunch before you start a new series of questions?

Q. I will defer to you. To be --

MR. VERBONCOEUR: Off the record.

(Discussion held off the record.)

(Recess.)

BY MR. VERBONCOEUR:

Q. Welcome back, Dr. Freedman.

A. Yes.

Q. At any point during the deposition and at any breaks that we took, did you discuss the substance of your testimony with counsel?

A. No, not at all.

Q. Thank you.

Do you know someone named Iain Richardson?

A. I don't know him personally but I know of him.

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

book has many citations. It's a well-known book.

Q. Earlier we were talking about H.265 and you agreed with me that that is also known by the acronym HEVC?

A. Correct.

Q. Are you familiar with HEVC Main 10 Profile?

A. I recall those names. However, I do not have a copy of the standard in front of me and I do not offhand recall the precise characteristics of that profile.

Q. Are you familiar with the concept of a right shift?

A. In the context of the '267 Patent, I believe you are speaking about a right shift of a certain number of bits.

Q. Yes. Do you know what a logical and an arithmetic right shift is?

A. Yes, I do, and this relates to how the shift is performed and whether logical operations such as and/or or X/or at a bit level are used to effect that shift.

Q. For purposes of your opinions about the '267 Patent, does it matter whether we are talking about logical or arithmetic right shifts?

A. We are speaking about a conceptual right shift that effectively -- we are speaking about conceptual left shifts and right shifts which relate to multiplication by positive or negative powers of 2 in an uncompressed binary representation. How that shift is effected is not material to the discussion.

Q. In both the arithmetic and logical right-shift scenarios, a right shift has the effect of multiplying a number by a power of 2?

A. I simply -- I think I recall that to be true. However, I would have to go away and look up to be 100 percent sure.

Q. I apologize. I actually may have said that backwards. Let me rephrase that.

In both the arithmetic and logical right shift scenarios, a right shift has the effect of dividing a number by the power of 2?

A. That's a clearer statement.

Q. Just to be clear for the record --
A. And for the record, when I say multiplying by a negative power of 2, it is the same as dividing by a power of 2.
Q. So I think we can agree the effect of a logical or arithmetic right shift is to divide by a power of 2 or multiply by a negative power of 2?
A. Correct.
Q. And then the effect of a logical or arithmetic left shift is to multiply by a power of 2?
A. Yes.
Q. When one is right shifting, they can figure out what power of 2 the number at issue is being divided by by looking at the number of bits they are right-shifting by?
A. Yes.
Q. And so the way you would figure out the division operation to do is you would say 2 to the nth power or n is the number of bits in that particular right shift?

A. Well, 2 to the minus n.
Q. Yes. If you put it as multiplication, you would multiply by 2 to the minus n where n is the number of bits shifted to the right. Alternatively, you could divide by 2 to the n where n is the number that's been shifted --
A. In terms of practical implementation, I can't think of anybody who would implement that by a division operation.
Q. So let's just talk about multiplication. In terms of the way you are putting it, if you want to figure out what you are multiplying by for a right shift, you would do 2 to the negative n where n is the number of bits right-shifted?
A. Correct.
Q. Likewise, for a left shift, you would multiply by 2 to the n where n is the number of bits left-shifted?
A. Yes.
Q. In going back to our earlier discussion, you could look at this mathematically

where, if you right-shift by a certain number of bits, you are dividing the number or multiplying by a negative power, which has the effect in your view of reducing its precision?

A. In that representation.

Q. And then for a left shift, you are now multiplying by a positive power of 2, and that has the effect of increasing its precision?

A. Ah, but we need to be very careful about -- I see where you are going with this.

We need to be very careful about the representation. So, for example, if the representation, let us say, has been cast to a certain number of bits, one should be careful to properly count how many bits are needed to represent the result in that operation.

Q. Let me explore that.

A. There are some tables in my declaration that I believe were obtained from either Walker or Karczewicz that explore that in depth.

So, here is one for example. Table 5

on page 93 of the first declaration.

Q. We are looking at Exhibit 1 at page 93. Where in the table are you --

A. Paragraph 154, the whole table. So, operation r1 is integer pixel x, minimum value 0, maximum value 255, register 8 bits unsigned.

Q. I see.

A. Next operation is shift left by 5. The result is 32 times the integer pixel x. The range is now 0 to 8160 and the required register size is 13 bits unsigned.

MR. VERBONCOEUR: No further questions. Thank you for your time, Doctor.

THE WITNESS: Also, Counsel, even though you are opposing counsel, I thank you for a pleasant and civil deposition.

MR. VERBONCOEUR: No problem.

MR. LIANG: I do have one redirect question, Dr. Freedman.

EXAMINATION BY
MR. LIANG:

Q. If you could take a look at Exhibit 6?

Do you have it in front of you?

A. I have Exhibit 6 in front of me.

Q. And if you could turn to your declaration on page 182?

A. The first declaration?

Q. Yes. Your first declaration. There it is.

A. Yes.

Q. What is on page 182 of your declaration?

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

A. Quite a lot of things. But I would describe it as Appendix 2, Materials Considered in the Preparation of This Declaration. I am assuming you are saying what is the title of that.

Q. Right. If you could review Exhibit No. 1010 on page 182 of your declaration, let me know after you are done reviewing that entry.

MR. VERBONCOEUR: Same objections.

A. The publication numbers appear to match.

Q. So does reviewing your Appendix 2 refresh your memory about Exhibit 1010?

A. Yes, it does. I clearly have -- I clearly have seen this before, though I did not recall it offhand during my deposition. I did not memorize the entire document.

MR. LIANG: Okay. Thank you. No further questions.

MR. VERBONCOEUR: Just a brief recross on that.

FURTHER EXAMINATION BY
MR. VERBONCOEUR:

Q. Doctor, if we could please go back to what is Exhibit 1010 as mentioned in your declaration and what has been marked as Exhibit 6, I believe it is?

A. Yes.

Q. Earlier I asked you about Exhibit 6. Do you recall that?

A. Yes.

Q. One of the inventors listed on Exhibit 6 is someone named Marta Karczewicz?

A. Yes.

Q. I believe you mentioned your view that it was highly probable that the inventor Marta Karczewicz was the same person that is an inventor on both of the Karczewicz references on which you rely for your Ground 2?

A. That is a statement of probability, not a determination. I don't have her in front of me. I don't have her legal government ID so I can't tell you.

Q. As part of your analysis in preparing your opinions for these cases, did you consider Marta Karczevicz's background and experiences in video coding?

A. Counsel, you have asked me this question before. I can only see the disclosure, the patent in front of me. From this information, I cannot fully evaluate her training, background and experience. I don't have a CV for her and I cannot immediately tell whether she does or does not meet the requirements for a POSITA.

Q. Just to put a finer point on it, then,

you don't have an opinion, one way or another, about Marta Karczewicz's or any of the other inventor's on the references we discussed today levels of experience or skill?

A. No, I can't do so. There is a definite criterion to be a POSITA expressed in my declaration. It requires consideration of education, training, background and experience, which is usual. And since I don't have that information, I can't make an opinion.

MR. VERBONCOEUR: No further questions. Thank you.

[TIME NOTED: 12:58 p.m EST]

_____
IMMANUEL FREEDMAN, PH.D.

_____
Subscribed and sworn to
Before me this _____
Day of _____, 2024.

_____
Notary Public

CERTIFICATION

I, DEBRA STEVENS, a Notary Public for and within the State of New York, do hereby certify:

That the witness whose testimony as herein set forth, was duly sworn by me; and that the within transcript is a true record of the testimony given by said witness.

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

IN WITNESS WHEREOF, I have hereunto set my hand this 1st day of December, 2024.

DEBRA STEVENS, RPR-CRR

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J