

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

UNIFIED PATENTS, LLC,)	<div>CERTIFIED COPY</div>
)	
Petitioner,)	
)	
vs.)	IPR2022-01086
)	
VL COLLECTIVE IP LLC,)	Patent No. 8,605,794
)	
Patent Owner.)	CM#50348.76US01
)	

DEPOSITION OF
MICHAEL T. GOODRICH, PH.D.
VIA ZOOM VIDEOCONFERENCE
JUNE 14, 2023

Reported by:
COLLEEN M. PETERMAN
CSR 7882
No. 23-124939

 THE SULLIVAN GROUP
OF COURT REPORTERS
SULLIVANCOURTREPORTERS.COM
PHONE 855.525.3860 | 323.938.8750

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

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

UNIFIED PATENTS, LLC,)	<div>CERTIFIED COPY</div>
)	
Petitioner,)	
)	IPR2022-01086
vs.)	
)	Patent No. 8,605,794
VL COLLECTIVE IP LLC,)	
)	CM#50348.76US01
Patent Owner.)	
_____)	

DEPOSITION OF
MICHAEL T. GOODRICH, PH.D.
VIA ZOOM VIDEOCONFERENCE
JUNE 14, 2023

Reported by:
COLLEEN M. PETERMAN
CSR 7882
No. 23-124939

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

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

UNIFIED PATENTS, LLC,)	
)	
Petitioner,)	
)	IPR2022-01086
vs.)	
)	Patent No. 8,605,794
VL COLLECTIVE IP LLC,)	
)	CM#50348.76US01
Patent Owner.)	
_____)	

DEPOSITION OF MICHAEL T. GOODRICH,
PH.D., a witness herein, taken on
behalf of the Petitioner via Zoom
videoconference at 9:01 a.m. on
Wednesday, June 14, 2023, before
Colleen M. Peterman, CSR 7882.

1 APPEARANCES (All Participants Appeared Remotely):

2

For Petitioner:

3

HAYNES AND BOONE, LLP
BY JONATHAN R. BOWSER
800 17th Street NW, Suite 500
Washington, DC 20006
202.654.4500
jonathan.bowser@haynesboone.com

7

For Patent Owner:

8

REICHMAN JORGENSEN LEHMAN & FELDBERG LLP
BY JAIME F. CARDENAS-NAVIA
400 Madison Avenue, Suite 14D
New York, New York 10017
646.921.1474
jcardenas-navia@reichmanjorgensen.com

9

10

11

12

Also Present:

13

Ellyan Barazesh

14

15

16

17

18

19

20

21

22

23

24

25

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

I N D E X

WITNESS: MICHAEL T. GOODRICH, PH.D.

EXAMINATION BY	PAGE
MR. BOWSER	5
MR. CARDENAS-NAVIA	118

E X H I B I T S

PETITIONER'S	DESCRIPTION	PAGE
Exhibit A	Document entitled "Bitstream syntax description: a tool for multimedia resource adaptation within MPEG-21"	43

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

VIA ZOOM VIDEOCONFERENCE

JUNE 14, 2023

MICHAEL T. GOODRICH, PH.D.,
HAVING BEEN DULY ADMINISTERED AN
OATH BY THE REPORTER, WAS EXAMINED
AND TESTIFIED AS FOLLOWS:

EXAMINATION

BY MR. BOWSER:

Q. Good morning, Dr. Goodrich.

Is that how you pronounce your name?

A. Yes. Good morning.

Q. My name is Jonathan Bowser, and I'm counsel
for petitioner. I will be asking you questions today
about your declaration, which is Exhibit 2007, in
IPR2022-01086.

Can you please state your full name for the
record.

A. Michael T. Goodrich.

Q. Is there any reason why you would not be able
to answer my questions today fully, accurately, and
honestly?

A. No.

1 Q. Okay. Do you understand that during today's
2 deposition, you are under oath and providing sworn
3 testimony just as if you are in court?

4 A. Yes.

5 Q. If you don't understand any of my questions,
6 please let me know. If you answer my question, I will
7 assume that you understood my question.

8 Is that okay?

9 A. That's fine with me.

10 Q. Okay. Your counsel may object to questions
11 throughout this deposition. Unless your counsel
12 instructs you specifically not to answer a question, you
13 are required to answer my question.

14 Is that understood?

15 A. Yes. I understand.

16 Q. Okay. The court reporter will prepare a
17 transcript of this deposition today. To ensure that we
18 obtain a clear record of the deposition, please answer
19 each question with a full verbal response, such as "yes"
20 or "no." Please do not answer with verbal indications
21 such as "uh-huh" or head movements.

22 Is that understood?

23 A. Yes.

24 Q. Also, to ensure a clear record, I ask that you
25 let me finish my question before you provide an answer.

1 The court reporter may have difficulties accurately
2 recording who is speaking when there is cross talk.

3 Is that understood?

4 A. Yes. I'll do my best.

5 Q. Okay. And I will also do my best to let you
6 finish your answers.

7 At various points during the deposition, I may
8 ask you to read out loud a portion of your declaration
9 or one of the exhibits to ensure a full record. If I
10 ask you to read out loud a portion of your declaration
11 or another exhibit, please do not speed-read because the
12 court reporter may not be able to accurately transcribe
13 what you're saying.

14 During the portion of this deposition where
15 I'm asking you questions, you are not permitted to speak
16 with your counsel about the substance of your testimony,
17 including your deposition and your declaration.

18 Is that understood?

19 A. Yes.

20 Q. Okay. We'll plan to take a break after each
21 hour-long period of questioning, but if you need a break
22 before then, please let me know. The only thing is if
23 we take a break, I ask that you please answer my
24 question just so that we can ensure an accurate record.

25 Is that okay?

1 A. Yes.

2 Q. Okay. As I mentioned, I will be asking you
3 questions about your declaration, which is Exhibit 2007
4 in this proceeding. And I will upload that into the
5 chat right now.

6 Do you see that in the chat?

7 A. I do. And I've downloaded it.

8 Q. Okay. Perfect. Can you please open it up.

9 A. Yep. I have it in front of me on another
10 screen.

11 Q. Okay. Just for housekeeping purposes, do you
12 have the exhibits local on your computer?

13 A. I have copies of them, but I've marked them
14 up. So if you want clean copies, I would need them to
15 be downloaded through the chat window.

16 Q. Okay. Yeah. So we're going to use the clean
17 copies. And I would ask, also, that you refrain from
18 using any of the versions with your notes on them.

19 Is that understood?

20 A. Yes. That's fine with me.

21 Q. All right. So you have downloaded
22 Exhibit 2007; is that correct?

23 A. That is correct.

24 Q. All right. And is this your declaration?

25 A. Yes.

1 Q. Okay. If I refer to "your declaration," will
2 you understand that I'm referring to this document which
3 is Exhibit 2007?

4 A. Yes.

5 Q. Okay. What equipment are you using today for
6 this deposition?

7 A. I have an Apple iMac Pro computer that I'm
8 using to do the Zoom, as well as a side screen that's
9 attached to that.

10 Q. Okay. Where are you located today?

11 A. I'm in my office at the University of
12 California, Irvine, in Irvine, California.

13 Q. Are you alone in that room?

14 A. Yes.

15 Q. Do you have a phone with you?

16 A. I do.

17 Q. Okay. That's normal, but absent an emergency,
18 do you agree not to use your phone during the
19 questioning portion of today's deposition for any
20 reason?

21 A. Yes. I put on do not disturb, in fact, on my
22 phone.

23 Q. Okay. Do you have any chat windows open where
24 you are communicating with counsel of patent owner?

25 A. No.

1 Q. Are you communicating with any other
2 representatives of patent owner?

3 A. No.

4 Q. Have you been deposed before?

5 A. Yes.

6 Q. How many times, approximately?

7 A. I've lost count, but I believe it's more than
8 30.

9 Q. Have you ever been deposed in connection with
10 an inter partes review or a post-grant review
11 proceeding?

12 A. Yes.

13 Q. Okay. And of those approximately 30 times
14 where you've been deposed, how many of those do you
15 recall are for IPR or PGR proceedings?

16 A. I don't recall as I sit here today.

17 Q. Okay. To the best of your knowledge, has any
18 court or other tribunal ever excluded or stricken your
19 testimony for any reason?

20 A. I believe there has been some portions of my
21 reports that have been stricken.

22 Does that count?

23 Q. Yes. Do you recall the circumstances where
24 your reports were stricken?

25 A. Yes. So there was a district court case where

1 a sentence of my report was stricken. There was also an
2 ITC case where portions of my report were stricken.

3 In the Texas case, I believe the reason was
4 that I used a term in a generic sense that was a claim
5 term, and the court only wanted -- had restriction on
6 the use of that term. So that sentence was struck.

7 In the ITC case, what I was told by counsel is
8 that they had failed --

9 MR. CARDENAS-NAVIA: And, Michael, just
10 caution you not to reveal the substance of any
11 attorney-client privileged communication. I think you
12 can answer that question without doing that, but, you
13 know, just stick to the fact and not any communications
14 you had with counsel.

15 THE WITNESS: Oh, okay.

16 Yeah. So yeah. What I understood was the
17 reasoning behind the court in that case was a failure to
18 disclose my opinions in a preliminary disclosure from
19 the attorneys.

20 BY MR. BOWSER:

21 Q. Those proceedings that you just mentioned
22 where your testimony was stricken, were those
23 proceedings involving this patent, the '794 patent?

24 A. No.

25 Q. Okay. Can you please turn to paragraph 1 of

1 your declaration.

2 A. I'm there.

3 Q. Okay. And do you see where you describe
4 patent owner in the first sentence?

5 A. Yes.

6 Q. Okay. During today's deposition, if I refer
7 to "patent owner," do you understand that that means I'm
8 referring to VL Collective IP LLC?

9 A. Yes. I understand that.

10 Q. Were you retained by patent owner to testify
11 in this proceeding?

12 A. I was retained through counsel on behalf of
13 the patent owner.

14 Q. Have you communicated with members of --
15 strike that.

16 Have you communicated with representatives of
17 patent owner other than counsel about this case?

18 A. Not to my knowledge.

19 Q. I'm going to upload another exhibit, and it is
20 going to be Exhibit 1001. One moment here.

21 Okay. If you could please download that.

22 Have you downloaded Exhibit 1001?

23 A. Yeah. It's coming now. I have it.

24 Q. Okay. All right. And for convenience, if you
25 could please keep Exhibit 2007 open throughout the

1 deposition.

2 A. Okay.

3 Q. Okay. We might refer to other exhibits, but
4 it would be helpful if you just keep Exhibit 2007 open.

5 So let's go back to Exhibit 2007, paragraph 1,
6 your declaration.

7 A. I'm there.

8 Q. And do you see where you refer to U.S. Patent
9 No. 8,605,794?

10 A. I see that.

11 Q. Okay. If I refer to the "'794 patent," will
12 you understand that I'm referring to U.S. Patent
13 8,605,794?

14 A. Yes.

15 Q. Okay. And the '794 patent is Exhibit 1001 in
16 this proceeding.

17 Is that your understanding?

18 A. Yes.

19 Q. And you've downloaded Exhibit 1007 on your
20 computer; is that right?

21 A. That's correct.

22 Q. Okay. And if I refer to Exhibit 1001, will
23 you understand that I'm referring to the '794 patent?

24 A. Yes.

25 Q. Okay. Are you aware that the '794 patent is

1 currently involved in three pending district court
2 litigation proceedings?

3 A. I'm not aware of the number. I knew there is
4 some district court actions occurring, but I didn't know
5 it was three.

6 Q. Okay. Are you serving as an expert witness
7 for patent owner in any of those district court
8 proceedings?

9 A. My understanding is I have been retained to
10 opine on at least one of those.

11 Q. And have you been retained to opine with
12 respect to the '794 patent?

13 A. I'm not recalling, as I sit here today, which
14 patents are involved in those other cases.

15 Q. Have you provided any opinions in those
16 district court proceedings yet?

17 A. I don't recall having submitted anything yet.

18 Q. Did you have any relationship with patent
19 owner prior to this IPR proceeding?

20 A. No.

21 Q. Who did you meet with to prepare for your
22 deposition?

23 A. I met with the attorney who's representing me
24 and the patent owner today, Jaime Cardenas-Navia, on
25 Zoom on Monday.

1 Q. Okay. Approximately how long did you meet
2 with counsel to prepare for your deposition?

3 A. Roughly two and a half hours.

4 Q. Can you please turn back to Exhibit 2007, and
5 I would like to direct you to page No. 45.

6 A. I'm there.

7 Q. Is that your signature?

8 A. Yes.

9 Q. Okay. And did you sign this declaration on
10 April 17, 2023?

11 A. That is correct.

12 Q. Did you prepare the first draft of your
13 declaration?

14 A. My recollection is that I prepared what could
15 be considered a first draft. Certainly parts of this I
16 prepared as, you know, original for me.

17 Q. Do you recall which portions of the
18 declaration that you prepared?

19 A. My recollection is I prepared at least
20 section 3, which is paragraphs 3 through 11.

21 Q. Okay. So the portions that you prepared of
22 the first draft were your background and qualifications;
23 is that right?

24 A. I do recall that.

25 MR. CARDENAS-NAVIA: Objection to form.

1 Vague.

2 THE WITNESS: I do recall having done that. I
3 believe I may have done some others, but I'm just not
4 recalling, as I sit here today, about the other
5 portions.

6 BY MR. BOWSER:

7 Q. What is your current occupation?

8 A. I'm a distinguished professor at the
9 University of California, Irvine.

10 Q. Can you turn to paragraph 6, please.

11 A. I'm there.

12 Q. Okay. And do you see where you indicate that
13 you, quote, "have consulting experience in matters
14 involving," and then you've identified some
15 technologies?

16 A. Yes.

17 Q. Okay. What do you mean by "consulting
18 experience"?

19 A. So if you go to Exhibit 2007, my declaration,
20 and go now to PDF page 77, which is native page 31 in my
21 C.V., I have a listing there of my consulting that I
22 have done, professional consulting that I've done over
23 the years. So that paragraph is in reference and in
24 summary of this consulting that I've done.

25 Q. So you said -- I'm sorry -- page 79, PDF

1 page 79; right?

2 A. No. I believe I said page 77.

3 Q. Oh. 77?

4 A. In the PDF.

5 Q. Okay. And this section of your C.V.

6 identifies about approximately 10 engagements; is that
7 right?

8 A. No. The first listed entities are -- I'm
9 listing by the type of work and entities who have
10 retained me over the years. And then the last item,
11 "Technical expert and expert witness," is a summary of a
12 number of different engagements.

13 Q. Okay. That entry says "Technical expert and
14 expert witness, retained for IP litigations, 2012," and
15 then there's no end here; is that right?

16 A. That's correct.

17 Q. Does that mean that this is an ongoing
18 consulting engagement?

19 A. It's summarizing a series of engagements, some
20 of which are ongoing.

21 Q. So your consulting experience involves serving
22 as a witness in litigation matters; is that right?

23 A. That's right.

24 Q. Do you have any consulting experience with
25 regard to video distribution?

1 A. Depending on how you interpret that. The item
2 just above that in my C.V., I have experience consulting
3 with Walt Disney Animation Studios. That dealt with the
4 part of their video production pipeline that then, also,
5 of course, would entail distribution.

6 Q. Okay. Can you go back to paragraphs 1 and 2
7 of your declaration, please.

8 A. I'm there.

9 Q. Let me know when you're there. Okay.

10 The last sentence in paragraph 1, can you
11 please read that.

12 A. "I have also been asked to analyze the
13 anticipation and obviousness analysis based on
14 U.S. Patent No. 5,627,656 ('Sonohara') that is set forth
15 in Petitioner Unified Patents' ('Petitioner') petition
16 for inter partes review of the '794 patent ('Petition')
17 and the supporting declaration of Dr. Immanuel
18 Freedman."

19 Q. Okay. So you were asked to analyze the
20 anticipation and obviousness analysis based on Sonohara;
21 is that right?

22 A. That is correct.

23 Q. Okay. Can you please go to paragraph 2.

24 A. I'm there.

25 Q. Okay. And that is under a heading "Materials

1 Considered"; is that right?

2 A. Yes.

3 Q. Okay. And in paragraph 2, you have identified
4 the materials you considered; is that right?

5 A. That's right.

6 Q. Okay. And one of those materials is the
7 petition; is that right?

8 A. That's right.

9 Q. Okay. Did you review the petition in its
10 entirety?

11 A. I believe I did.

12 Q. Okay. I am going to upload the petition. Let
13 me know when you have that.

14 A. I have it.

15 Q. Okay. Can you please open up the petition.

16 A. I have it in front of me.

17 Q. Okay. Can you please turn to page 9.

18 A. I'm there.

19 Q. Okay. And do you see in the petition that
20 petitioner also challenged claims 1, 3, 5, 9, 12, 13,
21 15, 20, and 21 under the basis of the Abbott reference?

22 A. Yes, I see that.

23 Q. Okay. Do you address the Abbott base grounds
24 in your declaration?

25 A. No.

1 Q. Were you asked to review the Abbott base
2 grounds?

3 A. No. I mean I read it, but I wasn't asked to
4 opine on it, if that's your question.

5 Q. Okay. Are you aware that the board instituted
6 trial on this proceeding?

7 A. Yes.

8 Q. Turning back to paragraph 2, identifying the
9 materials considered, do you identify the institution
10 decision in paragraph 2?

11 A. I don't know if I do directly. I might
12 indirectly by that sentence, that phrase at the end,
13 other materials that are cited.

14 Q. And do you recall if you addressed the
15 institution decision in your declaration?

16 A. I don't recall having done that.

17 Q. Did you review the institution decision?

18 A. I did, as I recall.

19 Q. Okay. So paragraph 2 identifies the materials
20 considered.

21 And at the end of the paragraph, it indicates
22 "any materials cited or referenced herein"; right?

23 A. Yeah.

24 Q. Okay. So would it be fair to say that if a
25 document is not specifically cited or referenced in your

1 declaration, then you did not consider that document
2 when preparing your declaration?

3 MR. CARDENAS-NAVIA: Objection to form.
4 Vague.

5 THE WITNESS: That seems like an overstatement
6 to what I'm trying to say here. So, for example, I did
7 review the institution decision. I'm not specifically
8 relying on that for my opinion. So I don't cite it.
9 But I did review it. I read it, as I recall.

10 There may be some other materials that I
11 reviewed. And if there's any specific instances of
12 opinions that come up -- you know, I tried to be
13 complete as I possibly could here, but if there's any
14 omissions, I'll be happy to point those out, as I would
15 also be happy to point out any typos, if those need
16 clarification.

17 BY MR. BOWSER:

18 Q. Okay. Can you please go to column 7 of the
19 '794 patent.

20 A. I'm there.

21 Q. Okay. Do you see, beginning at, let's say,
22 line 28, there's a heading called "Documents"?

23 A. Yes.

24 Q. And do you see there that there are four
25 documents identified in column 7?

1 A. Yes.

2 Q. Did you consider documents 1 to 4?

3 A. My recollection is I did.

4 Q. Did you cite those documents 1 to 4 in your
5 declaration?

6 A. I don't recall having cited those directly
7 'cause they're cited inside the '974 [sic] patent
8 itself. I did cite to the file history of the '974
9 patent in paragraph 2.

10 Q. Can you go to paragraph 12 of your
11 declaration, please.

12 A. Sorry. Just to back up to a previous
13 question, is the institution decision considered a part
14 of the file history for the '794 patent?

15 Q. Are you asking me?

16 A. Yes. Clarification for your question.

17 Q. Well, the institution decision would be part
18 of the IPR proceeding.

19 A. So it is not considered a part of the file
20 history of the '794 patent.

21 That's what your representation is?

22 Q. My representation is that the file history is
23 for the prosecution of the '794 patent.

24 A. Okay. Yeah. So thanks for that
25 clarification. I may have been confused about that when

1 I said that I'm including and relying on the file
2 history of the '794 patent in my paragraph 2. I am not
3 an attorney. So, you know, I need additional
4 clarification about what all is included or not included
5 in the file history 'cause I am citing to the file
6 history of the '794 patent in paragraph 2.

7 And thanks for that clarification, and could
8 you repeat the question that's pending, please.

9 Q. Sure. If you could please go to paragraph 12.

10 A. I'm there.

11 Q. Okay. And above paragraph 12, it indicates
12 "Legal Principles Applied in this Declaration"; is that
13 right?

14 A. Yes.

15 Q. And in paragraph 12, you indicate that, quote,
16 "Counsel for Patent Owner has informed me of the legal
17 principles that apply for purposes of my declaration,"
18 end quote; is that right?

19 A. Yes. That is correct.

20 Q. Okay. And the legal principles section of
21 your declaration spans paragraphs 12 to 35 of your
22 declaration; is that right?

23 A. Yes.

24 Q. Did you discuss the substance of these legal
25 principles with patent owner's counsel?

1 A. Yes.

2 MR. CARDENAS-NAVIA: I was just going to say
3 to answer that just "yes" or "no," but you already did.

4 THE WITNESS: Yes.

5 BY MR. BOWSER:

6 Q. Did you apply these legal principles when
7 preparing your declaration?

8 A. Yes.

9 Q. Okay. So can you go to paragraph 16, please.

10 A. I'm there.

11 Q. And in the first sentence, it indicates that
12 "I have been informed that a patent is presumed valid."

13 Do you see that?

14 A. Yes.

15 Q. Is it your opinion that the presumption of
16 validity applies in IPRs?

17 A. My understanding from counsel is that it
18 applies from the point that the patent is issued; that
19 this is a presumption of validity that we get from the
20 patent office.

21 Q. And were you informed that the presumption of
22 validity applies in IPRs?

23 A. I don't recall any specific discussion about
24 that issue as I sit here today.

25 Q. The reason I ask is 'cause I'm curious if you

1 applied that presumption of validity in your analysis.

2 A. I stand by paragraph 16, if that's your
3 question.

4 Q. Would your analysis change if you understood
5 that there is in fact no presumption of validity in
6 IPRs?

7 A. No. My opinion would not change. I stand by
8 my opinions.

9 Q. Okay. Can you go to the "Claim Construction"
10 section that begins at paragraph 13 of your declaration.

11 A. There's two sections in my declaration dealing
12 with claim construction.

13 (Simultaneous speakers)

14 THE WITNESS: To the understanding of the law
15 regarding claims construction; correct?

16 BY MR. BOWSER:

17 Q. Yes. I apologize. Let me clarify.

18 So paragraph 13 begins with your understanding
19 of the law with respect to claim construction.

20 A. That is correct.

21 Q. Okay. So in paragraph 13 to 15, you provide
22 your understanding of the law with respect to claim
23 construction; is that right?

24 A. That is right.

25 Q. Okay. And can you please turn to

1 paragraph 26. I'm sorry. Page 26.

2 A. I'm there.

3 Q. Okay. And you see beginning on page 26, there
4 is a section of your declaration that specifically
5 addresses claim construction; is that right?

6 A. That's right. That's what I was referring to
7 earlier.

8 Q. Okay. And under paragraph 54, there is a
9 table where three terms are construed; is that right?

10 A. Yes.

11 Q. Okay. And those terms are "content-related
12 ... data segments" -- correct?

13 A. That's the first one, yes.

14 Q. And the second one is the preamble of claims 1
15 and 9?

16 A. Correct.

17 Q. And the third one is the assignment rule
18 limitations; is that right?

19 A. I'm fine if you want to say it that way. I
20 have a longer description of it, but it's fine just to
21 call it the assignment rule limitations.

22 Q. Okay. We'll get into the constructions of
23 those three terms in more detail later on, but I just
24 wanted to confirm your understanding that you addressed
25 those three terms in your declaration; correct?

1 A. Yes, specifically.

2 Q. Okay. And in paragraph 55, you indicate "I
3 agree with Patent Owner with respect to these
4 constructions"; correct?

5 A. That's right.

6 Q. So have you provided an opinion on claim
7 construction?

8 A. Yes.

9 Q. Let me go back to paragraph 14. I just want
10 to follow up something here about your understanding of
11 the law. Can you please go to paragraph 14.

12 A. I'm there.

13 Q. Okay. Do you see the last sentence, which
14 reads "I further understand, however, that it is
15 inappropriate to import limitations from preferred
16 embodiments recited in the specification into the claim
17 language"? Do you see that?

18 A. Yes.

19 Q. Did you apply this principle when providing
20 your opinions on claim construction?

21 A. Yes. Yes. I'm sorry if I cut out there.

22 Can you hear me?

23 Q. Yes. I can hear you.

24 Can you please turn to paragraph 36 of your
25 declaration.

1 A. I'm there.

2 Q. And in paragraphs 36 to 41 -- please scroll
3 through -- you provide an overview of the '794 patent;
4 is that right?

5 A. Yes.

6 Q. So I'm going to focus on the overview section
7 of your declaration next.

8 And in paragraph 37, you have included
9 portions of the abstract to summarize the '794 patent;
10 is that right?

11 A. That's right.

12 Q. Okay. Do you believe that the portions of the
13 abstract as contained in paragraph 37 accurately
14 summarize the objective of the '794 patent?

15 A. I mean my understanding is that we go by the
16 claim language, but the language in the abstract is a
17 summary form that appears to be consistent with that.
18 I'm not quite following what you're asking me.

19 Q. What I'm asking is, what would be your summary
20 of the '794 patent as recited in the claims?

21 A. So I provided a summary of the '794 patent in
22 paragraphs 36 through 41, as we mentioned, that
23 describes the specification and goes into additional
24 details about preferred embodiments. And then in
25 paragraph 42, I give a summary of two independent

1 claims, 1 and 9, which was the basis of my analysis. So
2 that's what I'm focusing on specifically.

3 And then in paragraphs 36 through 41, I'm
4 giving an overview of the specification.

5 Q. Okay. Can we go back to paragraph 37.

6 A. I'm there.

7 Q. Okay. Do you see in the first three lines of
8 paragraph 37, it mentions the term "content-dependent"?

9 A. Yes, I see that.

10 Q. Okay. And the terms "content-dependent" are
11 used in the abstract and the title of the '794 patent;
12 is that right?

13 A. Yes.

14 Q. Are you aware of whether the terms
15 "content-dependent" are used anywhere else in the
16 specification of the '794 patent?

17 A. Yes.

18 Q. And are the terms "content-dependent" used
19 anywhere else in the specification of the '794 patent
20 other than the abstract and the title?

21 A. Well, the title appears again in column 1. I
22 guess that's the title again.

23 MR. CARDENAS-NAVIA: And I'll just note for
24 the record that the copy of the '794 patent, the
25 exhibit, doesn't appear to be OCR'd or searchable.

1 THE WITNESS: Yeah. So I'm not immediately
2 seeing that exact phrase again. Instead, I see
3 repeatedly the phrase "content-related ... data
4 segments," for example, as well as "content-based."

5 BY MR. BOWSER:

6 Q. I'm going to put a link in the chat window to
7 the Google Patents version.

8 A. I have that in front of me.

9 MR. BOWSER: Okay. And with counsel's
10 approval, with all qualifications, noting that we don't
11 represent that the Google Patents version is entirely
12 accurate, I feel as though we could at least let him
13 look at the text on the Google Patents version as a
14 text-searchable version.

15 Is that okay?

16 MR. CARDENAS-NAVIA: I'm okay with that, yeah.
17 That's fine.

18 BY MR. BOWSER:

19 Q. Dr. Goodrich, would you do a -- you said
20 you're using a Mac, so a command-F search for
21 "content-dependent."

22 A. I see it. I see the hits.

23 Q. And how many hits do you get?

24 A. I get five hits.

25 Q. And where are those hits? In the

1 specification?

2 A. Three of them are in the specification
3 directly, and then there's two more in metadata
4 citations that Google Patents has for the patent.

5 Q. And those citations are from similar -- strike
6 that.

7 The first three hits I see as one in the title
8 and two in the abstract.

9 Is that what you see?

10 A. Yes.

11 Q. Okay. And the second two hits are from other
12 citations.

13 A. Correct.

14 Q. Okay. So it appears that the term
15 "content-dependent" is used in the title in the
16 abstract, and that's it; is that right?

17 A. That appears to be correct.

18 Q. Okay. What is your understanding of the term
19 "content-dependent"?

20 A. Exactly what it says. Content-dependent.
21 That it -- yeah. I would say it exactly the same way.
22 That's not a confusing term.

23 Q. Do you think that the term -- strike that.

24 Is it your opinion that the term
25 "content-dependent" is the same as "content-related"?

1 A. I don't recall having been asked that
2 question. To answer that question would require more
3 time for me to think about that. It doesn't seem to be
4 relevant to my analysis.

5 Q. Well, in paragraph 37 of your declaration, you
6 specifically use the words "content-dependent"; right?

7 A. Yes, because, like you said, I'm paraphrasing
8 from the abstract. I didn't think there was any
9 confusion there in doing that.

10 Q. Okay. So since you used the terms
11 "content-dependent" in paragraph 37, what is your
12 understanding of the term "content-dependent"?

13 A. Just that.

14 MR. CARDENAS-NAVIA: Objection. Asked and
15 answered.

16 THE WITNESS: That it's content-dependent data
17 segments, the way that the patent is describing them.
18 And then I have opinions about "content-related," that
19 specific phrase, later on.

20 BY MR. BOWSER:

21 Q. Okay. So just to summarize, your
22 understanding of the term "content-dependent" is just
23 the term itself.

24 A. Yeah. It's understood; that
25 content-dependent.

1 Q. Can you turn to paragraphs 38 and 39 of your
2 declaration.

3 A. I'm there.

4 Q. And in these paragraphs, you are discussing
5 figure 1 of the '794 patent; is that right?

6 A. That is correct.

7 Q. Okay. Can you keep out figure 1 in one of
8 your documents while we discuss portions of your
9 declaration?

10 A. Sure.

11 Q. Okay. Can you refer to column 3, line 67, to
12 column 4, line 5, of the '794 patent.

13 A. Yes. I see that.

14 Q. Okay. And in that portion of the
15 specification, it describes that an example of D1 in
16 figure 1 is a video data file; is that right?

17 A. So it says in column 4, beginning at line 3,
18 "Said video data stream is identified in FIG. 1 as the
19 first data file D1."

20 Q. So based on that example, do you consider data
21 file D1 to be a video stream?

22 A. I'm not understanding your question. I
23 thought I answered that already.

24 Q. Okay. Can you go to column 4, lines 5 to 8.

25 A. I'm there.

1 Q. And do you see beginning at line 7, it says
2 "The audio data stream is designated in FIG. 1 by way of
3 a name second data file D2"? Do you see that?

4 A. Yes.

5 Q. Would you be okay if we occasionally refer to
6 D1 as the video file and D2 as the audio data file?

7 A. In this example, I'm comfortable with that.

8 Q. And if you can go to column 4, lines 9 to 14,
9 please.

10 A. I'm there.

11 Q. Okay. Please read over that section.

12 A. "For every first and second data file D1, D2
13 there exists in each case a fragmentation description
14 file D1_BSD, B2_BSD. Said fragmentation description
15 file D1_BSD, B2_BSD specifies how content-related first
16 and content-related second data segments S1, S2 can be
17 obtained from the respective first and second data file
18 D12, D2."

19 Q. It would appear that there's a typographical
20 error in line 14.

21 Should that not be "D1" instead of "D12"?

22 A. I agree.

23 Q. Okay. So after you've read that portion of
24 column 4, would it be fair to say that the data
25 description file D1_BSD in figure 1 specifies how

1 content-related data segments S1 in figure 1 are
2 obtained from the data file D1?

3 A. I believe that's what I just read.

4 Q. Okay. And, likewise, the data description
5 file D2_BSD in figure 1 specifies how content-related
6 data segments S2 are obtained from the data file D2; is
7 that right?

8 A. I believe that's consistent with what I read.

9 Q. Okay. Can you go to column 4, lines 42 to 49,
10 please.

11 A. Yes. I'm there.

12 Q. And if you'd like to, please, you can read
13 that to yourself.

14 A. I'm done.

15 Q. Okay. Thank you.

16 So based on your review of column 4, lines 42
17 to 49, would you agree that in figure 1, the first data
18 file D1 and the first fragmentation description file
19 D1_BSD are supplied to the fragmentation module MF on
20 the left?

21 A. Yes.

22 Q. So does the fragmentation module MF on the
23 left-hand side of figure 1 split up the video data file
24 D1 into video segments S1?

25 A. I disagree with that characterization.

1 Q. What is incorrect about that characterization?

2 A. It sounds like this is suggesting -- your
3 question is suggesting that the MF unit does the
4 segmentation, chops up the data into segments. However,
5 it states very clearly, instead, at line 44, "This takes
6 first data segments S1 from the first data file D1
7 according to the fragmentation rule."

8 So it's clear from this to a person of
9 ordinary skill in the art that the data segments S1 are
10 coming from the first data file in D1. They're already
11 in the file D1 as sent, which is also consistent then
12 with the claim language, for example, of claim 1 and
13 claim 9.

14 Q. Okay. So what then is the function of the
15 fragmentation module on the left-hand side?

16 A. Just exactly what it says in the
17 specification; that the two files D1 and D1_BSD are fed
18 into the fragmentation module, which then passes that
19 information on to the synchronization module MS. And I
20 can go into more detail if you would like.

21 Q. What is your understanding of the phrase or --
22 sorry -- the term "takes" in column 4, line 44?

23 A. Just what it means; that it takes the first
24 data segment S1 from the first data file D1. So in
25 other words, those segments exist inside the file D1,

1 and this fragmentation module MF takes those from it --
2 "extracts," I think, would be another synonym you could
3 use here -- those segments from D1.

4 Q. Okay. So would it be accurate to say then
5 that the segments S1 are contained in the video data
6 file D1, and the fragmentation module MF extracts those
7 segments?

8 A. Yes. That's consistent with what the
9 specification is saying here. And it's consistent with
10 the claim language, which states that these are segments
11 of the first data file, for example, claim 1. So
12 they're in the data file of the claim also.

13 Q. All right. Let's look at column 4, lines 43
14 to 46, again.

15 A. I'm there.

16 Q. And if we use the word "extracts" as a synonym
17 for the word "takes," the second sentence in this cited
18 portion says this extracts first data segments S1 from
19 the first data file D1 according to the fragmentation
20 rule of the first fragmentation description file D1_BSD;
21 is that right?

22 A. Sure. That would be fine with me. That's
23 consistent with what I said.

24 Q. What is the fragmentation rule?

25 A. So if we go to figure 3 in the patent, it

1 talks about how these BSD files, D1_BSD and D2_BSD, can
2 have fragmentation instructions in them that then would
3 be used here in this specification example embodiment.

4 Q. Okay. Since you referred to figure 3, can we
5 talk about that for a second.

6 Figure 3, in the upper right-hand corner, has
7 the letter Z and an arrow pointing to everything in
8 figure 3; is that right?

9 A. Yes.

10 Q. Okay. Can you turn to column 5, lines 10 to
11 13, please.

12 A. I'm there.

13 Q. Okay. And isn't the letter Z used for the,
14 quote, predefinable assignment rule?

15 A. Yes, which then, in turn, references the
16 fragmentation instructions in column 3 -- or in
17 figure 3.

18 Q. So where are the -- strike that.

19 Where is the fragmentation rule?

20 A. So if we go now to figure 4, we see another
21 example of what is referred to in this embodiment as
22 fragmentation instructions. So if you go -- it has
23 delineated in its notation some notations of a B_D1, a
24 B_D21, and so on, and these have references to
25 fragmentation instructions.

1 Q. Can you go to column 3, lines 54 to 55.

2 A. I'm there.

3 Q. And it reads "FIG. 4 shows the contents of an

4 assignment rule formed with the aid of the XML

5 description language"; is that right?

6 A. That's right. Again, it's referencing two

7 fragmentation rules.

8 Q. So you're saying that the assignment rule

9 references the fragmentation rules?

10 A. In this example, yes.

11 MR. BOWSER: We've been going for about an

12 hour. How about we take a 10-minute break?

13 THE WITNESS: Okay.

14 MR. CARDENAS-NAVIA: Sure.

15 (Recess)

16 BY MR. BOWSER:

17 Q. Dr. Goodrich, welcome back.

18 A. Thank you.

19 Q. Did you speak with anyone during the break?

20 A. Yes.

21 Q. Was it about your testimony?

22 A. No.

23 Q. Do you recall before the break we were talking

24 about the fragmentation module in figure 1?

25 A. Yes. I recall that.

1 Q. So let's just recap just one thing so that we
2 can all be on the same page here.

3 Go to column 4, lines 43 to 46, please.

4 A. I'm there.

5 Q. Okay. Sorry. I'm looking at the transcript.
6 We already covered that.

7 Can you go to column 4, lines 46 to 49.

8 A. I'm there.

9 Q. Okay. And in that portion, it's referring to
10 the first data segments S1; right?

11 A. Yes.

12 Q. And it says "Said first data segments S1 are
13 passed by the fragmentation module MF to a
14 synchronization module MS in the same chronological
15 sequence R1 in which they are to be output."

16 Do you see that?

17 A. Yes.

18 Q. So is it your understanding that segments S1
19 are passed to the synchronization module MS in a
20 chronological sequence R1?

21 A. Yes.

22 Q. And that chronological sequence R1 is the same
23 chronological sequence in which the segments are to be
24 output from the synchronization module MS; is that
25 right?

1 A. With respect to the segments that came from
2 the file D1, yes.

3 Q. Where does the chronological sequence R1 come
4 from?

5 A. I'm not sure I follow your question.

6 Q. Is the chronological sequence R1 in the video
7 data file D1?

8 A. I'm still not following your question.

9 Q. So on the left-hand side of figure 1, we see
10 two inputs to the fragmentation module MF; is that
11 right?

12 A. That's right.

13 Q. Okay. And those two inputs are the first data
14 file D1 and the fragmentation description file D1_BSD;
15 is that right?

16 A. That's right.

17 Q. So how does the fragmentation module know to
18 extract video data segments S1 in the chronological
19 sequence R1?

20 A. There's a number of ways that can be done. So
21 any of them would satisfy this description and, to a
22 person of ordinary skill in the art, would be consistent
23 with this description.

24 Q. Is there a portion in the specification of the
25 '794 patent that you're relying on to reach this

1 opinion?

2 A. Yes.

3 Q. And what is that portion?

4 A. It describes the gBSD format, for example, in
5 the documents that we referred to earlier today. And in
6 figure 1, the file D1_BSD is disclosed as possibly being
7 in the gBSD format. That's just one example.

8 Q. So tell me if I'm wrong here, but there are
9 two inputs to the fragmentation module that we talked
10 about; right?

11 A. Correct.

12 Q. Okay. So which one of those two inputs
13 contains the chronological sequence R1?

14 A. I don't understand your question. That's
15 not -- that's not what's being said here.

16 Q. Well, how does the fragmentation module know
17 to extract the segments in the chronological sequence
18 R1?

19 A. As I mentioned earlier, there's a number of
20 ways it can know. I can give you examples if you want.

21 Q. Would you point to an example in the
22 specification of the '794 patent?

23 A. Sure. Please upload the documents that we
24 discussed earlier, that I mentioned and discussed, that
25 talk about the bitstream syntax description language.

1 These are documents that are part of the specification
2 that are described and identified in column 7, from
3 lines 30 through 43.

4 MR. BOWSER: Okay. So I've marked what is
5 labeled as document 1 in column 7 as Exhibit A.

6 (Exhibit A referenced)

7 THE WITNESS: Yeah. So, for example, if we go
8 to PDF page 7, which is native 727, the first full
9 paragraph describes an exemplary way that that can be
10 done.

11 BY MR. BOWSER:

12 Q. Hold on a second. You said PDF page 7, which
13 is native 727. Okay.

14 And what, in particular, on this page are you
15 relying on?

16 A. The whole paragraph. It talks about this.
17 So, for example, it begins "A binary media resource
18 consists of a structured sequence of binary symbols,
19 this structure being specific to the coding format. A
20 bitstream is defined as the sequence of binary symbols
21 representing this resource. XML is used to describe the
22 high-level structure of a bitstream; the resulting XML
23 document is called a Bitstream Syntax Description (BSD).
24 This description is not meant to replace the original
25 binary data, but acts as an additional layer, similar to

1 metadata. In most cases, it will not describe the
2 bitstream on a bit-per-bit basis, but rather address its
3 high-level structure, e.g. how the bitstream is
4 organized in layers or packets of data. For this, a
5 specific mechanism is provided to indicate a segment of
6 data in the original bitstream instead of actually
7 including the data since this would make the description
8 too verbose." I could go on.

9 Q. Okay. So you're saying that this paragraph,
10 which references a BSD file, that would contain the
11 chronological sequence?

12 A. I don't think you understood what I just read
13 perhaps. That's not what I'm saying. I read it right
14 out of the spec. To a person of ordinary skill in the
15 art, it would be clear what's going on here.

16 Q. Okay. You've said that several times; that it
17 would be clear to a person of ordinary skill in the art.

18 So which of those two files, the first data
19 file or the fragmentation description file, would
20 specify the chronological sequence R1?

21 A. Like I said, there's multiple ways that can be
22 done. One example would be the one that's described
23 here, that the second file is in the BSD format, the
24 bitstream syntax description language format. And this
25 particular example is talking about how the segments

1 would be in the file D1 in the correct order, and then
2 the BSD language talks about the syntax of how you are
3 to read those segments.

4 Again, it said "In most cases, it will not
5 describe the bitstream on a bit-per-bit basis, but
6 rather address its high-level structure, e.g. how the
7 bitstream is organized in layers or packets of data.
8 For this, a specific mechanism is provided to indicate a
9 segment of data in the original bitstream instead of
10 actually including the data" since that is too verbose.

11 Q. Okay. So just to summarize, you're saying
12 that one example could be to have chronological sequence
13 in the BSD file; is that right?

14 A. No. You still are misunderstanding what I
15 said.

16 Q. Can we turn to figure 1 again of the '794
17 patent.

18 A. I'm there.

19 Q. Okay. And in figure 1, using the example of
20 video data file D1 and audio data file D2, the video
21 data segments are denoted by S1 on the left-hand side of
22 figure 1; is that right?

23 A. Yes.

24 Q. And the audio data segments are denoted by S2
25 on the right-hand side of figure 1; is that right?

1 A. I agree.

2 Q. And there are 10 video segments S1, numbered
3 from 0 to 9; is that right?

4 A. In this picture, yes.

5 Q. And in the example of figure 1, there are five
6 audio segments S2, numbered from 0 to 4; is that right?

7 A. I believe that's consistent with how a person
8 of ordinary skill in the art would read this.

9 Q. And those 10 video segments passing through
10 the fragmentation module MF are then passed to the
11 synchronization module MS in the chronological sequence
12 R1; is that right?

13 A. Yes. That's what it said. We read that
14 earlier.

15 Q. And the video data segments S1 are passed to
16 the synchronization module MS in the order of 0 to 9
17 based on the chronological sequence R1; is that right?

18 A. I'm not following your question. I'm sorry.

19 Q. Okay. The video data segments numbered 0 to
20 9, they are passed to the synchronization module MS in
21 the order of 0 to 9; is that right?

22 A. Yes.

23 Q. And they are passed that way because of the
24 chronological sequence R1; is that right?

25 A. I'm not understanding what you mean by

1 "because of."

2 What do you mean by that?

3 Q. Okay.

4 A. They are passed in that order.

5 Q. So if you go to column 4, lines 46 to 49, it
6 says "Said first data segments S1 are passed by the
7 fragmentation module MF to a synchronization module MS
8 in the same chronological sequence R1 in which they are
9 to be output"; right?

10 A. Yes.

11 Q. So the chronological sequence R1 is what
12 specifies the output order; is that right?

13 A. I don't agree with the way you're describing
14 R1. R1 is a sequence. To a person of ordinary skill in
15 the art, that's just the sequence. Like 0, 1, 2, 3, 4,
16 5, 6, 7, 8, 9. That's a sequence. So that's what R1
17 is. And it's in that order, that numerical order.
18 That's what, to a person of ordinary skill in the art,
19 it would mean to say the chronological sequence R1.

20 Q. Okay. Can you go to column 5, lines 5 to 9.

21 A. I'm there.

22 Q. And it says in this portion that "A similar
23 procedure to that described above is followed in order
24 to implement the fragmentation of the second data file
25 D2 by way of the second fragmentation description file

1 D2_BSD and hence to output the content-related second
2 data segments S2 in the chronological sequence R2"; is
3 that right?

4 A. Yes.

5 Q. So in the example of figure 1, using the
6 example we talked about earlier where S2 denotes audio
7 data segments, there are five audio data segments that
8 would be output from the synchronization module MS in
9 the order of 0 to 4; is that right?

10 A. Yes. Yes. 0 to 4. That's right.

11 Q. Okay. So let's turn to column 5, lines 10 to
12 13.

13 A. I'm there.

14 Q. Please also refer again to figure 1.

15 Okay. So column 5, lines 10 to 13 -- and I'll
16 read this -- says "In a next processing step of the
17 method according to an embodiment of the invention, the
18 first and second data segments S1, S2 are synchronized
19 on the basis of a predefinable assignment rule Z."

20 Did I read that correctly?

21 A. I believe so.

22 Q. Okay. Now let's look at figure 1, please.

23 A. I'm there.

24 Q. Can you look at the middle of the drawing,
25 above the synchronization module MS?

1 A. I see that.

2 Q. And do you see an oval with the letter Z
3 pointing to that oval?

4 A. I do.

5 Q. And from that oval, there's an arrow pointing
6 to the synchronization module MS; is that right?

7 A. That is correct.

8 Q. So in your opinion, does the letter Z above
9 the oval pointing to the synchronization module MS
10 represent the assignment rule in figure 1?

11 A. Yes. I agree with that.

12 Q. Okay. So can you go to column 5, lines 38 to
13 43, please.

14 A. I'm there.

15 Q. And this portion that I just cited, it refers
16 to, quote, a second data segment S2 that's being
17 assigned to a, quote, first data segment S1; is that
18 right?

19 A. I think so.

20 Q. You said you think so?

21 A. Yeah. I mean it's not in those exact words,
22 but that sounds consistent with what is being said.

23 Q. Okay. So in the example of figure 1 described
24 in column 5, lines 38 to 58, the number of video data
25 segments is twice the number of audio data segments; is

1 that right?

2 A. In this example, for this period of audio and
3 video data example, yes.

4 Q. Okay. So it's stating it another way.

5 So for every second video data segment, it
6 will be assigned with one audio segment; is that right?

7 A. I mean it gives that as an example. So it
8 talks about how there's a note that one assignment rule
9 could be based on number A, where you assign a certain
10 number of segments of audio to a certain number of
11 segments of video, and in this case A equals 2.

12 Q. So as shown in figure 1, video data segments
13 S1 are output from the synchronization module MS
14 according to the chronological sequence R1; right?

15 A. That is correct.

16 Q. And as shown in figure 1 as well, audio data
17 segments S2 are output from the synchronization module
18 MS according to the chronological sequence R2; is that
19 right?

20 A. Yes, in this example.

21 Q. Okay. And it's the assignment rule Z that
22 specifies how the video and audio data segments are to
23 be synchronized to each other when they're being output;
24 is that right?

25 A. Yes, in this example. That's right.

1 Q. So let's turn to claim 1, below paragraph 42
2 of your declaration, please.

3 A. I'm there.

4 Q. Okay. So you reproduced claim 1 below
5 paragraph 42, and you also reproduced claim 9 below
6 paragraph 42; is that right?

7 A. Yes.

8 Q. Okay. And are you aware that in claim 1, it
9 had the preamble?

10 A. Yes. I opine on that.

11 Q. And then the rest of the claim I'll refer to
12 as the body of the claim.

13 Is that okay?

14 A. Yeah. I referred to the preamble as the
15 portion of the words from "A method" to the colon, the
16 first colon.

17 Q. Okay. So referring to the body of claim 1,
18 that begins with "sequentially outputting." I'm going
19 to start there.

20 Okay?

21 A. Sure.

22 Q. And it reads "a device for synchronizing
23 content-related data."

24 Do you see that?

25 A. Yes.

1 Q. Okay. Is the device in figure 1 what reads on
2 the device in claim 1?

3 A. I'm not sure what you're referring to.

4 Which device are you referring to in figure 1?

5 Q. Go to column 3, lines 46 to 47, please.

6 A. I'm there.

7 Q. Okay. And what does that say?

8 A. "FIG. 1 shows a device for performing the
9 method according to an embodiment of the invention."

10 So just to further clarify, you're referring
11 to the entire figure as the device, as is shown in this
12 embodiment; correct?

13 Q. I am, yes.

14 A. Okay. So what is your question then?

15 Q. So is the -- and I'm quoting claim 1.

16 Is the, quote, device for synchronizing
17 content-related data, end quote, in claim 1 shown in
18 figure 1?

19 A. Figure 1 shows a possible embodiment of
20 claim 1, in my opinion.

21 Q. Do any of the other drawings in the '794
22 patent show a device?

23 A. I don't believe so, no. It's showing other
24 things about the invention.

25 Q. So I'm trying to -- I'm going to turn back to

1 the body of the claim, beginning with "sequentially
2 outputting."

3 Okay?

4 A. Okay.

5 Q. And if you could please refer to figure 1. I
6 understand that you're saying that that's an example,
7 but it is a device.

8 Is that your understanding?

9 A. Yes. I agree.

10 Q. Okay. So at what point in figure 1 does the
11 "sequentially outputting" step happen?

12 A. And by your question, you're asking, like,
13 where in the picture would that be illustrated?

14 Q. Yes. Where -- let me rephrase.

15 So where in figure 1 does the "sequentially
16 outputting" step happen?

17 A. I'm not quite following. It's -- as we just
18 discussed, figure 1 is illustrating a device. And then
19 it shows its various inputs and various components and
20 various data put. So the device is doing the output.

21 Q. Okay. And the outputting occurs from the
22 synchronization module MS; is that right?

23 A. That's where it finally comes out. But the
24 entire device is doing the outputting.

25 Q. Okay. Can you refer to --

1 (Simultaneous speakers)
2 BY MR. BOWSER:
3 Q. I'm sorry. I apologize.
4 Do you want to finish?
5 A. I'm done.
6 Q. Okay. So column 5, lines 44 to 46, please.
7 Can you refer to that.
8 A. Yeah. I'm there.
9 Q. Okay. And I'm going to read that. It says
10 "The first and second data segments S1, S2 are output in
11 their chronological sequence R1, R2 by the
12 synchronization module MS at the latter's data output
13 G."
14 Do you see that?
15 A. Yes.
16 Q. Okay. So does the output G refer to the
17 output of the synchronization module MS?
18 A. Yes. That's the component in the device of
19 figure 1 where the output comes out of.
20 Q. So can you refer back to the body of claim 1
21 that begins with "sequentially outputting."
22 A. I'm there.
23 Q. So does this step, "sequentially outputting,
24 by a device for synchronizing content-related data,"
25 refer to what is being output from the synchronization

1 module MS at the data output G?

2 A. As an exemplary embodiment, yes.

3 Q. And just to summarize, the synchronization
4 module MS that's shown in figure 1, it receives as
5 inputs the video data segments S1 in the chronological
6 sequence R1; No. 2, the audio data segments S2 in the
7 chronological sequence R2; and, 3, the assignment
8 rule Z; is that right?

9 A. I agree.

10 Q. So please go back to paragraph 42.

11 A. I'm there.

12 Q. And it reads "The '794 patent claims methods
13 and systems that simplify how audio and video data are
14 synchronized before playback, resulting in faster
15 rendering and lower overhead"; is that right?

16 A. Yes.

17 Q. Okay. Are these features recited in claim 1?

18 A. No. These are benefits that are derived from
19 claim 1. I mean the synchronization is described, but
20 the results of faster rendering and lower overhead,
21 those are benefits that are derived from claims 1 and 9,
22 in my opinion.

23 Q. Okay. Let's turn to paragraph 54 of your
24 declaration, please.

25 A. I'm there.

1 Q. And there are three terms that are construed
2 here; is that right?

3 A. That's right.

4 Q. And before we start discussing the individual
5 terms, those three terms are specified in the table
6 beneath paragraph 54; is that right?

7 A. That's correct.

8 Q. Okay. And in the top row of the table, in the
9 right column, it says, quote, "Patent Owner's Proposed
10 Construction"; correct?

11 A. Yes.

12 Q. Did you participate in the preparation of
13 these claim constructions?

14 A. I'm not sure what you mean by that.

15 Q. Were you consulted to prepare these claim
16 constructions?

17 A. Still not quite following.

18 What period of time are you referring to?

19 Q. When you were preparing this declaration, were
20 you asked to participate in the preparation of these
21 constructions?

22 A. I don't understand what you mean by
23 "preparation of these constructions."

24 So if by that question you're asking did I
25 have discussions about these, I think I'm allowed to say

1 yes but not go into the details of that. Do I agree
2 with these constructions? Yes. Do I have opinions
3 about that that are my opinions? Yes. I provide those
4 in paragraphs 56 through 64. And 65, technically.

5 Q. Are you aware that these are the same claim
6 construction positions that patent owner has advanced in
7 the district court litigation cases?

8 A. Could you please upload documents to support
9 that representation?

10 Q. One second. Hold on. I have to find the
11 right exhibit here. Give me one moment.

12 Okay. I found it, and I am uploading it right
13 now. This is Exhibit 2005 in the IPR proceeding. Let
14 me know when you have that open.

15 A. I have it in front of me.

16 Q. Okay. The constructions for the '794 patent
17 begin on page 7.

18 A. I'm there.

19 Q. Can you please review these in comparison with
20 the constructions that you have beneath paragraph 54 in
21 your declaration.

22 A. Okay. I've reviewed those.

23 Q. And do those constructions in Exhibit 2005
24 from the patent owner appear to be the same as the
25 constructions beneath paragraph 54 of your declaration?

1 A. No.

2 Q. What's different?

3 A. The first one is different from my last one.
4 No. That's not -- not the first one. So what is
5 different is the proposed construction for "assignment
6 rule for assigning each one of the content-related
7 second data segments to one of the content-related first
8 data segments."

9 Q. I'm just looking at the transcript here. You
10 said "The first one is different from my last one."

11 Can you --

12 A. That was incorrect. That was incorrect, the
13 way I said that. I was reading the table. The first
14 one on page 8, which is, yeah, PDF 8, so -- which is
15 technically the second one in that table, which is then
16 different from the third one, in my opinion, which I
17 presumed you were asking about whether or not they would
18 be the same, and they are not the same.

19 Q. Okay. And would it be accurate to say that
20 the construction for assignment rule in Exhibit 2005 is
21 not the same as your construction for assignment rule
22 underneath paragraph 54 because your construction
23 doesn't include the "e.g." parenthetical?

24 A. For example, yeah. That's the difference,
25 yeah.

1 Q. And do you see any other difference?

2 A. Not sitting here today.

3 Q. Did you assist patent owner's counsel in
4 preparing the constructions in Exhibit 2005?

5 A. I don't recall having done that as I sit here
6 today.

7 Q. And in paragraph 55 of your declaration, you
8 state "I agree with Patent Owner with respect to these
9 constructions."

10 Do you see that?

11 A. Yes.

12 Q. So does that mean that patent owner's
13 constructions are also your constructions?

14 A. I'm not -- I'm not following what you mean by
15 that. If you're asking do I agree with the
16 constructions that are in my paragraph 54, yes. That's
17 what I'm saying.

18 Q. So let's go back to the table underneath
19 paragraph 54, and let's focus on the first term, which
20 is "content-related ... data segments."

21 Do you see that?

22 A. Yes.

23 Q. Okay. The proposed construction reads, quote,
24 "data segments ordered in a file such that they will
25 present the file's contents in their intended

1 presentation order when rendered sequentially."

2 Do you see that?

3 A. Yes.

4 Q. Okay. Can you refer to claim 1, please.

5 That's beneath paragraph 42.

6 A. Sure. I'm there.

7 Q. Does claim 1 specifically recite the concept
8 that, quote, data segments are ordered in a file?

9 A. I'm not -- I'm not understanding your
10 question.

11 What are you asking?

12 Q. Okay. So you've construed "content-related
13 ... data segments" as we previously discussed; right?

14 A. I agree with that construction, yes.

15 Q. Okay. And that construction is "data segments
16 ordered in a file." I'm going to break this in parts.
17 The first part is "data segments ordered in a file."

18 A. Yes.

19 Q. Okay. Do you see "data segments ordered in a
20 file" in claim 1?

21 A. I'm not following your -- what you're saying.

22 I've been told by counsel that claim
23 construction is trying to understand what claim terms
24 mean. So, you know, those definitions would have words
25 that may not necessarily appear into the claim.

1 So -- and this is one of those instances where
2 a person of ordinary skill in the art could understand
3 the term with respect to this claim construction as I
4 proposed. And some of those words did not appear in the
5 claim directly. They're embodied in that claim
6 "content-related ... data segments" in this case.

7 Q. So I'm asking a simple yes-or-no question
8 here.

9 Do you see the terms "data segments ordered in
10 a file" in claim 1?

11 A. I believe I answered that already. As I said,
12 those exact words are not in the claim. They're a part
13 of what a person of ordinary skill in the art would
14 understand is the meaning of the claim term
15 "content-related ... data segments."

16 Q. Okay. And the second part of your
17 construction says, quote, "such that they will present
18 the file's contents in their intended presentation order
19 when rendered sequentially"; is that right?

20 A. Yes.

21 Q. And do you see that phrase in claim 1?

22 A. I'd answer that the same way I did the other
23 part. That exact wording is not in the claim, which is
24 why I believe this term needs to be construed, so that
25 that clear understanding of a person of ordinary skill

1 in the art for what is the meaning of "content-related
2 ... data segments" is clear.

3 Q. Okay. Let's turn to paragraph 57, where you
4 specifically discuss the construction of
5 "content-related ... data segments."

6 Do you see that?

7 A. Yes. I'm there.

8 Q. Okay. And in that paragraph, you reference
9 the disclosure in column 4, lines 14 to 17.

10 Do you see that?

11 A. Yes.

12 Q. Okay. And I will read that portion. It says
13 The term "content-related" is understood to mean that
14 first and data segments have a syntactical meaning
15 within the respective data file, such as e.g. a
16 plurality of succeeding second data segments represent
17 the speech signal of a specific speaker within a
18 dialogue sequence, end quote.

19 Did I read that correctly?

20 A. Not completely, but you came close. You
21 misspoke on the word "second" data segments. But that's
22 fine.

23 Q. Okay. So would it be okay if we divided that
24 sentence into two parts, the first part being "The term
25 'content-related,'" which is the beginning of the

1 sentence, and the second part beginning with "such as
2 e.g."?

3 A. That's fine with me.

4 Q. So that portion of the specification that
5 you've identified, column 4, at lines 14 and 17,
6 contains two parts. So just keep that in mind as we
7 walk through this. Okay?

8 In paragraph 57, you say, in the second
9 sentence, quote, "In my opinion, a POSITA would
10 understand this to be an express definition of the
11 phrase 'content-related' in the context of 'data
12 segments'"; is that right?

13 A. Yes, that's right.

14 Q. Okay. What do you mean by the word "this" in
15 paragraph 57?

16 A. I'm referring to the entire portion of that
17 sentence, but the first part is more prescriptive,
18 whereas the second part is exemplary, 'cause it's set
19 off by the letters "e.g."

20 Q. So do you consider this -- sorry. Let me
21 strike that.

22 Do you consider the first part of that
23 sentence in column 4, lines 14 to 17, to be a definition
24 of the term "content-related"?

25 A. Yes. Absolutely. But then there's a problem,

1 of course. And now that definition has inside of it yet
2 another technical term, "syntactical meaning," which, in
3 my opinion, also needs to be construed. And so I
4 provide that opinion, also, in my paragraph 57. And
5 then, as a shortcut, the proposed construction for the
6 entire phrase "content-related ... data segments"
7 combines those for brevity.

8 Q. So the claims recite the term "content-related
9 ... data segments"; is that right?

10 A. Yes. I agree.

11 Q. Okay. And you indicated earlier that the term
12 "content-related" has an express definition in the
13 specification; is that right?

14 A. Yes. I think that's a fair characterization
15 of my testimony.

16 Q. Okay. So why did you not construe
17 "content-related data" to simply include the express
18 definition?

19 A. I just answered that question. So, again, to
20 repeat, in my opinion, the express definition is
21 provided in the patent specification, but then that
22 express definition itself has embedded a technical term
23 that needs construction, in my opinion, and that is,
24 what does it mean to have a syntactical meaning?

25 So -- and if the board wants to do this in two

1 steps, that's clearly up to them. But for the sake of
2 brevity, I'm offering an opinion that combines those two
3 steps into one, because the syntactic meaning, what that
4 means, to a person of ordinary skill in the art in light
5 of the specifications of the '794 patent is that data
6 segments are to be ordered in a file such that they will
7 present the file's content in their intended
8 presentation order when rendered sequentially.

9 Q. Okay. So just to summarize, the express
10 definition has a term that, according to you, needs
11 further explanation; is that right?

12 A. That's a fair characterization, yes. So
13 instead of doing it in two steps, I'm offering a
14 definition that combines that for brevity.

15 Q. So let's go to -- let's stay in paragraph 57
16 here, the third and fourth sentences, that we just
17 talked about. And you have, as you just indicated,
18 provided some brevity, according to your explanation
19 here.

20 Let's refer to the '794 patent in the
21 specific -- in citations that you provide here. So I'm
22 going to refer to column 4, lines 14 to 22, first.

23 Okay?

24 A. Okay.

25 Q. Let's break these down. So column 4, lines 14

1 to 22, that includes the definition of "content-related
2 data"; is that right?

3 A. Say that again.

4 Q. Okay. I'm just going to give you a road map
5 here as to where I'm going to go, and then we're going
6 to talk about each one of these three.

7 So you have three citations in the last
8 sentence of paragraph 57; right?

9 A. That's right.

10 Q. Okay. So I'm going to talk about each of
11 these citations individually.

12 A. Okay.

13 Q. All right. So we're going to break this down.
14 So I'm going to first ask you about column 4, lines 14
15 to 22.

16 And that portion of the specification that you
17 cite, that's what contains the express definition for
18 "content-related"; is that right?

19 A. Yeah. It's inclusive of that passage, that
20 express definition.

21 Q. Okay. How does that portion, what I'm
22 referring to as "that portion" meaning column 4, lines
23 14 and 22, require data segments to be ordered in a file
24 such that they will present the file's contents in their
25 intended presentation order when rendered sequentially?

1 A. It's there in that "e.g." part of the express
2 definition. So, again, to recap, it says that "such as
3 e.g. a plurality of succeeding second data segments
4 represent the speech signal of a specific speaker within
5 a dialogue sequence."

6 So to a person of ordinary skill in the art,
7 this is indeed an e.g., but it's about the order that
8 the audio is coming in the sequence. And it's a
9 dialogue. And the way that we humans do dialogue is in
10 order of the words that we speak.

11 So that's referring to that dialogue sequence,
12 that order, that now is in the summary now of what it
13 means to be syntactic meaning, in my opinion.

14 Q. Okay. So your construction then is based on
15 an example.

16 A. That's one of the supports for my
17 construction.

18 Q. Okay. Let's talk about the next one then,
19 column 4, lines 49 to 60.

20 Okay?

21 A. I'm there.

22 Q. All right. Can you please read column 4,
23 lines 49 to 60. Again, read to yourself.

24 A. Yes. I'm done.

25 Q. Okay. So column 4, lines 49 to 60, that's

1 discussing a chronological sequence; is that right?

2 A. I mean it's one of the things it's describing.
3 It's describing a lot of things.

4 Q. Okay. Where is the discussion of syntax in
5 column 4, lines 49 to 60?

6 A. Oh. To a person of ordinary skill in the art,
7 this is now talking about the -- again, what is meant by
8 "content-related" 'cause it talks about how these data
9 files have a content-related meaning.

10 And just in the paragraph above that, it talks
11 about how that "content-related" means that it has a
12 syntactical meaning. So when it says "content-related
13 meaning," a person of ordinary skill in the art would
14 understand this is yet another reference to the
15 syntactical meaning, which is all about the sequence.

16 And it goes into a lot of detail about the
17 video sequence, the audio sequence, how there's a "good"
18 and "morning." This is, again, getting to the way that
19 we humans dialogue. We have a word order. So in
20 English we usually say "good morning," not "morning
21 good," for example.

22 Q. So let me look -- let's talk about column 4,
23 lines 55 to 60 or -- sorry -- 57 to 60. Okay?

24 And I want to get your take on something here
25 because it says that the data segment contains the word

1 "good" and the data segment contains the word "morning";
2 is that right?

3 A. Yes.

4 Q. Okay. So would it be accurate to say,
5 according to you, that because there is an order to
6 those two data segments, they would have to be output
7 sequentially according to some syntax?

8 A. That's not how I would phrase it. I would
9 phrase it instead that the syntactical meaning, the
10 meaning that's imparted through the syntax, is that
11 order where "good" comes first, before "morning."

12 Q. Okay. But where does the syntactical meaning
13 come from?

14 A. I'm not -- I'm not following what you mean by
15 that.

16 Q. Okay. You have cited column 4, lines 49 to
17 60, to support your understanding of what a syntactical
18 meaning is in paragraph 57; right?

19 A. For what that word means, that phrase, in the
20 context of the '794 patent, yes.

21 Q. Okay. Is there a discussion of syntactical
22 meaning in column 4, lines 49 to 60?

23 A. In my opinion, yes, because it refers to
24 "content-related meaning," and then it literally just
25 said that in the paragraphs above that, that for the

1 rest of the specification, when it talks about
2 "content-related" or -- it says, also, "content-based,"
3 which a person of ordinary skill in the art would
4 understand here is synonymous with "content-related" --
5 that it's referring to that syntactic meaning.

6 So it's saying -- the syntactic meaning means
7 it's presented in order. So that's what "syntactic
8 meaning" means in the context of the '794 patent. I'm
9 paraphrasing, of course. I still stand by the exact
10 words that I'm offering here for the construction.

11 Q. Okay. Just to be clear then, for column 4,
12 lines 49 to 60, are you saying that there is a
13 syntactical meaning because it uses the words
14 "content-related"?

15 A. Not just that. It says "content-related
16 meaning" in line 51, for example. So this is an exact
17 reference back to what is called the syntactic meaning.
18 That's how a person of ordinary skill in the art would
19 understand that.

20 Q. Okay. So then to summarize, would it be
21 accurate to say that because it says "content-related
22 meaning" in line 51, you're referring back to the
23 definition of "content-related" in column 4, lines 14 to
24 19? Is that right?

25 A. That's a fair characterization, yes.

1 Q. Okay. So let's look at column 5, line 35 to
2 63.

3 A. I'm there.

4 Q. Okay. And this section of the specification
5 of the '794 patent talks about the assignment rule;
6 right?

7 A. Yes.

8 Q. Okay. But you're relying on a portion of the
9 specification for the '794 patent that talks about the
10 assignment rule for your construction of
11 "content-related ... data segments"; is that right?

12 A. Yeah, because it's talking about the
13 importance of that ordering, not with respect to the
14 assignment.

15 Q. Okay. Don't you construe the assignment rule
16 limitation separately?

17 A. Yes. But this still is providing support for
18 the construction for "content-related ... data segments"
19 'cause it's relying on that syntactic meaning, hence the
20 sequential ordering, in order to then do what is being
21 taught here with respect to the assignment rule.

22 Q. Why don't you rely on these portions here,
23 column 5, line 35 to 63, for the construction of
24 "assignment rule"?

25 A. I don't think that's an accurate

1 characterization of my opinion. I am relying on the
2 entire specification of the '794 patent with respect to
3 my proposed construction for -- or the construction I
4 agree with with respect to "assignment rule." So it's
5 inclusive of this portion.

6 Instead, it's now returning to my opinions
7 that are in paragraph 61 through 65. This is -- I'm
8 focusing more particularly on the negative limitation
9 aspect of that construction 'cause that is, I thought,
10 where the dispute lie in this case.

11 So already we have -- the issue of sequential
12 is already taken care of with respect to the
13 construction for "content-related ... data segments." I
14 didn't see a need to repeat that. But you should read
15 it in the order that I present it in my declaration to
16 understand that's included here.

17 But now particularly what I'm focusing on in
18 paragraph 61 through 64, for example, is this aspect of
19 the assignment rule is not performed by using exact
20 timing information for the data segments.

21 Q. Okay. So just to clarify, you indicated
22 that -- excuse me.

23 For your construction of "assignment rule" in
24 paragraph 61 to 64, you're also relying on your
25 construction of "content data segments" in paragraphs 56

1 to 58; is that right?

2 A. Implicitly, because my construction at the
3 very end says the data segments. The data segments. So
4 there's an antecedent basis there.

5 MR. BOWSER: Okay. Let's take a 10-minute
6 break.

7 Jaime, is that okay?

8 THE WITNESS: You're on mute, Jaime. You're
9 still on mute. You could have been objecting this whole
10 time. I wouldn't even know.

11 MR. CARDENAS-NAVIA: How about now?

12 THE WITNESS: Now I hear you.

13 MR. CARDENAS-NAVIA: Okay. I made one
14 objection, and I wondered why you just kept talking.
15 Now I know.

16 MR. BOWSER: Okay.

17 MR. CARDENAS-NAVIA: But yeah. 10-minute
18 break is fine.

19 (Recess)

20 BY MR. BOWSER:

21 Q. Okay. We're back on the record.

22 Dr. Goodrich, did you speak with anyone during
23 the break?

24 A. Yes.

25 Q. Was it about the substance of your testimony?

1 A. No.

2 Q. Let's go back to paragraph 56 of your
3 declaration, where you're dealing with your construction
4 of "content-related."

5 A. I'm there.

6 Q. Okay. According to your construction, do the
7 content-related data segments themselves indicate how
8 the data segments will be ordered?

9 A. I'm not following your question.

10 Q. So you have construed "content-related ...
11 data segments," just that term, as meaning data segments
12 ordered in a file such that they will present the file
13 contents in their intended presentation order when
14 rendered sequentially; is that right?

15 A. That's right.

16 Q. Okay. And that's a construction for only the
17 terms "content-related ... data segments"; is that
18 right?

19 A. That's right.

20 Q. Okay. So does your construction indicate that
21 the content-related data segments themselves indicate
22 how they will be ordered when rendered sequentially?

23 A. I'm still not following what you mean by that.

24 Q. Okay. What do you not understand?

25 A. The question. What you mean by that they

1 indicate themselves.

2 What does that -- what does that mean to you?

3 Q. Well, to me, you're construing only the term
4 "content-related ... data segments"; is that right?

5 A. In this construction, that's right.

6 Q. Okay. And your construction indicates that
7 that term means that the data segments will be ordered
8 in a file such that they will present the file's
9 contents in their intended presentation order.

10 Okay?

11 A. Okay.

12 Q. So that's the construction for the terms
13 "content-related ... data segments."

14 A. I agree.

15 Q. Does that construction suggest that the data
16 segments themselves will indicate how they should be
17 output when rendered sequentially?

18 A. I don't understand what you mean by will
19 indicate themselves.

20 Q. Okay. Are you relying on any other feature of
21 claim 1 other than the content-related data segments?

22 A. Now I'm not understanding your question
23 either.

24 What do you mean by that?

25 Q. Okay. So let's take a simple scenario where

1 we have a claim saying A, B, and C.

2 Okay? Is that an example you can follow?

3 A. So far, yes.

4 Q. Okay. And your construction, you're
5 construing the term "A."

6 A. In this hypothetical, I'm willing to accept
7 that so far.

8 Q. Okay. Does your construction of just the term
9 "A" mean that it depends on any feature of B and C?

10 A. I mean -- yes, in the sense that for my second
11 construction, in my opinion, the preamble is limited,
12 and the preamble includes the phrase "content-related
13 first data segments of a first data file" and
14 content-related second data segments of a second data
15 file.

16 Q. Okay. So where in your declaration do you
17 indicate that your construction of "content-related ...
18 data segments" depends on your construction of the
19 preamble?

20 A. I talk about the preamble being limited in
21 paragraphs -- or limiting in paragraphs 59 through 60.

22 Q. Right. But you didn't answer my question.

23 Where have you indicated in your declaration
24 that your construction of "content-related ... data
25 segments" depends on your construction of the preamble?

1 A. I'm not understanding your question. I
2 thought I answered that already.

3 In my opinion, the preamble is limiting. So
4 when it refers to "the content-related ... data
5 segments," which I highlighted in bold in paragraph 59,
6 it's referring to the content-related data segments
7 found in the preamble.

8 And then I have a construction for
9 "content-related ... data segments," which appeared both
10 in the preamble and elsewhere in the claim.

11 Q. So you construed "content-related ... data
12 segments" first; right?

13 A. In the order of my declaration, yes.

14 Q. Where in your construction of "content-related
15 ... data segments" do you refer to, quote, "the
16 content-related ... data segments"?

17 A. If you're asking where in paragraphs 56 to 58,
18 I don't say "the" data segments there. I say that in
19 paragraph 59.

20 I'm not understanding this line of questioning
21 at all.

22 Q. Okay. Let's try a different step here. So
23 can you refer to paragraph 42, where you reproduce
24 claim 1 again.

25 A. I'm there.

1 Q. In the last clause in claim 1, it talks about
2 the assignment rule; right?

3 A. That's right.

4 Q. Okay. And it says that the content-related
5 first and second data segments are sequentially output
6 together, quote, "on the basis of an assignment rule for
7 assigning each one of the content-related second data
8 segments to one of the content-related first data
9 segments"; is that right?

10 A. That's right.

11 Q. Okay. So isn't it the assignment rule in
12 claim 1 that assigns each one of the content-related
13 second data segments to one of the content-related first
14 data segments?

15 A. Yes.

16 Q. And claim 1 requires that the content-related
17 data segments are to be output sequentially based on the
18 assignment rule; right?

19 A. Also. Yes. It says that.

20 Q. Okay. So doesn't the assignment rule indicate
21 the sequential ordering of the content-related data
22 segments?

23 A. It indicates the assignment -- the assignment
24 rule talks about the ordering of how things are to be
25 output, but the order from content-related data

1 segments, that construction is referring to what could
2 be considered an input to this method, the first and
3 second files. They have to have ordered segments in
4 them for this to make -- have a syntactic meaning in the
5 context of --

6 Q. So they have --

7 A. -- the '794 patent.

8 Q. So they have to have an order in order to have
9 any meaning; is that right?

10 A. We spoke over each other. So just to clarify
11 again, in order to have a syntactic meaning in the
12 context of the '794 patent, the data segments would be
13 ordered in a file such that they will present the file's
14 contents in their intended presentation order when
15 rendered sequentially.

16 So it's completely within the scope of that
17 definition for that action to occur based on the
18 assignment rule. They have to be ordered in the file.

19 So let me give you a simple example, maybe, to
20 help clear this up. In my opinion, it's completely in
21 scope for all the segments in the file to be in reverse
22 order in the original file.

23 They're ordered, and they have a syntactic
24 meaning, and then the assignment rule says, yeah,
25 they're in the wrong order; they're in reverse order in

1 the file; but now present them in the correct order in
2 the output.

3 To me, that seems to be completely in scope,
4 just sitting here today. And it's consistent with both
5 of those limitations that there's an additional
6 limitation that's provided by the assignment rule.

7 Q. So if all the segments are in the wrong order
8 or they're in the reverse order, how do the segments
9 themselves indicate their intended presentation order?

10 A. I don't think that's what I'm saying. I think
11 you're misunderstanding what I'm saying here.

12 So the data segments are ordered in the file
13 such that they will present the file's contents in their
14 intended presentation order when rendered sequentially.

15 So an example that's perfectly, I believe, in
16 scope, just sitting here today, for the order in the
17 file to be the reverse order, and then the assignment
18 rule could say, for example, we're going to output them
19 in the other order 'cause that is the intended
20 presentation order.

21 Q. So in your construction, the "such that," are
22 you saying that that's the intended result?

23 A. No. That's talking about how they're ordered
24 to then allow for this assignment rule to then do this.
25 So it's still prescriptive. It's not just an intent.

1 Q. What does the word -- or what does the phrase
2 "such that" mean to you?

3 A. Just its meaning. "Such that." That's a
4 well-known English word phrase.

5 Q. Okay. So you're defining it by the term
6 itself.

7 A. I understand it to be the normal English word
8 "such that" -- I mean phrase "such that."

9 I don't understand your question then, what
10 you mean by -- I don't have a place in my -- I mean I
11 don't understand your question.

12 Q. Okay. So you use the term "such that" in your
13 construction; right?

14 A. Correct.

15 Q. But sitting here today, you're not willing to
16 say what that means?

17 A. I just did say what that means. It means such
18 that. That's a well-known English phrase.

19 Q. Okay. So --

20 (Simultaneous speakers)

21 THE WITNESS: You're asking me to define "is."
22 It's sort of at that level, when you have -- you know,
23 break down English words and then describe them in
24 definitions that are even longer than the phrase
25 themselves. I don't think that's necessary. A person

1 of ordinary skill in the art understands the words "such
2 that."

3 So then I don't understand your question. I
4 think it's plain what they mean, what it means.

5 BY MR. BOWSER:

6 Q. A person of ordinary skill in the art
7 understands "such that"; right?

8 A. Correct.

9 Q. Okay. So you're a person of ordinary skill in
10 the art; right?

11 A. At least. Yes.

12 Q. Okay. So then can you explain what "such
13 that" means?

14 A. What do you mean by that, to explain what
15 "such that" means? What do you mean by that question?

16 Q. All right. Let's back up here, since you're
17 not willing to answer.

18 You said that "such that" is prescriptive;
19 right?

20 A. In this case, yes. It's not just an intent,
21 this description, this offered definition.

22 So in other words, the ordering in the file is
23 such that when it's, you know, processed by and the step
24 of involving the assignment rule is performed, it
25 will -- you know, it will present the file's contents in

1 their intended presentation order when rendered
2 sequentially.

3 Q. Okay. Let's go to paragraph 61 of your
4 declaration.

5 A. I'm there.

6 Q. You know what? It would be easier, I think,
7 if we just look at paragraph 54 and the table for
8 "assignment rule."

9 A. I'm there.

10 Q. Okay. Would you agree that your construction
11 contains two parts, the first part being "assignment
12 rule for assigning each one of the content-related
13 second data segments to one of the content-related first
14 data segments"? Is that right?

15 A. Yes.

16 Q. Okay. That's the first part.

17 Can we call it that?

18 A. I accept that.

19 Q. Okay. And the second part says "wherein the
20 assignment is not performed by using exact timing
21 information for the data segments."

22 Can we call that the second part?

23 A. Sure.

24 Q. So isn't the first part just the claim
25 language itself?

1 A. Yeah. It's those words, which is why I
2 understand this is what's commonly referred to as a
3 negative limitation.

4 Q. So you've added the second part as your
5 construction.

6 A. Correct, 'cause that's the proper
7 understanding in light of the specification and file
8 history for the '794 patent.

9 Q. And would it be accurate to say then that your
10 construction is effectively just the negative limitation
11 because the first part is already contained in the
12 claim?

13 A. I'm not a lawyer. So my understanding is that
14 the proposed construction I'm offering is the entire two
15 parts.

16 Q. Okay. So your construction is part 1 plus
17 part 2, even though part 1 is already in the claim; is
18 that right?

19 A. Yeah. The way this was explained to me by
20 another attorney is that --

21 MR. CARDENAS-NAVIA: Again --

22 (Simultaneous speakers)

23 THE WITNESS: This isn't anything
24 confidential. This is something just an attorney was
25 explaining how to understand claim construction.

1 And that attorney said that one way to kind
2 of, you know, as a juristic, not as law but as a
3 juristic, to kind of do this is imagine that you just
4 substitute in the construction for the words that now
5 you'd be replacing.

6 And that totally works here. So that seems
7 consistent with what I understand to be the law
8 regarding claim construction.

9 BY MR. BOWSER:

10 Q. Can we go back to paragraph 16 again, please.
11 Sorry. I gave you the wrong citation. Paragraph 14.

12 A. I'm there.

13 Q. Last sentence, it says "I further understand,
14 however, that it is inappropriate to import limitations
15 from preferred embodiments recited in the specification
16 into the claim language."

17 A. Yes.

18 Q. Okay. Is it your opinion that the negative
19 limitation that you've added in your construction of
20 "assignment rule" is not an improper importation?

21 A. That is correct.

22 Q. Okay. And would it be accurate to say then
23 that part 2, that we talked about, is the negative
24 limitation? Can we call it that?

25 A. I'm fine with that.

1 Q. Okay. So in the negative limitation, what is
2 your understanding of the term "exact timing
3 information"?

4 A. That now what that's referring to is the
5 distinction that the patentee made in the file history,
6 for example, and it also appears in the specification of
7 the '794 patent, that the way you're doing the
8 synchronization is not based on exact time information.

9 So, like, you know, we do this at, you know,
10 one minute and 45 seconds. Then we do this other thing
11 at one minute and 46 seconds. This kind of stuff.
12 Exact time information. And that's distinguished by the
13 patentee and by the specification, in my opinion.

14 Q. All right. Can you go back to the Google
15 Patents link for the '794 patent.

16 A. I'm there.

17 Q. All right. Can you search for the word
18 "exact."

19 A. It did not find the word "exact."

20 Q. Okay. Can you search for the word "timing
21 information."

22 A. It did not have the word "timing." It does
23 have the word "information," but not the phrase "timing
24 information."

25 Q. Okay.

1 A. But, of course, Google Patents doesn't include
2 the entire file history.

3 Could you please upload the file history for
4 the '794 patent in searchable form?

5 Q. I don't have it in searchable form.

6 A. If you're willing to have me do OCR on it, I
7 can provide a searchable form from what you send to me.

8 Q. Okay. I just uploaded the file history.

9 A. I'm downloading it now. And with your
10 permission, I'd like to do OCR.

11 Is that okay?

12 Q. Sure.

13 A. This is going to take a while. If you have
14 any other questions you'd like to ask in the meantime,
15 that's fine with me. I can look at PDF files using a
16 different browser.

17 Q. Okay. Sure. So let's look at the way that
18 you've addressed your "assignment rule" limitation
19 construction.

20 And that's in paragraphs 61 to 64; right?

21 A. Yes. I believe so.

22 Q. Okay. And paragraph 61 contains your
23 explanation of the construction; right?

24 A. Yes, in summary form. That's right.

25 Q. Okay. And paragraphs 62 and 63 talk about the

1 alleged disclaimer; right?

2 A. I wouldn't say "alleged," but it's fine if you
3 want to call it that.

4 Q. Okay. And then in paragraph 64, there's an
5 explanation that a POSITA would understand the '794
6 patent discloses an assignment rule that does not need
7 to use timestamps; is that right?

8 A. That's right.

9 Q. Okay. So you're basing this negative
10 limitation on this not needing to use timestamps; is
11 that right?

12 A. So if we go to the '794 patent, now looking at
13 the specification, and we go to column 2 -- yeah.

14 So it makes it clear to a person of ordinary
15 skill in the art that the assignment rule is carried out
16 without the use of timestamps because it says, first,
17 "By way of the method according to at least one
18 embodiment of the invention, it is made possible in a
19 simple manner to synchronize content-related first and
20 second data segments."

21 The second, "The synchronization is controlled
22 by way of the predefinable assignment rule. In this
23 way, content-related data segments can be output
24 together according to their chronological sequence.
25 This is of advantage, since the assignment is carried

1 out without the use of timestamps."

2 So this is talking about that feature that
3 then is indeed a negative limitation with respect to
4 assignment rules as taught in the '794 patent.

5 Q. Okay. So why does your negative limitation
6 for the assignment rule in claims 1 and 9 not include
7 without the use of timestamps?

8 A. Oh. Yeah. So I -- yeah. So I discuss that
9 in paragraphs 92 through 94; that there's dependent
10 claims from 1 and 9 that have an additional limitation
11 that the assignment rule is not based on a timestamp.

12 So this is further narrowing the construction
13 that the assignment rule is not based on exact timing
14 information. So it's inclusive of that. It's certainly
15 inclusive of using timestamps. And, hence, when you go
16 to the negative and you say you're not including
17 timestamps, that is covered.

18 Q. Okay. So your paragraphs 92 and 93 are
19 concerning the analysis of the Sonohara reference;
20 right?

21 A. With respect to claims 20 and 21; that the
22 assignment rule is not based on a timestamp.

23 Q. So which, in your opinion, is the broader
24 concept? Without using exact timing information or
25 without using timestamps?

1 A. The first.

2 MR. CARDENAS-NAVIA: Vague.

3 THE WITNESS: So the broader limitation would
4 be without using exact timing information, and then a
5 more narrow, specific kind of timing information that
6 then would be narrower to say that you're not doing
7 those timestamps.

8 BY MR. BOWSER:

9 Q. Okay. So let's go back to paragraph 64, where
10 you describe your construction of "assignment rule."

11 And, again, that reference is column 2,
12 line 36 to 46, which has the phrase "without the use of
13 timestamps"; right?

14 A. That's right.

15 Q. Okay. So did you decide to not use that
16 phrase "without the use of timestamps" because it was
17 already recited in the dependent claim?

18 A. I'm not following --

19 MR. CARDENAS-NAVIA: Caution the witness not
20 to reveal any attorney-client privileged communications.

21 THE WITNESS: I'm not following your question.
22 I'm sorry.

23 BY MR. BOWSER:

24 Q. Okay. So what I'm asking you is, you cited to
25 one example in paragraph 64 that says "without the use

1 of timestamps"; right?

2 A. Right. From the specification. But then --
3 I'm still OCR'ing it, but I also have references to the
4 file history that further supports my opinion, in my
5 opinion.

6 Q. And that's based on arguments made over the
7 Shin and Rosenau references; right?

8 A. That's right.

9 Q. Do you understand a timestamp to correspond to
10 exact timing information?

11 A. That is an exemplary way you can do exact
12 timing information.

13 Q. Okay. I'm next going to talk or ask you some
14 questions about your testimony in your declaration about
15 the Sonohara reference, which is Exhibit 1003, and I'm
16 going to upload that right now.

17 A. Okay. I have that.

18 Q. Okay. Let's turn to -- well, let me back up.

19 So for the record, I'm referring to
20 Exhibit 1003 in this proceeding, which is U.S. Patent
21 No. 5,627,656.

22 If I refer to "Sonohara," will you understand
23 that I'm referring to Exhibit 1003 in this proceeding?

24 A. Yes.

25 Q. Okay. And you have addressed Sonohara in your

1 declaration beginning at the section heading "A" above
2 paragraph 66 of your declaration; right?

3 A. That's right.

4 Q. Okay. And above paragraph 66, in that heading
5 that I just referenced, it says Sonohara Does Not Teach
6 Synchronizing Content-Related Data Segments From Two
7 Distinct Files; is that right?

8 A. Yeah. It said "Two Distinct Data Files," but
9 that's close enough.

10 Q. Okay. So in paragraph 66, the first
11 sentence -- let's focus there -- you talk about how
12 Sonohara discloses that its apparatus "includes a file 1
13 into which image data of a moving object and audio data
14 are stored, a file production processing device 7 for
15 producing the file 1, and a file reproduction processing
16 device 8 for reproducing the video data and audio data
17 of the file 1."

18 A. Yes, I say that.

19 Q. Okay. Before we go too far on Sonohara, let
20 me just come back to the negative limitation with your
21 assignment rule. So we're referring to paragraph 61 to
22 64 again.

23 Okay?

24 A. Okay.

25 Q. So is it your opinion that the '794 patent

1 requires all embodiments need that negative limitation?

2 A. I'm not quite following what you mean by that.

3 Q. Okay. So you've pointed to one specific
4 example in column 2 --

5 A. That's right.

6 Q. -- lines 36 to 46.

7 So do all the embodiments in the '794 patent
8 require that negative limitation?

9 A. I'm not following that question.

10 What do you mean by "require"?

11 Do you mean that they all do that limitation?

12 Q. Yes. Do all of the embodiments in the '794
13 patent specifically exclude the use of a timestamp?

14 A. Yes. I believe so --

15 Q. Okay.

16 A. -- unless I'm just missing something today.
17 Certainly the claim convention is limiting that way.

18 Q. So would you say that the assignment rule does
19 not ever consider timing?

20 MR. CARDENAS-NAVIA: Objection to form.
21 Vague.

22 THE WITNESS: I'm not following your question.
23 BY MR. BOWSER:

24 Q. Let me go back to the transcript here just to
25 make sure I'm on the same page. You said that unless

1 you're missing something today, certainly the entirety
2 of the '794 patent excludes the use of -- sorry. Let me
3 rephrase.

4 Is it accurate to say that in your opinion,
5 all the embodiments of the '794 patent require that
6 negative limitation that you've added to the assignment
7 rule limitation?

8 MR. CARDENAS-NAVIA: Objection to form.
9 Vague.

10 THE WITNESS: Certainly that's true for the
11 claimed invention, if that's your question. My
12 understanding is that a patent may claim -- have claims
13 that don't necessarily read on every embodiment in the
14 patent.

15 If there's somewhere in the patent you'd like
16 me to point to and ask if this is embodied in the claim,
17 I'd be happy to address that.

18 BY MR. BOWSER:

19 Q. Well, I'm wondering just in general because
20 you're the proponent of this claim construction.

21 So are you saying that all the embodiments
22 require that negative limitation?

23 MR. CARDENAS-NAVIA: Objection to form.
24 Vague.

25 THE WITNESS: I would answer it the same way I

1 did before; that the claimed invention in the '794
2 patent requires that negative limitation based on both
3 the specification and the file history.

4 BY MR. BOWSER:

5 Q. Can there be any situation within the '794
6 patent alone where embodiments do not require the
7 negative limitation?

8 MR. CARDENAS-NAVIA: Same objection.

9 THE WITNESS: If there's a place you want to
10 point me to in the patent specification, I'll be happy
11 to address that. That question seems overly broad to
12 me, just sitting here today.

13 BY MR. BOWSER:

14 Q. So is it your opinion that the assignment rule
15 categorically excludes the consideration of timing?

16 MR. CARDENAS-NAVIA: Objection to form.
17 Vague.

18 THE WITNESS: Say that again. Could you
19 repeat that question?

20 BY MR. BOWSER:

21 Q. Okay. So you've added into the claim a
22 negative limitation; right?

23 We talked about that.

24 A. In my -- I agree with this claim construction
25 that has a negative limitation.

1 Q. Okay. So this is the claim construction that
2 you agree with; right?

3 A. Correct. Yes.

4 Q. And that's your construction, the patent
5 owner's construction, which contains the negative
6 limitation; right?

7 A. That's right.

8 Q. Okay. And since you agree with this, can you
9 offer an opinion on whether that negative limitation
10 categorically precludes the consideration of any timing
11 information with respect to the assignment rule?

12 MR. CARDENAS-NAVIA: Objection to form.
13 Vague.

14 THE WITNESS: And what do you mean by "any
15 timing information"? This is excluding exact timing
16 information. So there may be other things that you
17 would call timing information that would be in scope,
18 but not exact timing information, as is clear from both
19 the specification and the file history.

20 BY MR. BOWSER:

21 Q. So have you explained what you mean by "exact
22 timing information"?

23 A. I have exemplary explanations of that, for
24 what that entails. I think to a person of ordinary
25 skill in the art, that would be clear, what we're

1 talking about when we say "exact timing information."

2 Q. Okay. You said you have exemplary
3 explanations.

4 Can you point me to one?

5 A. Yes. It's in the paragraph 62 and 63, where I
6 talk about the distinctions in the file history with
7 respect to the Shin and Rosenau references.

8 Q. But aren't those characterizations of what the
9 Shin and Rosenau references teach?

10 A. I'm still doing an OCR on the file history.
11 But I believe that what I said here is accurate.
12 Another way we could do this is you could upload either
13 the Shin and/or the Rosenau references -- that might be
14 faster -- 'cause I have specific references to that here
15 in my paragraph 62 and 63.

16 Q. I'm uploading those now.

17 But sitting here today, you have not
18 identified any example in your construction of what
19 "exact timing information" means; right?

20 A. I disagree with that characterization of my
21 testimony.

22 Q. Okay. So what have you pointed to in the
23 specification of the '794 patent that explains your
24 understanding of the words "exact timing information"?

25 A. I pointed to, in the specification, the

1 summary section in 2, that we read earlier, and then I
2 also referenced the file history.

3 Q. And that specification portion we talked about
4 uses the words "without the use of a timestamp"; right?

5 A. That's right. That's the implication, because
6 that's a narrower limitation than without using exact
7 timing information. So it's implied. When you're not
8 using exact timing information, you're also not using
9 timestamps. No. It's the other way around. When
10 you're not -- 'cause it's a "not." Sorry. When you're
11 not using timestamps, you're not using exact timing
12 information.

13 Q. Sorry. I'm having trouble following a double
14 negative here.

15 If you're not using timestamps, you're not
16 using exact timing information; is that right?

17 A. Sounds right. Sometimes it's hard for me to
18 do the negatives, too, by De Morgan's law. Sounds
19 right, though. If you're not using timestamps, you're
20 also not -- yeah. So, hence, claims 20 and 21 are more
21 narrow than claims 1 and 9, in my opinion.

22 Q. Okay. But you cited to the concept of not
23 using timestamps to support your understanding of what
24 "exact timing information" means; right?

25 A. That's right, 'cause that's an implication of

1 that, together with the file history.

2 Q. Okay. But just to summarize then, what you're
3 doing is you're citing that example, but you're
4 broadening it out to use the words "exact timing
5 information"; is that right?

6 MR. CARDENAS-NAVIA: [Inaudible].

7 (Reporter clarification)

8 MR. CARDENAS-NAVIA: I said objection to form.
9 Mischaracterizes testimony.

10 THE WITNESS: Yeah. So I am citing to that
11 example, but I'm doing that together with the citing to
12 the file history, which I also understand to be part of
13 the intrinsic record, or the patent.

14 BY MR. BOWSER:

15 Q. Do you reference what is required to have a
16 disclaimer in your declaration?

17 A. I'm not following what you mean by that.

18 Q. Okay. So you mentioned the concepts of
19 disclaimer in paragraph 62 and 63; right?

20 A. Yes.

21 Q. Okay. What is your understanding of
22 disclaimer?

23 A. I understand that a patentee may provide
24 statements of disclaimer during a patent's prosecution
25 that may limit its meaning.

1 Q. Give me one second. I want to just find
2 something here.

3 Did you get the Shin and Rosenau files?

4 A. I do have them, yes.

5 Q. Okay. Give me one second here.

6 Actually, while I'm looking for that, other
7 than that example that you cited to in column 2, line 36
8 to 46, are there any other examples of exact timing
9 information in the '794 patent?

10 A. Nothing else is coming to mind. If you have a
11 place you want to point me to, I'll be happy to address
12 that.

13 Q. I do not because there isn't any. So let's
14 see here.

15 A. If that was a question, I disagree with that.

16 Q. And why do you disagree?

17 A. Just like we just talked about; that the
18 teaching about the implication of how it's doing
19 assignment rules implies that it's not using timestamps,
20 implies that it's not using exact timing, to a person of
21 ordinary skill in the art.

22 Q. Right. But you're citing the same example
23 over and over again; right?

24 A. I'm citing to the same portion of the
25 specification. It's not an example. It's a disclosure.

1 Q. Okay. What I'm asking you, though, is, you've
2 cited -- I mean I think we've all -- this is abundantly
3 clear. You've cited the example in column 2, line 36 to
4 46.

5 Are there any other examples that you can
6 point to that are examples of exact timing information
7 in the patent?

8 A. Nothing else is coming to mind from the patent
9 specification itself. Again, if you have a place you'd
10 like to point me, I'd be happy to address that. But I'm
11 also citing to the file history for this understanding,
12 which I understand is also part of the intrinsic record
13 for the '794 patent.

14 Q. Okay. So going back to your declaration, at
15 paragraphs 62 and 63, again, you reference the concept
16 of disclaimer; right?

17 A. That's right.

18 Q. Okay. And did you discuss the legal principle
19 of disclaimer with counsel?

20 A. Yes. That's why I say "I understand that a
21 patentee may provide statements of disclaimer during a
22 patent's prosecution that may limit its meaning."

23 Q. And were you advised, though, as to what the
24 legal standard actually is?

25 A. I don't recall the details of that

1 conversation.

2 Q. Okay. But you use the word "disclaimer" in
3 your declaration?

4 A. Yes. I just read it.

5 Q. And without using the same word for the
6 definition, what is your understanding of the word
7 "disclaimer"?

8 A. That during the prosecution of the patent,
9 that the patentee can respond to the patent office
10 saying that the meaning of certain terms is more
11 limiting than the examiner is considering and that that
12 then would constitute what I understand to be a
13 disclaimer that then reads on this negative limitation.

14 Q. Okay. So do you recall any discussions about
15 disclaimer requiring a clear and unambiguous disavowal
16 of claim scope?

17 A. I don't recall the details of those
18 conversations as I sit here today.

19 Q. All right. So let's go back to the Sonohara
20 reference in paragraph 66.

21 A. I'm there.

22 Q. And we read the first sentence in
23 paragraph 66, which talks about the file, reference
24 No. 1; right?

25 A. Yes. It refers to file 1.

1 Q. Okay. And the portion of that sentence that
2 you quoted in the specification, if I could ask that you
3 refer to column 3, lines 54 and 58, of Sonohara.

4 And can you see in column 3 what -- sorry --
5 column 3, line 54, what that sentence starts off with?

6 A. So you're at column 3, what line, again?

7 Q. Column 3, line 54. This is what you cited in
8 this first sentence of your declaration at paragraph 66.
9 You cited column 3, lines 54 to 58.

10 Do you see that?

11 A. Yes.

12 Q. Okay. And then it's a sort of partial
13 quotation in the first sentence.

14 Do you see that?

15 A. You mean what I excerpted? Is that what
16 you're asking?

17 Q. Yes.

18 A. Okay. I'm with you so far.

19 Q. Can you refer to column 3, lines 54 to 58, of
20 Sonohara.

21 A. I'm there.

22 Q. Okay. And what do you see at the beginning of
23 line 54?

24 A. It says "As shown in FIG. 2."

25 Q. Okay. So the portion that you quoted in

1 paragraph 66 is referencing what's contained in figure 2
2 of Sonohara; right?

3 A. That's what it's describing here. "The
4 apparatus."

5 Q. Okay.

6 A. The very next sentence -- the next words, "the
7 apparatus."

8 Q. In figure 2.

9 A. It says "As shown in FIG. 2, the apparatus
10 includes a file 1 into which," and then the rest we
11 already discussed.

12 Q. Okay. So in figure 2, if you can look at
13 that, of Sonohara, and I'm also going to refer to the
14 portion that you quoted in column 3, lines 54 to 58.

15 In figure 2, it's shown that the file
16 production processing device 7 produces the file 1.

17 A. Correct.

18 Q. And the file reproduction processing device 8
19 reproduces the video data and audio data of the file;
20 right?

21 A. That seems a reasonable interpretation of
22 figure 2.

23 Q. Okay. So the file -- sorry.

24 The file that's produced by the file
25 production processing device 7 is labeled with reference

1 No. 1; correct?

2 A. That's right.

3 Q. Okay.

4 A. That's kind of the point. It's an output, not
5 an input.

6 Q. Right. So let's look at the middle of the
7 paragraph of -- paragraph 66 where you cite to column 3,
8 line 66, to column 4, line 7.

9 A. I'm sorry. I lost -- I lost my place here.

10 Q. Sorry. Let me see here.

11 You see the line beginning one, two, three,
12 four, five -- five lines down? It starts with "As shown
13 in FIG. 3"?

14 A. Yes. I'm there.

15 Q. Okay. So can you take a look at figure 3,
16 please, of Sonohara.

17 A. Yeah. I'm there.

18 Q. Okay. So the file -- and I'm referencing what
19 you have in your declaration, which is a quote directly
20 from Sonohara.

21 It says that the file 1 is, quote, composed of
22 a header for controlling the video data and audio data;
23 right?

24 A. Yes.

25 Q. Okay. And then the file No. 1 also includes

1 image track 22 and a sound track 23; right?

2 A. That's right. And that's shown, also, in
3 other figures, like figure 7 and figure 8.

4 Q. Okay. And this file that we see in figure 3,
5 that's produced by -- it's produced by the file
6 production processing device 7 in figure 2; right?

7 A. I believe that is -- yeah, that's right. And
8 that's also shown in more detail in figure 4.

9 Q. Okay. So let's go to paragraph 69 and 70 of
10 your declaration --

11 A. I'm there.

12 Q. -- since we're talking about figure 4.

13 And do you see where you're referring to the
14 image file 11 and the sound file 12 as disclosed in
15 figure 4?

16 A. That's right.

17 Q. All right. Can you please turn to column 4,
18 line 11, of Sonohara.

19 And do you see that that says "Structure of
20 File Production Processing Device 7"?

21 A. I got lost again.

22 Where are you at, again?

23 Q. Column 4, line 11.

24 A. I'm there.

25 Q. Okay. And do you see that this line is a

1 header that says "Structure of File Production
2 Processing Device 7"? Right?

3 A. Yes.

4 Q. Okay. Can you please glance over column 4,
5 beginning at line 12, to column 5, ending at line 6.

6 And while you're glancing, if you could just
7 listen to my question, whether or not, in your opinion,
8 this section of the specification of Sonohara describes
9 the features of the file production processing device 7
10 as illustrated in figure 4.

11 A. Okay. I've finished. And I agree that this
12 describes the device shown in figure 4.

13 Q. Okay. So let's just walk through a few
14 examples here.

15 And so would you agree that the file
16 production processing device 7 as illustrated in
17 figure 4 is the same as the file production processing
18 device 7 in figure 2?

19 A. I accept that as an embodiment of what's shown
20 in figure 2, if that's your question.

21 Q. Yeah. So just for clarification, column 4,
22 lines 12 to 13, I'll read that. It says "FIG. 4 is a
23 block diagram showing a structure of the file production
24 processing device 7."

25 Do you see that?

1 A. Yes.

2 Q. Okay. So in your opinion, when a patent uses
3 the same reference numbers throughout, is it generally
4 meaning that it's the same elements?

5 A. Yes. That's my understanding.

6 Q. So let's turn to column 4, lines 12 to 24.

7 And do you see that this portion of Sonohara
8 describes the file production processing device being
9 provided with an image file 11 and a sound file 12?

10 A. Yes.

11 Q. And can we turn to column 4, lines 25 to 29.

12 A. I'm there.

13 Q. All right. And let me just inject something
14 here. I mean there's a lot in this text, and I'm going
15 to summarize some of the disclosures, and I'm just going
16 to ask if you agree with that summary. But if you
17 don't, then let me know.

18 Okay?

19 A. Okay.

20 Q. All right. So column 4, lines 25 to 29.

21 We're there.

22 So this portion explains that the image data
23 of the image file 11 and the sound data of the sound
24 file 12 are read by the file reader 16 and analyzed by
25 the data analyzer 17; correct?

1 A. Yeah. I mean it doesn't say those exact
2 words, but that's consistent with what it's saying, I
3 think.

4 Q. Okay. And then it says that the read and
5 analyzed data are output to a, quote, "header
6 formation/renewal section 14 and the image data and
7 sound data formation/renewal section 13"; right?

8 A. That's right.

9 Q. Okay. So what we have at this point is we've
10 got the image file, the sound file, and then we have the
11 image and sound data formation/renewal section and the
12 header formation/renewal section; right?

13 A. Exactly.

14 Q. Okay.

15 A. That's why it doesn't read on the '794 patent,
16 for example.

17 Q. All right. So let's go to Sonohara, column 4,
18 lines 30 to 54.

19 A. Okay. I'm there.

20 Q. So these portions explain that the track
21 identifying section 2 of the image and sound data
22 formation/renewal section 13, quote, "gives track
23 identification numbers 1 and 2 for identifying the image
24 track 22 and the sound track 23 to the above-described
25 header 21 and the image data and sound data per unit

1 time"; right?

2 A. That's right, 'cause now it's about the output
3 of what's been formed, 'cause it says, in line 30, "The
4 image data and sound data formation/renewal section 13
5 renews and forms the image data and sound data from the
6 file reader 16 on the basis of the analysis result of
7 the data analyzer 17, and includes a track identifying
8 section 2 and a data identifying section 3."

9 So a person of ordinary skill in the art
10 reading this would understand that anything that
11 Dr. Freedman is calling segments did not exist in the
12 files 11 and 12 but instead were created, formed, from
13 them. So they're not segments in a file. Separate
14 file.

15 Q. And you're saying that claim 1 excludes
16 forming segments?

17 A. The segments have to be from the files. Yes.
18 That's the plain language of the claim.

19 Q. Okay. And what portion are you saying is --
20 if I get this right, you said creates the segments, or
21 something like that?

22 I didn't understand.

23 A. The word in Sonohara is "forms." It forms
24 the -- what Dr. Freedman is calling segments are formed.
25 So they're not from the file 11 and 12.

1 Q. Oh. So you're saying that they're newly
2 created?

3 A. Yes, of course. That's exactly what Sonohara
4 teaches.

5 Q. And where is that?

6 A. The portion we just read. Lines 30 through 34
7 of column 6. No. Column 4. Wait. 6.

8 Q. Okay. So let's skip ahead a little bit. I
9 think we can walk through figure --

10 A. Column 4. We're in column 4.

11 Q. So you see that element 18 is the data primary
12 file, and element 19 is the header primary file; right?

13 A. 18 --

14 (Simultaneous speakers)

15 THE WITNESS: Data primary file. Header
16 primary file. Yeah. They're shown as such in figure 4.
17 BY MR. BOWSER:

18 Q. Okay. And then the header/data coupling
19 section takes the data primary file 18 with the header
20 file 19 and creates the file No. 1; right?

21 A. Exactly. It's created at this point.

22 Q. So let's look at figure 1, though, of
23 Sonohara; right?

24 A. Yes.

25 Q. Okay. And you can see the image data segments

1 at the top; right?

2 A. What Dr. Freedman is calling image data
3 segments. Yes.

4 Q. Okay. And you can see the audio data
5 segments; right?

6 A. Yes.

7 Q. Okay.

8 A. What he calls those.

9 Q. So are you saying that these were just created
10 out of thin air?

11 A. They're not created out of thin air, but the
12 point is those segments did not exist in the files 11
13 and 12, as required by the claims.

14 Q. Okay. So this, to me, seems like kind of a
15 binary choice here. You either get the segments from
16 the image file 11 and the audio file 12 or they're
17 created out of thin air.

18 A. I disagree with that characterization.

19 Q. So where do these segments come from?

20 A. They're created in that step that we just
21 read.

22 Q. Okay. But aren't -- strike that.

23 So if they're created in the step that you
24 just said, where do they come from?

25 A. That's where they come from. They're formed

1 at that moment. They're formed --

2 Q. You're saying -- sorry. Go ahead.

3 A. What Dr. Freedman calls segments are formed
4 and then produced into the file 1, a single file. They
5 are not coming from, hence they're not segments of, the
6 files 11 and 12.

7 Q. So are you saying that those image segments
8 and data segments have nothing to do with the image file
9 11 and the sound file 12?

10 A. I never said that. That's not what I'm saying
11 here. I'm saying they're created -- that is, formed --
12 at that step, and they are not in the file 11 or the
13 file 12.

14 Q. So they are not in -- so let's take the video
15 data segments.

16 You're saying that those segments are not in
17 the image file 11?

18 A. That is correct.

19 Q. So where do they come from?

20 A. They're formed in the step we just read at
21 line 30 in column 4. And if your question is asking
22 what data do they use to do that formation, that is
23 image data and sound data from the file reader 16 and
24 based on the analysis of the data analyzer 17.

25 Q. But the file receiver 16, does it not receive

1 the image file 11 and the sound file 12? Right?

2 A. Yes, which contains no segments. Those are
3 just raw image and raw data files -- sound files. In
4 Sonohara, what Dr. Freedman is calling the segments of
5 image and segments of audio are formed, are created, and
6 then put into the file 1, a single file, not two
7 separate files.

8 Q. Okay. I'm not sure exactly -- let me back up
9 here. You keep saying that they're formed.

10 Where did the segments exist beforehand?

11 A. They didn't. They didn't exist beforehand.

12 Q. So if they didn't exist beforehand, why are
13 you disagreeing that they're just created out of thin
14 air?

15 A. Because that's not how the system works. So
16 the segments that are formed are created using various
17 data, yes. Then they're formed as segments. Before
18 that they just -- there was -- there was data that
19 existed in the raw form. It just didn't have any
20 segments in it.

21 Q. So you're saying then that as you're pointing
22 out column 4, line 30 to 35, that that portion is what's
23 segmenting the data.

24 Is that what you're saying?

25 A. According to Dr. Freedman's read, yes.

1 That's -- what he's calling segments, that is where
2 they're formed. They are not in the file 11 or the
3 file 12.

4 Q. Okay. So let me understand this then.

5 So figure 1, if we go back to figure 1, it
6 specifically has segments; right?

7 A. Figure 1 has what Dr. Freedman is calling
8 segments. So inside the file 1.

9 Q. Okay. And you say that Dr. Freedman is
10 calling them segments.

11 Do you disagree that those are segments?

12 A. Yes. But I'm willing to take his mapping for
13 the sake of my analysis.

14 Q. Okay. So are you saying then that you're
15 going to agree, for the purposes of your analysis, that
16 these are in fact segments?

17 A. Sonohara does not contain the word "segment"
18 anywhere, according to my reading. And so for the sake
19 of my analysis, I was willing to, even for the sake of
20 the analysis, consider the possibility that what
21 Dr. Freedman is calling segments would read on the
22 segments of the claim. And even under that generous
23 interpretation, Sonohara fails to disclose or suggest
24 claims 1 or 9.

25 Q. Okay. So you haven't disputed that those are

1 segments; is that right?

2 A. That wasn't necessary for my analysis. I
3 don't agree that they are, but it wasn't necessary for
4 my analysis.

5 Q. Okay. It's a simple yes or no.

6 Have you disputed that they are segments?

7 A. I don't recall having disputed that. If
8 there's a place in my declaration where you feel I did
9 or didn't, I'd be happy to address that.

10 Q. Okay. I'm asking you. It's your declaration.

11 Did you dispute the fact that they're
12 segments?

13 A. I don't know how to answer that differently
14 than I just did. I've explained that whole process to
15 you.

16 MR. BOWSER: Why don't we take a 10-minute
17 break, and we'll come back at 12:50 Pacific.

18 THE WITNESS: Do you mind if we take a
19 45-minute break, and I can go eat some lunch?

20 MR. BOWSER: Sure.

21 * * *

22 (LUNCHEON RECESS)

23 * * *

24 BY MR. BOWSER:

25 Q. Dr. Goodrich, welcome back.

1 A. Thank you.

2 Q. Did you speak to anyone about the substance of
3 your testimony during the break?

4 A. No.

5 Q. Okay. So I want to turn to paragraph 80 of
6 your declaration.

7 A. I'm there.

8 Q. Okay. And here you are addressing the
9 analysis of Sonohara with respect to the assignment rule
10 limitations; is that right?

11 A. That's right.

12 Q. Okay. In paragraph 80, you reproduce your
13 claim construction from earlier in your declaration; is
14 that right?

15 A. Yes.

16 Q. Okay. And then if I have it correctly here,
17 you then analyze the Sonohara reference in paragraphs 81
18 to 91 with respect to the assignment rule limitation;
19 right?

20 A. That's right.

21 Q. Okay. So is your analysis in paragraphs 81 to
22 91 based on your claim construction of the assignment
23 rule limitation?

24 A. Yes.

25 MR. BOWSER: I have no further questions.

1 MR. CARDENAS-NAVIA: I just have one or two
2 questions.

3
4 EXAMINATION

5
6 BY MR. CARDENAS-NAVIA:

7 Q. Dr. Goodrich, did you and I have any
8 conversations during any of the breaks during the
9 deposition today?

10 A. No.

11 MR. CARDENAS-NAVIA: I have no further
12 questions.

13 MR. BOWSER: Well, Dr. Goodrich, thank you
14 very much for your time.

15 THE WITNESS: Thank you.

16 (Deposition concluded at 1:22 p.m.)

17 ***
18
19
20
21
22
23
24
25

1 STATE OF CALIFORNIA)
) ss
2 COUNTY OF SAN DIEGO)

3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

I, MICHAEL T. GOODRICH, PH.D., having appeared for my deposition on June 14, 2023, do this date declare under penalty of perjury that I have read the foregoing deposition, I have made any corrections, additions or deletions that I was desirous of making in order to render the within transcript true and correct.

IN WITNESS WHEREOF, I have hereunto subscribed my name this _____ day of _____, 20____.

MICHAEL T. GOODRICH, PH.D.

1 REPORTER'S CERTIFICATE

2
3
4 I, COLLEEN M. PETERMAN, CSR No. 7882, Certified
5 Shorthand Reporter, certify:

6 That the foregoing proceedings were taken before
7 me at the time and place therein set forth, at which
8 time the witness was put under oath by me;

9 That the testimony of the witness, the questions
10 propounded, and all objections and statements made at
11 the time of the examination were recorded
12 stenographically by me and were thereafter transcribed;

13 That a review of the transcript by the deponent
14 was not requested;

15 That the foregoing is a true and correct
16 transcript of my shorthand notes so taken;

17 I further certify that I am not a relative or
18 employee of any attorney of the parties, nor financially
19 interested in the action.

20 I declare under penalty of perjury under the laws
21 of California that the foregoing is true and correct.

22 Dated this 20th day of June, 2023.

23 

24 _____
25 COLLEEN M. PETERMAN, CSR No. 7882

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

DEPONENT'S CHANGES OR CORRECTIONS

Note: If you are adding to your testimony, print the exact words you want to add. If you are deleting from your testimony, print the exact words you want to delete. Specify with "Add" or "Delete" and sign this form.

DEPOSITION OF: MICHAEL T. GOODRICH, PH.D.
CASE: UNIFIED PATENTS vs. VL COLLECTIVE
DATE OF DEPOSITION: JUNE 14, 2023

PAGE	LINE	CHANGE/ADD/DELETE/REASON
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Deponent's Signature _____ Date _____

	PAGE	LINE	CHANGE/ADD/DELETE/REASON
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25	Deponent's Signature _____		Date _____

<div> <div>Exhibits</div> <div>Goodrich Ph.D. Exhibit A 4:10 43:5,6</div> <div>0</div> <div>0 46:3,6,16,19,21 47:15 48:9,10</div> <div>1</div> <div>1 11:25 13:5 18:6,10 19:20 22:2,4 26:14 29:1,21 33:5,7,16,18 34:2,25 35:1,5,17,23 36:12 37:11 39:24 41:9 42:6 43:5 45:16,19,22, 25 46:5 47:15 48:5,14, 22 49:10,23 50:12,16 51:1,4,8,17 52:1,2,4,8, 15,17,18,19,20 53:5,10, 15,18 54:19,20 55:4,17, 19,21 60:4,7,20 61:10, 21 75:21 77:24 78:1,12, 16 84:16,17 89:6,10 92:12,15,17 98:21 102:24,25 104:10,16 105:1,21,25 109:23 110:15 111:20,22 113:4 114:6 115:5,7,8,24</div> <div>10</div> <div>17:6 38:10 46:2,9 48:11,15</div> <div>10-minute</div> <div>39:12 73:5,17 116:16</div> <div>1001</div> <div>12:20,22 13:15,22</div> <div>1003</div> <div>91:15,20,23</div> <div>1007</div> <div>13:19</div> <div>11</div> <div>15:20 106:14,18,23 108:9,23 110:12,25 112:12,16 113:6,9,12, 17 114:1 115:2</div> </div>	<div> <div>12</div> <div>19:20 22:10 23:9,11,15, 21 106:14 107:5,22 108:6,9,24 110:12,25 112:13,16 113:6,9,13 114:1 115:3</div> <div>12:50</div> <div>116:17</div> <div>13</div> <div>19:20 25:10,18,21 38:11 48:12,15 107:22 109:7,22 110:4</div> <div>14</div> <div>5:2 27:9,11 34:8,20 62:9 63:5,23 65:22,25 66:14,23 70:23 85:11 109:6</div> <div>15</div> <div>19:21 25:21</div> <div>16</div> <div>24:9 25:2 85:10 108:24 110:6 113:23,25</div> <div>17</div> <div>15:10 62:9 63:5,23 108:25 110:7 113:24</div> <div>18</div> <div>111:11,13,19</div> <div>19</div> <div>70:24 111:12,20</div> <div>1:22</div> <div>118:16</div> <div>2</div> <div>18:6,23 19:3 20:8,10,19 22:9 23:2,6 47:15 50:11 55:6 84:17 85:23 88:13 90:11 93:4 98:1 100:7 101:3 103:24 104:1,8,9, 12,15,22 106:6 107:18, 20 109:21,23 110:8</div> <div>20</div> <div>19:21 89:21 98:20</div> <div>2005</div> <div>57:13,23 58:20 59:4</div> <div>2007</div> <div>5:17 8:3,22 9:3 12:25 13:4,5 15:4 16:19</div> </div>	<div> <div>2012</div> <div>17:14</div> <div>2023</div> <div>5:2 15:10</div> <div>21</div> <div>19:21 89:21 98:20 109:25</div> <div>22</div> <div>65:22 66:1,15,23 106:1 109:24</div> <div>23</div> <div>106:1 109:24</div> <div>24</div> <div>108:6</div> <div>25</div> <div>108:11,20</div> <div>26</div> <div>26:1,3</div> <div>28</div> <div>21:22</div> <div>29</div> <div>108:11,20</div> <div>3</div> <div>15:20 19:20 33:11,17 37:25 38:4,6,8,16,17 39:1 47:15 52:5 55:7 103:3,4,5,6,7,9,19 104:14 105:7,13,15 106:4 110:8</div> <div>30</div> <div>10:8,13 43:3 109:18 110:3 111:6 113:21 114:22</div> <div>31</div> <div>16:20</div> <div>34</div> <div>111:6</div> <div>35</div> <div>23:21 71:1,23 114:22</div> <div>36</div> <div>27:24 28:2,22 29:3 90:12 93:6 100:7 101:3</div> <div>37</div> <div>28:8,13 29:5,8 32:5,11</div> </div>	<div> <div>38</div> <div>33:1 49:12,24</div> <div>39</div> <div>33:1</div> <div>4</div> <div>22:2,4 33:12,17,24 34:8,24 35:9,16 36:22 37:13 38:20 39:3 40:3,7 46:6 47:5,15 48:9,10 62:9 63:5,23 65:22,25 66:14,22 67:19,22,25 68:5,22 69:16,22 70:11, 23 105:8 106:8,12,15, 17,23 107:4,10,12,17, 21,22 108:6,11,20 109:17 111:7,10,16 113:21 114:22</div> <div>41</div> <div>28:2,22 29:3</div> <div>42</div> <div>28:25 35:9,16 51:1,5,6 55:10 60:5 77:23</div> <div>43</div> <div>37:13 40:3 43:3 49:13</div> <div>44</div> <div>36:5,22 54:6</div> <div>45</div> <div>15:5 86:10</div> <div>45-minute</div> <div>116:19</div> <div>46</div> <div>37:14 40:3,7 47:5 52:5 54:6 86:11 90:12 93:6 100:8 101:4</div> <div>47</div> <div>52:5</div> <div>49</div> <div>35:9,17 40:7 47:5 67:19,23,25 68:5 69:16, 22 70:12</div> <div>5</div> <div>19:20 33:12,24 38:10 47:16,20 48:11,15</div> </div>
--	---	--	---

49:12,24 54:6 71:1,23 107:5	92:2,4,10 102:20,23 103:8 104:1 105:7,8		acts 43:25
5,627,656 18:14 91:21	67 33:11	9	added 84:4 85:19 94:6 95:21
51 70:16,22	69 106:9	19:17,20 26:15 29:1 34:8 36:13 46:3,16,20, 21 47:16,20 51:5 55:21 89:6,10 98:21 115:24	additional 23:3 28:23 43:25 80:5 89:10
54 26:8 39:1 55:23 56:6 57:20,25 58:22 59:16, 19 83:7 103:3,5,7,9,19, 23 104:14 109:18	7 21:18,25 34:1 43:2,5,8, 12 47:16 57:17 92:14 104:16,25 105:8 106:3, 6,20 107:2,9,16,18,24	91 117:18,22	address 19:23 44:2 45:6 94:17 95:11 100:11 101:10 116:9
55 27:2 39:1 59:7 68:23	70 106:9	92 89:9,18	addressed 20:14 26:24 87:18 91:25
56 57:4 72:25 74:2 77:17	727 43:8,13	93 89:18	addresses 26:5
57 62:3 63:8,15 64:4 65:15 66:8 68:23 69:18	77 16:20 17:2,3	94 89:9	addressing 117:8
58 49:24 73:1 77:17 103:3, 9,19 104:14	79 16:25 17:1	974 22:7,8	ADMINISTERED 5:5
59 76:21 77:5,19	794 11:23 13:11,15,23,25 14:12 18:16 21:19 22:14,20,23 23:2,6 28:3,9,14,20,21 29:11, 16,19,24 33:5,12 41:25 42:22 45:16 52:21 55:12 57:16 65:5,20 69:20 70:8 71:5,9 72:2 79:7,12 84:8 86:7,15 87:4 88:5,12 89:4 92:25 93:7,12 94:2,5 95:1,5 97:23 100:9 101:13 109:15	A	advanced 57:6
6 16:10 47:16 107:5 111:7	8 33:24 47:16 58:14 92:16 104:18 106:3	Abbott 19:21,23 20:1	advantage 88:25
60 67:19,23,25 68:5,23 69:17,22 70:12 76:21	8,605,794 13:9,13	above-described 109:24	advised 101:23
61 72:7,18,24 83:3 87:20, 22 92:21	80 117:5,12	absent 9:17	agree 9:18 27:3 34:22 35:17 46:1 47:13 49:11 53:9 55:9 57:1 59:8,15 60:14 64:10 72:4 75:14 83:10 95:24 96:2,8 107:11,15 108:16 115:15 116:3
62 87:25 97:5,15 99:19 101:15	81 117:17,21	absolutely 63:25	ahead 111:8 113:2
63 71:2,23 87:25 97:5,15 99:19 101:15		abstract 28:9,13,16 29:11,20 31:8,16 32:8	aid 39:4
64 57:4 72:18,24 87:20 88:4 90:9,25 92:22		abundantly 101:2	air 112:10,11,17 114:14
65 57:4 72:7		accept 76:6 83:18 107:19	alleged 88:1,2
66		accurate 7:24 30:12 37:4 58:19 69:4 70:21 71:25 84:9 85:22 94:4 97:11	allowed 56:25
		accurately 5:23 7:1,12 28:13	analysis 18:13,20 25:1,4 29:1 32:4 89:19 110:6
		action 79:17	
		actions 14:4	

113:24 115:13,15,19,20 116:2,4 117:9,21	38:7 49:5	105:22 112:4,16 114:5	beneath 56:6 57:20,25 60:5
analyze 18:12,19 117:17	art 36:9 41:22 44:15,17 46:8 47:15,18 61:2,13 62:1 65:4 67:6 68:6,13 70:3,18 82:1,6,10 88:15 96:25 100:21 110:9	aware 13:25 14:3 20:5 29:14 51:8 57:5	benefits 55:18,21
analyzed 108:24 109:5		B	binary 43:17,18,20,25 112:15
analyzer 108:25 110:7 113:24	aspect 72:9,18	B2_bsd 34:14,15	bit 111:8
and/or 97:13	assign 50:9	B_d1 38:23	bit-per-bit 44:2 45:5
Animation 18:3	assigned 49:17 50:6	B_d21 38:24	bitstream 42:25 43:20,22,23 44:2, 3,6,24 45:5,7,9
answers 7:6	assigning 58:6 78:7 83:12	back 13:5 15:4 18:6 20:8 22:12 27:9 29:5 39:17 52:25 54:20 55:10 59:18 70:17,22 73:21 74:2 82:16 85:10 86:14 90:9 91:18 92:20 93:24 101:14 102:19 114:8 115:5 116:17,25	block 107:23
antecedent 73:4	assignment 26:17,21 38:14 39:4,8 48:19 49:10 50:8,21 55:7 58:5,20,21 71:5, 10,14,15,21,24 72:4,19, 23 78:2,6,11,18,20,23 79:18,24 80:6,17,24 82:24 83:8,11,20 85:20 87:18 88:6,15,22,25 89:4,6,11,13,22 90:10 92:21 93:18 94:6 95:14 96:11 100:19 117:9,18, 22	background 15:22	board 20:5 64:25
anticipation 18:13,20	assigns 78:12	base 19:23 20:1	body 51:12,17 53:1 54:20
apologize 25:17 54:3	assist 59:3	based 18:13,20 33:20 35:16 46:17 50:9 67:14 78:17 79:17 86:8 89:11,13,22 91:6 95:2 113:24 117:22	bold 77:5
apparatus 92:12 104:4,7,9	assume 6:7	basing 88:9	Bowser 5:11,15 11:20 16:6 21:17 24:5 25:16 30:5, 9,18 32:20 39:11,16 43:4,11 54:2 73:5,16,20 82:5 85:9 90:8,23 93:23 94:18 95:4,13,20 96:20 99:14 111:17 116:16, 20,24 117:25 118:13
appeared 77:9	attached 9:9	basis 19:21 29:1 44:2 45:5 48:19 73:4 78:6 110:6	break 7:20,21,23 39:12,19,23 60:16 65:25 66:13 73:6, 18,23 81:23 116:17,19 117:3
appears 28:17 29:21 31:14,17 86:6	attorney 14:23 23:3 84:20,24 85:1	begin 57:17	breaks 118:8
Apple 9:7	attorney-client 11:11 90:20	beginning 21:21 26:3 33:17 34:1 53:1 62:25 63:1 92:1 103:22 105:11 107:5	brevity 64:7 65:2,14,18
applied 23:12 25:1	attorneys 11:19	begins 25:10,18 43:17 51:18 54:21	broad 95:11
applies 24:16,18,22	audio 34:2,6 45:20,24 46:6 48:6,7 49:25 50:2,6,10, 16,22 55:6,13 67:8 68:17 92:13,16 104:19	behalf 12:12	broadening 99:4
apply 23:17 24:6 27:19			broader 89:23 90:3
approval 30:10			browser
approximately 10:6,13 15:1 17:6			
April 15:10			
arguments 91:6			
arrow			

87:16	characterization 35:25 36:1 64:14 65:12 70:25 72:1 97:20 112:18	claimed 94:11 95:1	comfortable 34:7
BSD 38:1 43:23 44:10,23 45:2,13	characterizations 97:8	claims 19:20 25:15 26:14 28:20 29:1 55:12,21 64:8 89:6,10,21 94:12 98:20,21 112:13 115:24	command-f 30:20
C	chat 8:5,6,15 9:23 30:6	clarification 21:16 22:16,25 23:4,7 99:7 107:21	commonly 84:2
C.V. 16:21 17:5 18:2	choice 112:15	clarify 25:17 52:10 72:21 79:10	communicated 12:14,16
California 9:12 16:9	chops 36:4	clause 78:1	communicating 9:24 10:1
call 26:21 83:17,22 85:24 88:3 96:17	chronological 40:14,20,22,23 41:3,6, 18 42:13,17 44:11,20 45:12 46:11,17,24 47:8, 11,19 48:2 50:14,18 54:11 55:5,7 68:1 88:24	clean 8:14,16	communication 11:11
called 21:22 43:23 70:17	circumstances 10:23	clear 6:18,24 36:8 44:15,17 61:25 62:2 70:11 79:20 88:14 96:18,25 101:3 102:15	communications 11:13 90:20
calling 110:11,24 112:2 114:4 115:1,7,10,21	citation 85:11	close 62:20 92:9	comparison 57:19
calls 112:8 113:3	citations 31:4,5,12 65:21 66:7,11	coding 43:19	complete 21:13
Cardenas-navia 11:9 14:24 15:25 21:3 24:2 29:23 30:16 32:14 39:14 73:11,13,17 84:21 90:2,19 93:20 94:8,23 95:8,16 96:12 99:6,8 118:1,6,11	cite 21:8 22:4,8 66:17 105:7	Collective 12:8	completely 62:20 79:16,20 80:3
care 72:12	cited 20:13,22,25 22:6,7 37:17 49:15 69:16 90:24 98:22 100:7 101:2,3 103:7,9	colon 51:15,16	component 54:18
carried 88:15,25	citing 23:5 99:3,10,11 100:22, 24 101:11	column 21:18,25 29:21 33:11, 12,17,24 34:8,24 35:9, 16 36:22 37:13 38:10, 16 39:1 40:3,7 43:2,5 47:5,20 48:11,15 49:12, 24 52:5 54:6 56:9 62:9 63:5,23 65:22,25 66:14, 22 67:19,22,25 68:5,22 69:16,22 70:11,23 71:1, 23 88:13 90:11 93:4 100:7 101:3 103:3,4,5, 6,7,9,19 104:14 105:7,8 106:17,23 107:4,5,21 108:6,11,20 109:17 111:7,10 113:21 114:22	components 53:19
case 10:25 11:2,3,7,17 12:17 34:13 50:11 61:6 72:10 82:20	claim 11:4 25:9,12,19,22 26:5 27:6,16,20 28:16 36:12, 13 37:10,11,12 51:1,4, 5,8,11,12,17 52:2,15, 17,20 53:1 54:20 55:17, 19 56:13,15 57:5 60:4, 7,20,22,23,25 61:3,5, 10,12,14,21,23 75:21 76:1 77:10,24 78:1,12, 16 83:24 84:12,17,25 85:8,16 90:17 93:17 94:12,16,20 95:21,24 96:1 102:16 110:15,18 115:22 117:13,22	combines 64:7 65:2,14	composed 105:21
cases 14:14 44:1 45:4 57:7			computer 8:12 9:7 13:20
categorically 95:15 96:10			concept 60:7 89:24 98:22 101:15
caution 11:10 90:19			concepts 99:18
challenged 19:20			concluded 118:16
change 25:4,7			confidential 84:24
			confirm 26:24
			confused 22:25
			confusing 31:22
			confusion

32:9	contained 28:13 37:5 84:11 104:1	copy 29:24	cut 27:21
connection 10:9	content 65:7 72:25	corner 38:6	<hr/>
consideration 95:15 96:10	content-based 30:4 70:2	correct 8:22,23 13:21 15:11 17:16 18:22 23:19 25:15,20 26:12,16,25 27:4 31:13,17 33:6 42:11 45:1 49:7 50:15 52:12 56:7,10 80:1 81:14 82:8 84:6 85:21 96:3 104:17 105:1 108:25 113:18	D
considered 15:15 19:1,4 20:9,20 22:13,19 79:2	content-dependent 29:8,10,15,18 30:21 31:15,19,20,25 32:6,11, 12,16,22,25	correctly 48:20 62:19 117:16	D1 33:15,19,21 34:6,12,21 35:2,18,24 36:6,10,11, 17,24,25 37:3,6,19 41:2,7,14 45:1,20
consistent 28:17 35:8 36:11 37:8, 9,23 41:22 46:7 49:22 80:4 85:7 109:2	content-related 26:11 30:3 31:25 32:18 34:15,16 35:1,5 48:1 51:23 52:17 54:24 58:6, 7 59:20 60:12 61:6,15 62:1,5,13 63:11,24 64:6,8,12,17 66:1,18 68:8,9,11,12 69:24 70:2,4,14,15,21,23 71:11,18 72:13 74:4,7, 10,17,21 75:4,13,21 76:12,14,17,24 77:4,6, 9,11,14,16 78:4,7,8,12, 13,16,21,25 83:12,13 88:19,23 92:6	correspond 91:9	D12 34:18,21
consists 43:18	content-related,' 62:25	counsel 5:15 6:10,11 7:16 9:24 11:7,14 12:12,17 15:2 23:16,25 24:17 59:3 60:22 101:19	D1_bsd 34:14,15,25 35:19 36:17 37:20 38:1 41:14 42:6
constitute 102:12	contents 39:3 59:25 61:18 66:24 74:13 75:9 79:14 80:13 82:25	counsel's 30:9	D2 34:3,6,12,18 35:6 45:20 47:25
construction 25:9,12,15,19,23 26:5 27:7,20 56:10 57:6 58:5,20,21,22 59:23 60:14,15,23 61:3,17 62:4 64:5,23 67:14,17 70:10 71:10,18,23 72:3, 9,13,23,25 73:2 74:3,6, 16,20 75:5,6,12,15 76:4,8,11,17,18,24,25 77:8,14 79:1 80:21 81:13 83:10 84:5,10,14, 16,25 85:4,8,19 87:19, 23 89:12 90:10 94:20 95:24 96:1,4,5 97:18 117:13,22	context 63:11 69:20 70:8 79:5, 12	count 10:7,22	D2_bsd 35:5 38:1 48:1
constructions 26:22 27:4 56:13,16,21, 23 57:2,16,20,23,25 59:4,9,13,16	controlled 88:21	coupling 111:18	data 26:12 30:3 32:16 33:16, 18,19,20 34:2,3,6,12, 16,17,24 35:1,2,4,6,17, 23 36:4,6,9,10,24 37:5, 11,12,18,19 40:10,12 41:7,13,18 43:25 44:4, 6,7,18 45:7,9,10,20,21, 24 46:15,19 47:6,24 48:2,7,18 49:16,17,24, 25 50:3,5,12,16,22 51:23 52:17 53:20 54:10,12,24 55:1,5,6,13 58:7,8 59:20,24 60:8, 13,15,17,19 61:6,9,15 62:2,5,14,15,16,21 63:11 64:6,9,17 65:5 66:2,23 67:3 68:8,25 69:1,6 71:11,18 72:13, 20,25 73:3 74:7,8,11, 17,21 75:4,7,13,15,21 76:13,14,18,24 77:4,6, 9,11,15,16,18 78:5,7,8, 13,14,17,21,25 79:12 80:12 83:13,14,21 88:20,23 92:6,8,13,16 104:19 105:22 108:22, 23,25 109:5,6,7,11,21, 25 110:4,5,7,8 111:11, 15,19,25 112:2,4 113:8, 15,22,23,24 114:3,17,
construe 64:16 71:15	controlling 105:22	court 6:3,16 7:1,12 10:18,25 11:5,17 14:1,4,7,16 57:7	
construed 26:9 56:1 60:12 61:24 64:3 74:10 77:11	convenience 12:24	covered 40:6 89:17	
construing 75:3 76:5	convention 93:17	created 110:12 111:2,21 112:9, 11,17,20,23 113:11 114:5,13,16	
consulted 56:15	conversation 102:1	creates 110:20 111:20	
consulting 16:13,17,21,22,24 17:18,21,24 18:2	conversations 102:18 118:8	cross 7:2	
	copies 8:13,14,17	curious 24:25	
		current 16:7	

18,23	89:9 90:17	differently 116:13	72:10 116:11
De 98:18	Depending 18:1	difficulties 7:1	disputed 115:25 116:6,7
dealing 25:11 74:3	depends 76:9,18,25	direct 15:5	Distinct 92:7,8
dealt 18:3	deposed 10:4,9,14	directly 20:11 22:6 31:3 61:5 105:19	distinction 86:5
decide 90:15	deposition 6:2,11,17,18 7:7,14,17 9:6,19 12:6 13:1 14:22 15:2 118:9,16	disagree 35:25 97:20 100:15,16 112:18 115:11	distinctions 97:6
decision 20:10,15,17 21:7 22:13, 17	derived 55:18,21	disagreeing 114:13	distinguished 16:8 86:12
declaration 5:17 7:8,10,17 8:3,24 9:1 12:1 13:6 15:9,13, 18 16:19 18:7,17 19:24 20:15 21:1,2 22:5,11 23:12,17,21,22 24:7 25:10,11 26:4,25 27:25 28:7 32:5 33:2,9 51:2 55:24 56:19 57:21,25 59:7 72:15 74:3 76:16, 23 77:13 83:4 91:14 92:1,2 99:16 101:14 102:3 103:8 105:19 106:10 116:8,10 117:6, 13	describe 12:3 43:21 44:1 45:5 81:23 90:10	disavowal 102:15	distribution 17:25 18:5
define 81:21	describes 28:23 33:15 42:4 43:9 107:8,12 108:8	disclaimer 88:1 99:16,19,22,24 101:16,19,21 102:2,7, 13,15	district 10:25 14:1,4,7,16 57:7
defined 43:20	describing 32:17 47:13 68:2,3 104:3	disclose 11:18 115:23	disturb 9:21
defining 81:5	description 26:20 34:13,14,25 35:4, 18 37:20 39:5 41:14,21, 23 42:25 43:23,24 44:7, 19,24 47:25 82:21	disclosed 42:6 106:14	divided 62:23
definition 63:10,23 64:1,12,18,20, 22 65:10,14 66:1,17,20 67:2 70:23 79:17 82:21 102:6	designated 34:2	discloses 88:6 92:12	document 9:2 20:25 21:1 43:5,23
definitions 60:24 81:24	detail 26:23 36:20 68:16 106:8	disclosure 11:18 62:9 100:25	documents 21:22,25 22:2,4 33:8 42:5,23 43:1 57:8
delineated 38:23	details 28:24 57:1 101:25 102:17	disclosures 108:15	double 98:13
denoted 45:21,24	device 51:22 52:1,2,4,8,11,16, 22 53:7,18,20,24 54:18, 24 92:14,16 104:16,18, 25 106:6,20 107:2,9,12, 16,18,24 108:8	discuss 23:24 33:8 62:4 89:8 101:18	download 12:21
denotes 48:6	diagram 107:23	discussed 42:24 53:18 60:13 104:11	downloaded 8:7,15,21 12:22 13:19
dependent	dialogue 62:18 67:5,9,11 68:19	discussion 24:23 68:4 69:21	downloading 87:9
	difference 58:24 59:1	discussions 56:25 102:14	draft 15:12,15,22
		Disney 18:3	drawing 48:24
		dispute	drawings 52:21
			DULY 5:5
			<hr/>
			E
			e.g. 44:3 45:6 58:23 62:15

Index: De-e.g.

63:2,19 67:1,3,7	entire 52:11 53:24 63:16 64:6 72:2 84:14 87:2	96:23 97:2	failed 11:8
earlier 26:7 42:5,19,24 46:14 48:6 64:11 98:1 117:13	entirety 19:10 94:1	exhibit 5:17 7:11 8:3,22 9:3 12:19,20,22,25 13:4,5, 15,19,22 15:4 16:19 29:25 43:5,6 57:11,13, 23 58:20 59:4 91:15,20, 23	fails 115:23
easier 83:6	entities 17:8,9	exhibits 7:9 8:12 13:3	failure 11:17
eat 116:19	entry 17:13	exist 36:25 110:11 112:12 114:10,11,12	fair 20:24 34:24 64:14 65:12 70:25
effectively 84:10	equals 50:11	existed 114:19	faster 55:14,20 97:14
element 111:11,12	equipment 9:5	exists 34:13	feature 75:20 76:9 89:2
elements 108:4	error 34:20	experience 16:13,18 17:21,24 18:2	features 55:17 107:9
embedded 64:22	exact 30:2 49:21 61:12,23 70:9,16 72:19 83:20 86:2,8,12,18,19 89:13, 24 90:4 91:10,11 96:15, 18,21 97:1,19,24 98:6, 8,11,16,24 99:4 100:8, 20 101:6 109:1	expert 14:6 17:11,13,14	fed 36:17
embodied 61:5 94:16	EXAMINATION 5:9 118:4	explain 82:12,14 109:20	feel 30:12 116:8
embodiment 38:3,21 48:17 52:9,12, 19 55:2 88:18 94:13 107:19	EXAMINED 5:6	explained 84:19 96:21 116:14	FIG 33:18 34:2 39:3 52:8 103:24 104:9 105:13 107:22
embodiments 27:16 28:24 85:15 93:1, 7,12 94:5,21 95:6	examiner 102:11	explaining 84:25	figure 33:5,7,16 34:25 35:1,5, 17,23 37:25 38:4,6,8, 17,20 39:24 41:9 42:6 45:16,19,22,25 46:5 48:5,14,22 49:10,23 50:12,16 52:1,4,11,18, 19 53:5,10,15,18 54:19 55:4 104:1,8,12,15,22 105:15 106:3,4,6,8,12, 15 107:10,12,17,18,20 111:9,16,22 115:5,7
emergency 9:17	examples 42:20 100:8 101:5,6 107:14	explains 97:23 108:22	figures 106:3
end 17:15 20:12,21 23:18 52:17 62:18 73:3	excerpted 103:15	explanation 65:11,18 87:23 88:5	file 22:8,14,19,22 23:1,5 33:16,19,21 34:3,6,12, 14,15,17,25 35:2,5,6, 18,23 36:6,10,11,24,25 37:6,11,12,19,20 41:2, 7,14 42:6 44:10,19,23 45:1,13,20 47:24,25 59:24 60:8,16,17,20 61:10 62:15 65:6 66:23 74:12 75:8 76:13,15 79:13,18,21,22 80:1,12,
ending 107:5	exclude 93:13	explanations 96:23 97:3	
engagement 17:18	excluded 10:18	express 63:10 64:12,17,20,22 65:9 66:17,20 67:1	
engagements 17:6,12,19	excludes 94:2 95:15 110:15	extract 41:18 42:17	
English 68:20 81:4,7,18,23	excluding 96:15	extracts 37:2,6,16,18	
ensure 6:17,24 7:9,24	excuse 72:22	fact 9:21 11:13 25:5 115:16 116:11	
entail 18:5	exemplary 43:9 55:2 63:18 91:11		
entails 96:24			

17 82:22 84:7 86:5 87:2,3,8 91:4 92:12,14, 15,17 95:3 96:19 97:6, 10 98:2 99:1,12 101:11 102:23,25 104:10,15, 16,18,19,23,24 105:18, 21,25 106:4,5,14,20 107:1,9,15,17,23 108:8, 9,23,24 109:10 110:6, 13,14,25 111:12,15,16, 19,20 112:16 113:4,8,9, 12,13,17,23,25 114:1,6 115:2,3,8 file's 59:25 61:18 65:7 66:24 75:8 79:13 80:13 82:25 files 36:17 38:1 44:18 68:9 79:3 87:15 92:7,8 100:3 110:12,17 112:12 113:6 114:3,7 finally 53:23 find 57:10 86:19 100:1 fine 6:9 8:20 26:19,20 30:17 37:22 62:22 63:3 73:18 85:25 87:15 88:2 finish 6:25 7:6 54:4 finished 107:11 focus 28:6 59:19 92:11 focusing 29:2 72:8,17 follow 27:10 41:5 76:2 form 15:25 21:3 28:17 87:4, 5,7,24 93:20 94:8,23 95:16 96:12 99:8 114:19 format 42:4,7 43:19 44:23,24 formation 113:22	formation/renewal 109:6,7,11,12,22 110:4 formed 39:4 110:3,12,24 112:25 113:1,3,11,20 114:5,9,16,17 115:2 forming 110:16 forms 110:5,23 found 57:12 77:7 fourth 65:16 fragmentation 34:13,14 35:18,19,22 36:7,15,18 37:1,6,19, 20,24 38:2,16,19,22,25 39:7,9,24 40:13 41:10, 14,17 42:9,16 44:19 46:10 47:7,24,25 Freedman 18:18 110:11,24 112:2 113:3 114:4 115:7,9,21 Freedman's 114:25 front 8:9 19:16 30:8 57:15 full 5:19 6:19 7:9 43:8 fully 5:23 function 36:14	generous 115:22 give 28:25 42:20 57:11 66:4 79:19 100:1,5 giving 29:4 glance 107:4 glancing 107:6 good 5:12,14 68:17,20,21 69:1,11 Goodrich 5:4,12,21 30:19 39:17 73:22 116:25 118:7,13 Google 30:7,11,13 31:4 86:14 87:1 grounds 19:23 20:2 guess 29:22	27:22,23 73:12 helpful 13:4 high-level 43:22 44:3 45:6 highlighted 77:5 history 22:8,14,20,22 23:2,5,6 84:8 86:5 87:2,3,8 91:4 95:3 96:19 97:6,10 98:2 99:1,12 101:11 hits 30:22,23,24,25 31:7,11 Hold 43:12 57:10 honestly 5:24 hour 39:12 hour-long 7:21 hours 15:3 housekeeping 8:11 humans 67:9 68:19 hypothetical 76:6
			<hr/> I identification 109:23 identified 16:14 19:3 21:25 33:18 43:2 63:5 97:18 identifies 17:6 20:19 identify 20:9 identifying 20:8 109:21,23 110:7,8 illustrated 53:13 107:10,16

illustrating 53:18	includes 66:1 76:12 92:12 104:10 105:25 110:7	instructions 38:2,16,22,25	item 17:10 18:1
imac 9:7	including 7:17 23:1 44:7 45:10 89:16	instructs 6:12	<hr/> J
image 92:13 106:1,14 108:9, 22,23 109:6,10,11,21, 23,25 110:4,5 111:25 112:2,16 113:7,8,17,23 114:1,3,5	inclusive 66:19 72:5 89:14,15	intended 59:25 61:18 65:7 66:25 74:13 75:9 79:14 80:9, 14,19,22 83:1	Jaime 14:24 73:7,8
imagine 85:3	incorrect 36:1 58:12	intent 80:25 82:20	Jonathan 5:15
Immanuel 18:17	independent 28:25	inter 10:10 18:16	JUNE 5:2
immediately 30:1	indications 6:20	interpret 18:1	juristic 85:2,3
imparted 69:10	indirectly 20:12	interpretation 104:21 115:23	<hr/> K
implement 47:24	individual 56:4	intrinsic 99:13 101:12	kind 85:1,3 86:11 90:5 105:4 112:14
implication 98:5,25 100:18	individually 66:11	invention 48:17 52:9,24 88:18 94:11 95:1	knew 14:3
Implicitly 73:2	information 36:19 72:20 83:21 86:3, 8,12,21,23,24 89:14,24 90:4,5 91:10,12 96:11, 15,16,17,18,22 97:1,19, 24 98:7,8,12,16,24 99:5 100:9 101:6	involved 14:1,14	knowledge 10:17 12:18
implied 98:7	informed 23:16 24:12,21	involves 17:21	<hr/> L
implies 100:19,20	inject 108:13	involving 11:23 16:14 82:24	labeled 43:5 104:25
import 27:15 85:14	input 79:2 105:5	IP 12:8 17:14	language 27:17 28:16 36:12 37:10 39:5 42:25 44:24 45:2 83:25 85:16 110:18
importance 71:13	inputs 41:10,13 42:9,12 53:19 55:5	IPR 10:15 14:19 22:18 57:13	latter's 54:12
importation 85:20	inside 22:7 36:25 64:1 115:8	IPR2022-01086 5:18	law 25:14,19,22 27:11 85:2, 7 98:18
improper 85:20	instances 21:11 61:1	IPRS 24:16,22 25:6	lawyer 84:13
inappropriate 27:15 85:14	instituted 20:5	Irvine 9:12 16:9	layer 43:25
Inaudible 99:6	institution 20:9,15,17 21:7 22:13, 17	issue 24:24 72:11	layers 44:4 45:7
include 58:23 64:17 87:1 89:6		issued 24:18	left 35:20
included 23:4 28:8 72:16		ITC 11:2,7	left-hand 35:23 36:15 41:9 45:21

legal 23:12,16,20,24 24:6 101:18,24 letter 38:7,13 49:2,8 letters 63:19 level 81:22 lie 72:10 light 65:4 84:7 likewise 35:4 limit 99:25 101:22 limitation 71:16 72:8 80:6 84:3,10 85:19,24 86:1 87:18 88:10 89:3,5,10 90:3 92:20 93:1,8,11 94:6,7, 22 95:2,7,22,25 96:6,9 98:6 102:13 117:18,23 limitations 26:18,21 27:15 80:5 85:14 117:10 limited 76:11,20 limiting 76:21 77:3 93:17 102:11 lines 29:7 33:24 34:8 35:9,16 37:13 38:10 39:1 40:3,7 43:3 47:5,20 48:11,15 49:12,24 52:5 54:6 62:9 63:5,23 65:22,25 66:14, 22 67:19,23,25 68:5,23 69:16,22 70:12,23 93:6 103:3,9,19 104:14 105:12 107:22 108:6, 11,20 109:18 111:6 link 30:6 86:15 listed 17:8	listen 107:7 listing 16:21 17:9 literally 69:24 litigation 14:2 17:22 57:7 litigations 17:14 LLC 12:8 local 8:12 located 9:10 long 15:1 longer 26:20 81:24 lost 10:7 105:9 106:21 lot 68:3,16 108:14 loud 7:8,10 lower 55:15,20 lunch 116:19 LUNCHEON 116:22 <hr/> M <hr/> Mac 30:20 made 73:13 86:5 88:18 91:6 make 44:7 79:4 93:25 makes 88:14 manner 88:19	map 66:4 mapping 115:12 marked 8:13 43:4 materials 18:25 19:4,6 20:9,13, 19,22 21:10 matters 16:13 17:22 meaning 61:14 62:1,14 64:2,24 65:3 66:22 67:13 68:9, 12,13,15 69:9,10,12,18, 22,24 70:5,6,8,13,16, 17,22 71:19 74:11 79:4, 9,11,24 81:3 99:25 101:22 102:10 108:4 means 12:7 36:23 65:4 67:13 68:11 69:19 70:6,8 75:7 81:16,17 82:4,13,15 97:19 98:24 meant 43:24 68:7 meantime 87:14 mechanism 44:5 45:8 media 43:17 meet 14:21 15:1 members 12:14 mentioned 8:2 11:21 28:22 42:19, 24 99:18 mentions 29:8 met 14:23 metadata 31:3 44:1 method	48:17 51:15 52:9 79:2 88:17 methods 55:12 MF 35:19,22 36:3 37:1,6 40:13 41:10 46:10 47:7 Michael 5:4,21 11:9 middle 48:24 105:6 mind 63:6 100:10 101:8 116:18 minute 86:10,11 Mischaracterizes 99:9 missing 93:16 94:1 misspoke 62:21 misunderstanding 45:14 80:11 module 35:19,22 36:15,18,19 37:1,6 39:24 40:13,14, 19,24 41:10,17 42:9,16 46:10,11,16,20 47:7 48:8,25 49:6,9 50:13,17 53:22 54:12,17 55:1,4 moment 12:20 57:11 113:1 Monday 14:25 Morgan's 98:18 morning 5:12,14 68:18,20 69:1, 11 movements 6:21 moving 92:13 multiple 44:21
---	---	---	---

mute 73:8,9	numerical 47:17	office 9:11 24:20 102:9	original 15:16 43:24 44:6 45:9 79:22
<hr/> N <hr/>	<hr/> O <hr/>	omissions 21:14	output 40:15,24 47:9,12 48:1,8 50:13,17,23 53:20 54:10,12,16,17,19,25 55:1 69:6 75:17 78:5, 17,25 80:2,18 88:23 105:4 109:5 110:2
narrow 90:5 98:21	oath 5:6 6:2	ongoing 17:17,20	outputting 51:18 53:2,11,16,21,24 54:21,23
narrower 90:6 98:6	object 6:10 92:13	open 8:8 9:23 12:25 13:4 19:15 57:14	oval 49:2,3,5,9
narrowing 89:12	objecting 73:9	opine 14:10,11 20:4 51:10	overhead 55:15,20
native 16:20 43:8,13	objection 15:25 21:3 32:14 73:14 93:20 94:8,23 95:8,16 96:12 99:8	opinion 21:8 24:15 25:7 27:6 31:24 42:1 49:8 52:20 55:22 58:16 63:9 64:3, 4,20,23 65:2 67:13 69:23 72:1 76:11 77:3 79:20 85:18 86:13 89:23 91:4,5 92:25 94:4 95:14 96:9 98:21 107:7 108:2	overly 95:11
necessarily 60:25 94:13	objective 28:14	opinions 11:18 14:15 21:12 25:8 27:20 32:18 57:2,3 72:6	overstatement 21:5
needing 88:10	obtain 6:18	order 45:1 46:16,21 47:4,12, 17,23 48:9 60:1 61:18 65:8 66:25 67:7,10,12 68:19 69:5,11 70:7 71:20 72:15 74:13 75:9 77:13 78:25 79:8,11,14, 22,25 80:1,7,8,9,14,16, 17,19,20 83:1	overview 28:3,6 29:4
negative 72:8 84:3,10 85:18,23 86:1 88:9 89:3,5,16 92:20 93:1,8 94:6,22 95:2,7,22,25 96:5,9 98:14 102:13	obtained 34:17 35:2,6	ordered 59:24 60:8,16,17,19 61:9 65:6 66:23 74:8, 12,22 75:7 79:3,13,18, 23 80:12,23	owner 9:24 10:2 12:4,7,10,13, 17 14:7,19,24 23:16 27:3 57:6,24 59:8
negatives 98:18	obviousness 18:13,20	ordering 71:13,20 78:21,24 82:22	owner's 23:25 56:9 59:3,12 96:5
newly 111:1	occasionally 34:5	ordinary 36:9 41:22 44:14,17 46:8 47:14,18 61:2,13, 25 65:4 67:6 68:6,13 70:3,18 82:1,6,9 88:14 96:24 100:21 110:9	<hr/> P <hr/>
normal 9:17 81:7	occupation 16:7	organized 44:4 45:7	p.m. 118:16
notation 38:23	occur 79:17		Pacific 116:17
notations 38:23	occurring 14:4		packets 44:4 45:7
note 29:23 50:8	occurs 53:21		paragraph 11:25 13:5 16:10,23 18:10,23 19:3 20:8,10, 19,21 22:9,10 23:2,6,9, 11,15 24:9 25:2,10,18, 21 26:1,8 27:2,9,11,24 28:8,13,25 29:5,8 32:5, 11 43:9,16 44:9 51:1,5, 6 55:10,23 56:6 57:20, 25 58:22 59:7,16,19 60:5 62:3,8 63:8,15
notes 8:18	OCR 87:6,10 97:10		
noting 30:10	OCR'D 29:25		
number 14:3 17:12 41:20 42:19 49:24,25 50:9,10	OCR'ING 91:3		
numbered 46:2,6,19	offer 96:9		
numbers 108:3 109:23	offered 82:21		
	offering 65:2,13 70:10 84:14		

64:4 65:15 66:8 68:10 69:18 72:7,18,24 74:2 77:5,19,23 83:3,7 85:10,11 87:22 88:4 90:9,25 92:2,4,10,21 97:5,15 99:19 102:20, 23 103:8 104:1 105:7 106:9 117:5,12	24:12,18,20 27:3 28:3, 9,14,20,21 29:11,16,19, 24 31:4 32:17 33:5,12 37:25 41:25 42:22 45:17 52:22 55:12 56:9 57:6,16,24 59:3,8,12 64:21 65:5,20 69:20 70:8 71:5,9 72:2 79:7, 12 84:8 86:7,15 87:4 88:6,12 89:4 91:20 92:25 93:7,13 94:2,5, 12,14,15 95:2,6,10 96:4 97:23 99:13 100:9 101:7,8,13 102:8,9 108:2 109:15	70:3,18 81:25 82:6,9 88:14 96:24 100:20 110:9	points 7:7
paragraphs 15:20 18:6 23:21 28:2, 22 29:3 33:1,4 57:4 69:25 72:25 76:21 77:17 87:20,25 89:9,18 101:15 117:17,21	patent's 99:24 101:22	petition 18:15 19:7,9,12,15,19	portion 7:8,10,14 9:19 33:14 34:23 37:18 40:9 41:24 42:3 47:22 49:15 51:15 62:12 63:4,16 66:16,21, 22 71:8 72:5 98:3 100:24 103:1,25 104:14 108:7,22 110:19 111:6 114:22
paraphrasing 32:7 70:9	patentee 86:5,13 99:23 101:21 102:9	Petition' 18:16	portions 10:20 11:2 15:17,21 16:5 28:9,12 33:8 71:22 109:20
parenthetical 58:23	patents 14:14 30:7,11,13 31:4 86:15 87:1	petitioner 5:16 18:15 19:20	POSITA 63:9 88:5
part 18:4 22:13,17,19 43:1 60:17 61:12,16,23 62:24 63:1,17,18,22 67:1 83:11,16,19,22,24 84:4,11,16,17 85:23 99:12 101:12	Patents' 18:15	Petitioner' 18:15	positions 57:6
partes 10:10 18:16	PDF 16:20,25 17:4 43:8,12 58:14 87:15	PGR 10:15	possibility 115:20
partial 103:12	pending 14:1 23:8	PH.D. 5:4	possibly 21:13 42:6
participate 56:12,20	Perfect 8:8	phone 9:15,18,22	post-grant 10:10
parts 15:15 60:16 62:24 63:6 83:11 84:15	performed 72:19 82:24 83:20	phrase 20:12 30:2,3 32:19 36:21 61:21 63:11 64:6 69:8,9,19 76:12 81:1,4, 8,18,24 86:23 90:12,16	preamble 26:14 51:9,14 76:11,12, 19,20,25 77:3,7,10
passage 66:19	perfectly 80:15	picture 46:4 53:13	precludes 96:10
passed 40:13,19 46:10,15,20, 23 47:4,6	performing 52:8	pipeline 18:4	predefinable 38:14 48:19 88:22
passes 36:18	period 7:21 50:2 56:18	place 81:10 95:9 100:11 101:9 105:9 116:8	preferred 27:15 28:24 85:15
passing 46:9	permission 87:10	plain 82:4 110:18	preliminary 11:18
patent 9:24 10:2 11:23 12:4,7, 10,13,17 13:8,11,12,15, 23,25 14:7,12,18,24 18:14,16 21:19 22:7,9, 14,20,23 23:2,6,16,25	permitted 7:15	plan 7:20	preparation 56:12,20,23
	person 36:8 41:22 44:14,17 46:7 47:14,18 61:2,13, 25 65:4 67:6 68:6,13	playback 55:14	prepare 6:16 14:21 15:2,12 56:15
		plurality 62:16 67:3	prepared 15:14,16,18,19,21
		point 21:14,15 24:18 42:21 53:10 94:16 95:10 97:4 100:11 101:6,10 105:4 109:9 111:21 112:12	preparing 21:2 24:7 56:19 59:4
		pointed 93:3 97:22,25	prescriptive
		pointing 38:7 49:3,5,9 114:21	

63:17 80:25 82:18	82:23		7:8,10 18:11 20:3 21:9 34:11,23 35:3,8,12 44:12,13 45:3 46:8,13 48:16,20 54:9 62:12,19 67:22,23 72:14 94:13 98:1 102:4,22 107:22 108:24 109:4,15 111:6 112:21 113:20 114:25 115:21
present 59:25 61:17 65:7 66:24 72:15 74:12 75:8 79:13 80:1,13 82:25	processing 48:16 92:14,15 104:16, 18,25 106:6,20 107:2,9, 16,17,24 108:8	Q	reader 108:24 110:6 113:23
presentation 60:1 61:18 65:8 66:25 74:13 75:9 79:14 80:9, 14,20 83:1	produced 104:24 106:5 113:4	qualifications 15:22 30:10	reading 58:13 110:10 115:18
presented 70:7	produces 104:16	question 6:6,7,12,13,19,25 7:24 11:12 20:4 22:13,16 23:8 25:3 32:2 33:22 36:3 41:5,8 42:14 46:18 52:14 53:12 56:24 60:10 61:7 64:19 74:9, 25 75:22 76:22 77:1 81:9,11 82:3,15 90:21 93:9,22 94:11 95:11,19 100:15 107:7,20 113:21	reads 27:14 39:3 51:22 52:1 55:12 59:23 102:13
presumed 24:12 58:17	producing 92:15	questioning 7:21 9:19 77:20	reason 5:22 9:20 10:19 11:3 24:25
presumption 24:15,19,21 25:1,5	production 18:4 92:14 104:16,25 106:6,20 107:1,9,16,17, 23 108:8	questions 5:16,23 6:5,10 7:15 8:3 87:14 91:14 117:25 118:2,12	reasonable 104:21
previous 22:12	professional 16:22	quotation 103:13	reasoning 11:17
previously 60:13	professor 16:8	quote 16:13 23:15,18 38:14 49:16,17 52:16,17 56:9 59:23 60:8 61:17 62:18 63:9 77:15 78:6 105:19, 21 109:5,22	recall 10:15,16,23 14:17 15:17,24 16:2 20:14,16, 18 21:9 22:6 24:23 32:1 39:23,25 59:5 101:25 102:14,17 116:7
primary 111:11,12,15,16,19	pronounce 5:13	quoted 103:2,25 104:14	recalling 14:13 16:4
principle 27:19 101:18	proper 84:6	quoting 52:15	recap 40:1 67:2
principles 23:12,17,20,25 24:6	proponent 94:20	R	receive 113:25
prior 14:19	proposed 56:9 58:5 59:23 61:4 64:5 72:3 84:14	R1 40:15,20,22 41:3,6,19 42:13,18 44:20 46:12, 17,24 47:8,11,14,16,19 50:14 54:11 55:6	receiver 113:25
privileged 11:11 90:20	prosecution 22:23 99:24 101:22 102:8	R2 48:2 50:18 54:11 55:7	receives 55:4
Pro 9:7	provide 6:25 25:21 28:3 57:3 64:4 65:21 87:7 99:23 101:21	raw 114:3,19	Recess 39:15 73:19 116:22
problem 63:25	provided 14:15 27:6 28:21 44:5 45:8 64:21 65:18 80:6 108:9	reach 41:25	recite 60:7 64:8
procedure 47:23	providing 6:2 27:19 71:17	read	recited 27:16 28:20 55:17 85:15 90:17
proceeding 8:4 10:11 12:11 13:16 14:19 20:6 22:18 57:13 91:20,23	purposes 8:11 23:17 115:15		
proceedings 10:15 11:21,23 14:2,8, 16	put 9:21 30:6 53:20 114:6		
process 116:14			
processed			

recollection 15:14,19 22:3 record 5:20 6:18,24 7:9,24 29:24 73:21 91:19 99:13 101:12 recording 7:2 refer 9:1 12:6 13:3,8,11,22 33:11 34:5 48:14 51:11 53:5,25 54:7,16,20,25 60:4 65:20,22 77:15,23 91:22 103:3,19 104:13 reference 16:23 19:21 62:8 68:14 70:17 89:19 90:11 91:15 99:15 101:15 102:20,23 104:25 108:3 117:17 referenced 20:22,25 43:6 92:5 98:2 references 38:15,24 39:9 44:10 91:3,7 97:7,9,13,14 referencing 39:6 104:1 105:18 referred 38:4,21 42:5 51:14 84:2 referring 9:2 12:8 13:12,23 26:6 40:9 51:17 52:3,4,10 56:18 63:16 66:22 67:11 70:5,22 77:6 79:1 86:4 91:19,23 92:21 106:13 refers 49:15 69:23 77:4 102:25 refrain 8:17 regard 17:25 relationship 14:18 relevant 32:4	rely 71:22 relying 21:8 23:1 41:25 43:15 71:8,19 72:1,24 75:20 rendered 60:1 61:19 65:8 66:25 74:14,22 75:17 79:15 80:14 83:1 rendering 55:15,20 renews 110:5 repeat 23:8 64:20 72:14 95:19 repeatedly 30:3 rephrase 53:14 94:3 replace 43:24 replacing 85:5 report 11:1,2 reporter 5:6 6:16 7:1,12 99:7 reports 10:21,24 represent 30:11 49:10 62:16 67:4 representation 22:21,22 57:9 representatives 10:2 12:16 representing 14:23 43:21 reproduce 77:23 117:12 reproduced 51:4,5 reproduces 104:19 reproducing 92:16	reproduction 92:15 104:18 require 32:2 66:23 93:8,10 94:5,22 95:6 required 6:13 99:15 112:13 requires 78:16 93:1 95:2 requiring 102:15 resource 43:17,21 respect 14:12 25:19,22 27:3 41:1 59:8 61:3 71:13,21 72:2,4,12 89:3,21 96:11 97:7 117:9,18 respective 34:17 62:15 respond 102:9 response 6:19 rest 51:11 70:1 104:10 restriction 11:5 result 80:22 110:6 resulting 43:22 55:14 results 55:20 retained 12:10,12 14:9,11 17:10, 14 returning 72:6 reveal 11:10 90:20 reverse 79:21,25 80:8,17 review 10:10 18:16 19:9 20:1, 17 21:7,9 35:16 57:19	reviewed 21:11 57:22 right-hand 38:6 45:25 road 66:4 room 9:13 Rosenau 91:7 97:7,9,13 100:3 Roughly 15:3 row 56:8 rule 26:17,21 36:7 37:20,24 38:14,19 39:4,8 48:19 49:10 50:8,21 55:8 58:6,20,21 71:5,10,15, 21,24 72:4,19,23 78:2, 6,11,18,20,24 79:18,24 80:6,18,24 82:24 83:8, 12 85:20 87:18 88:6,15, 22 89:6,11,13,22 90:10 92:21 93:18 94:7 95:14 96:11 117:9,18,23 rules 39:7,9 89:4 100:19 <hr/> S S1 34:16 35:1,24 36:6,9,24 37:5,18 40:10,12,18 41:18 45:21 46:2,15 47:6 48:18 49:17 50:13 54:10 55:5 S2 34:16 35:6 45:24 46:6 48:2,6,18 49:16 50:17 54:10 55:6 sake 65:1 115:13,18,19 satisfy 41:21 scenario 75:25
---	---	--	---

scope 79:16,21 80:3,16 96:17 102:16 screen 8:10 9:8 scroll 28:2 search 30:20 86:17,20 searchable 29:25 87:4,5,7 seconds 86:10,11 section 15:20 17:5 23:20 25:10 26:4 28:6 34:11 71:4 92:1 98:1 107:8 109:6, 7,11,12,21,22 110:4,8 111:19 sections 25:11 segment 36:24 44:5 45:9 49:16, 17 50:5,6 68:25 69:1 115:17 segmentation 36:4 segmenting 114:23 segments 26:12 30:4 32:17 34:16 35:1,6,24 36:4,6,9,25 37:3,5,7,10,18 40:10, 12,18,23 41:1,18 42:17 44:25 45:3,21,24 46:2, 6,9,15,19 47:6 48:2,7, 18 49:25 50:10,11,12, 17,22 54:10 55:5,6 58:7,8 59:20,24 60:8, 13,15,17,19 61:6,9,15 62:2,5,14,16,21 64:6,9 65:6 66:23 67:3 69:6 71:11,18 72:13,20,25 73:3 74:7,8,11,17,21 75:4,7,13,16,21 76:13, 14,18,25 77:5,6,9,12, 15,16,18 78:5,8,9,13, 14,17,22 79:1,3,12,21 80:7,8,12 83:13,14,21 88:20,23 92:6 110:11,	13,16,17,20,24 111:25 112:3,5,12,15,19 113:3, 5,7,8,15,16 114:2,4,5, 10,16,17,20 115:1,6,8, 10,11,16,21,22 116:1,6, 12 segments' 63:12 send 87:7 sense 11:4 76:10 sentence 11:1,6 12:4 18:10 20:12 24:11 27:13 37:17 62:24 63:1,9,17,23 66:8 85:13 92:11 102:22 103:1,5,8,13 104:6 sentences 65:16 separate 110:13 114:7 separately 71:16 sequence 40:15,20,22,23 41:3,6, 19 42:13,17 43:18,20 44:11,20 45:12 46:11, 17,24 47:8,11,14,15,16, 19 48:2 50:14,18 54:11 55:6,7 62:18 67:5,8,11 68:1,15,17 88:24 sequential 71:20 72:11 78:21 sequentially 51:18 53:1,11,15 54:21, 23 60:1 61:19 65:8 66:25 69:7 74:14,22 75:17 78:5,17 79:15 80:14 83:2 series 17:19 serving 14:6 17:21 set 18:14 63:18 Shin 91:7 97:7,9,13 100:3	shortcut 64:5 show 52:22 showing 52:23 107:23 shown 50:12,16 52:11,17 55:4 103:24 104:9,15 105:12 106:2,8 107:12,19 111:16 shows 39:3 52:8,19 53:19 sic 22:7 side 9:8 35:23 36:15 41:9 45:21,25 sign 15:9 signal 62:17 67:4 signature 15:7 similar 31:5 43:25 47:22 simple 61:7 75:25 79:19 88:19 116:5 simplify 55:13 simply 64:17 simultaneous 25:13 54:1 81:20 84:22 111:14 single 113:4 114:6 sit 10:16 14:13 16:4 24:24 59:5 102:18 sitting 59:2 80:4,16 81:15 95:12 97:17 situation 95:5	skill 36:9 41:22 44:14,17 46:8 47:14,18 61:2,13, 25 65:4 67:6 68:6,13 70:3,18 82:1,6,9 88:15 96:25 100:21 110:9 skip 111:8 Sonohara 18:20 89:19 91:15,22, 25 92:5,12,19 102:19 103:3,20 104:2,13 105:16,20 106:18 107:8 108:7 109:17 110:23 111:3,23 114:4 115:17, 23 117:9,17 Sonohara' 18:14 sort 81:22 103:12 sound 106:1,14 108:9,23 109:7,10,11,21,24,25 110:4,5 113:9,23 114:1, 3 sounds 36:2 49:22 98:17,18 spans 23:21 speak 7:15 39:19 67:10 73:22 117:2 speaker 62:17 67:4 speakers 25:13 54:1 81:20 84:22 111:14 speaking 7:2 spec 44:14 specific 21:11 24:23 32:19 43:19 44:5 45:8 62:17 65:21 67:4 90:5 93:3 97:14 specifically 6:12 20:25 21:7 26:4
--	--	--	---

27:1 29:2 32:6 60:7 62:4 93:13 115:6	113:12,20	summary 16:24 17:11 28:17,19, 21,25 67:12 87:24 98:1 108:16	T
specification 27:16 28:23 29:4,16,19 31:1,2 33:15 36:17 37:9 38:3 41:24 42:22 43:1 63:4 64:13,21 66:16 70:1 71:4,9 72:2 84:7 85:15 86:6,13 88:13 91:2 95:3,10 96:19 97:23,25 98:3 100:25 101:9 103:2 107:8	steps 65:1,3,13	supplied 35:19	table 26:9 56:5,8 58:13,15 59:18 83:7
specifications 65:5	stick 11:13	support 57:8 69:17 71:17 98:23	takes 36:5,22,23 37:1,17 111:19
specifies 34:15,25 35:5 47:12 50:22	stored 92:14	supporting 18:17	talk 7:2 38:5 42:25 66:6,10 67:18 68:22 76:20 87:25 91:13 92:11 97:6
speech 62:17 67:4	stream 33:18,21 34:2	supports 67:16 91:4	talked 42:9 48:6 65:17 85:23 95:23 98:3 100:17
speed-read 7:11	stricken 10:18,21,24 11:1,2,22	sworn 6:2	talking 39:23 44:25 68:7 71:12 73:14 80:23 89:2 97:1 106:12
split 35:23	strike 12:15 31:5,23 38:18 63:21 112:22	symbols 43:18,20	talks 38:1 43:16 45:2 50:8 68:8,10 70:1 71:5,9 78:1,24 102:23
spoke 79:10	struck 11:6	synchronization 36:19 40:14,19,24 46:11,16,20 47:7 48:8, 25 49:6,9 50:13,17 53:22 54:12,17,25 55:3, 19 86:8 88:21	taught 71:21 89:4
stand 25:2,7 70:9	structure 43:19,22 44:3 45:6 106:19 107:1,23	synchronize 88:19	teach 92:5 97:9
standard 101:24	structured 43:18	synchronized 48:18 50:23 55:14	teaches 111:4
start 51:19 56:4	Studios 18:3	synchronizing 51:22 52:16 54:24 92:6	teaching 100:18
starts 103:5 105:12	stuff 86:11	synonym 37:2,16	technical 17:11,13 64:2,22
state 5:19 59:8	submitted 14:17	synonymous 70:4	technically 57:4 58:15
statements 99:24 101:21	substance 7:16 11:10 23:24 73:25 117:2	syntactic 65:3 67:13 70:5,6,7,17 71:19 79:4,11,23	technologies 16:15
states 36:5 37:10	substitute 85:4	syntactical 62:14 64:2,24 68:12,15 69:9,12,17,21 70:13	term 11:4,5,6 29:8 31:14,18, 22,23,24 32:12,22,23 36:22 59:19 61:3,14,24 62:13,24 63:24 64:2,8, 11,22 65:10 74:11 75:3, 7 76:5,8 81:5,12 86:2
stating 50:4	succeeding 62:16 67:3	syntax 42:25 43:23 44:24 45:2 68:4 69:7,10	terms 26:9,11,23,25 29:10,14, 18 32:10 56:1,5 60:23
stay 65:15	suggest 75:15 115:23	system 114:15	
step 48:16 53:11,16 54:23 77:22 82:23 112:20,23	suggesting 36:2,3	systems 55:13	
	summarize 28:9,14 32:21 45:11 55:3 65:9 70:20 99:2 108:15		
	summarizing 17:19		

61:9 74:17 75:12 102:10 TESTIFIED 5:7 testify 12:10 testimony 6:3 7:16 10:19 11:22 39:21 64:15 73:25 91:14 97:21 99:9 117:3 Texas 11:3 text 30:13 108:14 text-searchable 30:14 thin 112:10,11,17 114:13 thing 7:22 40:1 86:10 things 52:24 68:2,3 78:24 96:16 thought 33:23 72:9 77:2 time 32:3 56:18 73:10 86:8, 12 110:1 118:14 times 10:6,13 44:16 timestamp 89:11,22 91:9 93:13 98:4 timestamps 88:7,10,16 89:1,7,15, 17,25 90:7,13,16 91:1 98:9,11,15,19,23 100:19 timing 72:20 83:20 86:2,20,22, 23 89:13,24 90:4,5 91:10,12 93:19 95:15 96:10,15,17,18,22 97:1, 19,24 98:7,8,11,16,24 99:4 100:8,20 101:6 title 29:11,20,21,22 31:7,15	today 5:16,23 6:17 9:5,10 10:16 14:13,24 16:4 24:24 42:5 59:2,6 80:4, 16 81:15 93:16 94:1 95:12 97:17 102:18 118:9 today's 6:1 9:19 12:6 told 11:7 60:22 top 56:8 112:1 totally 85:6 track 106:1 109:20,22,24 110:7 transcribe 7:12 transcript 6:17 40:5 58:9 93:24 trial 20:6 tribunal 10:18 trouble 98:13 true 94:10 turn 11:25 15:4 16:10 19:17 25:25 27:24 33:1 38:10, 15 45:16 48:11 51:1 52:25 55:23 62:3 91:18 106:17 108:6,11 117:5 Turning 20:8 type 17:9 typographical 34:19 typos 21:15	<hr/> U U.S. 13:8,12 18:14 91:20 uh-huh 6:21 unambiguous 102:15 underneath 58:22 59:18 understand 6:1,5,15 9:2 12:7,9 13:12,23 27:14 42:14 53:6 56:22 60:23 61:2, 14 63:10 68:14 70:4,19 72:16 74:24 75:18 81:7, 9,11 82:3 84:2,25 85:7, 13 88:5 91:9,22 99:12, 23 101:12,20 102:12 110:10,22 115:4 understanding 13:17 14:9 24:17 25:14, 18,22 26:24 27:10 28:15 31:18 32:12,22 33:22 36:21 40:18 46:25 53:8 60:9 61:25 69:17 75:22 77:1,20 84:7,13 86:2 94:12 97:24 98:23 99:21 101:11 102:6 108:5 understands 82:1,7 understood 6:7,14,22 7:3,18 8:19 11:16 25:4 32:24 44:12 62:13 Unified 18:15 unit 36:3 109:25 University 9:11 16:9 upload 8:4 12:19 19:12 42:23 57:8 87:3 91:16 97:12 uploaded 87:8	uploading 57:12 97:16 upper 38:6 <hr/> V Vague 16:1 21:4 90:2 93:21 94:9,24 95:17 96:13 valid 24:12 validity 24:16,19,22 25:1,5 verbal 6:19,20 verbose 44:8 45:10 version 30:7,11,13,14 versions 8:18 video 17:25 18:4 33:16,18,21 34:6 35:23,24 37:5 41:6,18 45:20 46:2,9, 15,19 49:24 50:3,5,11, 12,22 55:5,13 68:17 92:16 104:19 105:22 113:14 VIDEOCONFERENCE 5:1 VL 12:8 <hr/> W Wait 111:7 walk 63:7 107:13 111:9 Walt 18:3 wanted 11:5 26:24 ways 41:20 42:20 44:21
---	--	---	---

well-known

81:4,18

window

8:15 30:6

windows

9:23

wondered

73:14

wondering

94:19

word

37:16,17 62:21 63:14
68:19,25 69:1,19 81:1,
4,7 86:17,19,20,22,23
102:2,5,6 110:23
115:17

wording

61:23

words

32:6 36:25 49:21 51:15
60:24 61:4,12 67:10
70:10,13 81:23 82:1,22
84:1 85:4 97:24 98:4
99:4 104:6 109:2

work

17:9

works

85:6 114:15

wrong

42:8 79:25 80:7 85:11

X**XML**

39:4 43:21,22

Y**years**

16:23 17:10

yes-or-no

61:7

Z**Zoom**

5:1 9:8 14:25



ELSEVIER

Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

Signal Processing: *Image Communication* 18 (2003) 721–747

SIGNAL PROCESSING:

IMAGE
COMMUNICATIONwww.elsevier.com/locate/image

Bitstream syntax description: a tool for multimedia resource adaptation within MPEG-21

Gabriel Panis^{a,*}, Andreas Hutter^a, Jörg Heuer^a, Hermann Hellwagner^b,
Harald Kosch^b, Christian Timmerer^b, Sylvain Devillers^{c,1}, Myriam Amielh^c

^a Siemens AG, CT IC 2, Munich 81730, Germany

^b University Klagenfurt, Klagenfurt, Austria

^c Philips Digital Systems Labs, 51, rue Carnot-BP 301, Suresnes 92156, France

Abstract

In this paper, a generic method is described to allow the adaptation of different multimedia resources by a single, media resource-agnostic processor. This method is based on an XML description of the media resource's bitstream syntax, which can be transformed to reflect the desired adaptation and then be used to generate an adapted version of the bitstream. Based on this concept, two complementary technologies, BSD¹ and gBS Schema, are presented. The two technologies provide solutions for parsing a bitstream to generate its XML description, for the generic structuring and marking of this description, and the generation of an adapted bitstream using its transformed description. The two technologies can be used as stand-alone tools; however, a joint approach has been developed in order to harmonise the two solutions and exploit their strengths. This paper is focusing on the gBS Schema and the joint BSD/gBS Schema harmonised approach.

© 2003 Elsevier B.V. All rights reserved.

1. Introduction

The information revolution of the last decade has resulted in a phenomenal increase in the quantity of content (including multimedia content) available to an increasing number of users who access it through a plethora of devices and networks. Devices range from mobile phones to high definition TVs and access networks can be as diverse as GSM and broadband cable networks. In order to enhance the user's experience, the delivered content³ must be tailored (adapted) to the specific device and network capabilities, as well as to the natural environment and user characteristics and preferences.

*Corresponding author. Tel.: +49-89-636-49015; fax: +49-89-636-51115.

E-mail addresses: Gabriel.Panis@mchp.siemens.de (G. Panis), Andreas.Hutter@siemens.com (A. Hutter), Joerg.Heuer@siemens.com (J. Heuer), hellwagn@itec.uni-klu.ac.at (H. Hellwagner), harald@itec.uni-klu.ac.at (H. Kosch), christian.timmerer@itec.uni-klu.ac.at (C. Timmerer), Sylvain.Devillers@imec.be (S. Devillers), Myriam.Amielh@ifrance.com (M. Amielh).

¹ Sylvain Devillers is now with IMEC, Kapeldreef 75, B-3001 Leuven, Belgium.

² Part of the work described in this paper (Philips contribution) was funded by the European project OZONE (IST-2000-30026).

³ Content is understood here as a general term, including Web content, multimedia resources, presentations, etc., whereas resource is an individually identifiable asset such as a video or audio clip.

The need to standardise a framework that facilitates the control of adaptations has been recognised by several standardisation bodies (W3C, WAP, and MPEG). Standards have already been established or are currently under development that provide tools for content description (MPEG-7 [11]) and capability description and negotiation (CC/PP [21], UAProf [23], and MPEG-21 DIA [16]).

But still a major obstacle to apply these frameworks in adaptive multimedia systems is the adaptation of the encoded multimedia resource itself. The adaptation of encoded media bitstreams is, in general, coding format-specific. Given the variety of coding formats available, the implementation of an adaptation processor covering a high percentage thereof is expensive and difficult to maintain with respect to new codecs.

In this paper, we describe an approach that overcomes this obstacle and facilitates the adaptation of encoded multimedia bitstreams in a generic way, by describing the high-level structure of the bitstream with an XML document called *Bitstream Syntax Description* (BSD). This description allows a device, even if it is agnostic of the specific coding format of a binary media resource, to adapt such a media resource.

This novel approach is currently under consideration for Part 7 of the MPEG-21 standard (Digital Item Adaptation) [16]. In this paper, besides the illustration of the BSD, the overall adaptation architecture is described, examples are given, and experimental performance measurements, in terms of file sizes and computational times, are discussed.

The remainder of the paper is organised as follows. In Section 2, the general adaptation approach and possible applications are described; brief background information on content adaptation, XML, and media scalability is also provided. In Section 3, the adaptation process using BSD is explained in detail; a special, but anticipated use case of multi-step adaptation is also analysed in Section 3. The application of the proposed BSD-based adaptation methods on MPEG-4 Visual Elementary Streams and JPEG2000 images is demonstrated in Section 4; performance results are presented as well. Finally, conclusions are given in Section 5.

2. Media resource adaptation framework

2.1. Application scenarios

The overall approach to multimedia resource adaptation as outlined above delineates the capabilities and application areas of the proposed techniques.

The application scenarios are in general limited by the capabilities of the engaged technologies. For the approach described in this paper, on the one hand, versatile and powerful adaptation tools are facilitated even on devices with limited computational and storage capabilities, since the high-level, XML-based Bitstream Syntax Descriptions abstract from the “bits and pieces” of the binary media resources. In addition, since the adaptation processes become independent from the specific coding formats of the media resources, adaptation engines can be located anywhere in a distributed multimedia system: on a server, a client, and conceptually even on network nodes like proxies, gateways, or routers.

On the other hand, producing an adapted version of a media bitstream requires XML and XSLT processing, as described in the remainder of the paper. Also, adaptation according to a given set of constraints involves a well-informed and potentially non-trivial decision process, taking as input capability, preference, and constraint descriptions. These factors rule out low-end devices, due to insufficient computational resources, and make the approach ill-suited for hard real-time adaptation applications, such as on-the-fly manipulation of media bitstreams in an intermediate network device that is, e.g., forced to drop packets from the bitstream due to temporary congestion. Further constraints are represented by the pre-requisite of suitable scalable media resource coding and by the restrictions to editing-style adaptation operations on bitstreams.

Thus, adaptations as considered here, based on bitstream syntax descriptions, are best performed on devices with reasonable computational power and storage capacity, capable of XML and XSLT processing, and applications tolerant to small delays. Two examples are given below; other application scenarios in the same spirit are easily derived.

The evolving MPEG-21 standard aims to provide a multimedia framework that will “*enable transparent and augmented use of multimedia resources across a wide range of networks and devices*” [12]. The MPEG-21 defined use cases [15] span already a wide range of envisaged applications of the approach described in this paper. An obvious application area is the *delivery of digital resources in a heterogeneous environment*, most often referred to as *Universal Multimedia Access* (UMA). Simple transformations can be performed to adapt the resources to e.g.:

- client devices with different audio–visual (e.g., display size), user interaction, communication, computational and storage capabilities;
- user preferences, constraints, and behaviour (e.g., movement, speed); and
- (static) network characteristics and QoS (e.g., bandwidth, delay, jitter, error rate).

These adaptations can be performed on servers, proxy servers, dedicated media gateways, or on reasonably powerful client devices. It is likely that highly dynamic QoS fluctuations, e.g. network contention, need other adaptation mechanisms which can be conducted with low delays on a router. Such cases are not considered here.

Another promising application is *quality-aware multimedia caching* as discussed in [3]. In the scenario reported there the video cache stores videos in several quality layers. If the cache is about to run out of storage, it degrades the quality and thus decreases the size of unpopular videos rather than completely discarding them from the store, according to different strategies. Since this type of quality reduction is a background (i.e., non-real-time) process and the video cache is assumed to be in a computationally powerful machine, the adaptation can be performed using the proposed bitstream syntax description and transformation techniques.

It must be noted that one of the techniques (gBS Schema; cf. Section 3.4) goes beyond pure syntactical modifications of the media resource bitstreams. It introduces a mechanism (a handle called “marker”) that allows semantic-driven adaptations to be performed by resource adaptation engines that are agnostic to the resource’s coding format and semantics, based on the very same process as used in other bitstream manipulations. The semantic information, expressed using metadata schemes like MPEG-7, can be linked to the corresponding bitstream segments through the use of the marker. The marker concept is described in more detail in Section 3.4.1. Examples of this type of semantic-related adaptations are the removal of violent scenes from a video (cf. Section 4) and the display of specific regions of interest from JPEG2000 images. Applications of this technique are manifold.

2.2. Overall approach

As pointed out in the previous section, the motivation for multimedia resource adaptation is to deliver the best possible content (in terms of information and perceived quality) to the end user given the current set of constraints, e.g. device characteristics and user preferences. The high-level adaptation architecture is depicted in Fig. 1.

Even though this architecture is applicable to the adaptation of any type of content, the focus of this work is on binary multimedia resources. Hence, any reference to “resource” will imply a binary multimedia resource.

The *Adaptation Engine* is a logical unit that can be located on the originating server, an intermediate network device (gateway, router, proxy) or even on the client. This engine comprises two logical modules, the Adaptation Decision Engine and the Resource Adaptation Engine.

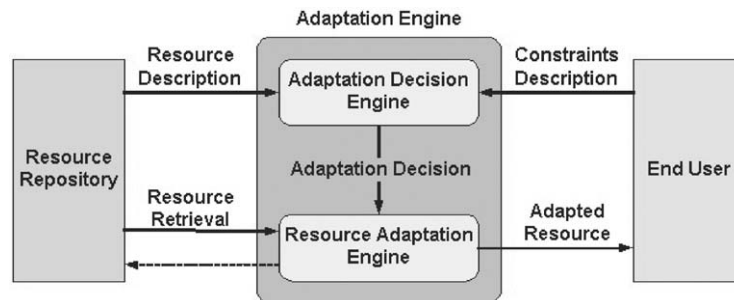


Fig. 1. High-level adaptation architecture.

The *Adaptation Decision Engine* receives the metadata information about the available content (semantics, format, and adaptation options) from the *Resource Repository* and the constraints (terminal and network capabilities, user characteristics and preferences, and natural environment characteristics) from the receiving side. If there are multiple versions of the content pre-stored in the repository and one of these versions matches the constraints, then this version is selected, retrieved, and sent to the end user. However, if the available resource does not match the constraints, but can be adapted, then the *Adaptation Decision Engine* determines the optimal adaptation for the given constraints and passes this decision to the *Resource Adaptation Engine*. Then the *Resource Adaptation Engine* retrieves the resource from the repository, applies the selected adaptation and sends the adapted resource to the end user.

The described architecture exhibits the following essential elements of multimedia resource adaptation:

1. *Resource Description*: The *Resource Description* contains all metadata that are related to the adaptation process. This includes metadata that provide information assisting the adaptation decision making and metadata that are used for the resource adaptation. The description should therefore include information on the resource type and semantics (e.g. MPEG-7 descriptors [11]), the available adaptation options and characteristics of the adapted versions of the resource and the bitstream syntax (e.g. MPEG-21 DIA descriptors [16]).
2. *Constraints Description*: The constraints can be grouped into four broad categories: user and natural environment characteristics, terminal capabilities, and network characteristics. The terminal and network constraints will set an upper bound on the resources that can be transmitted over the network and rendered by the terminal. Information like the network's maximum bandwidth, delay and jitter, or the terminal's resolution, buffer size, and processing power, will help the *Adaptation Engine* determine the optimal version of the resource for the given network and terminal device. As the user is the actual consumer (and judge) of the resource, user related information, including user preferences, user demographics, usage history and natural environment, is equally important in deciding which resource should be delivered to the terminal.
3. *Resource Scalability*: A multimedia resource is defined to be scalable if the data is organised in such a way that, by retrieving parts of the data, an adapted version of the original content can be rendered. Scalability, therefore, can be available in one of the following forms:
 - an individual resource that is encoded with increasing SNR quality, spatial, or temporal resolution;
 - an individual resource, parts of which can be removed (e.g., a scene from a video sequence);
 - a multimedia presentation where one or more individual resources may be removed (e.g., video is removed, only audio is kept from a news broadcast).

4. *Adaptation Decision Engine*: This algorithm takes as input the resource and constraints description and outputs the adaptation that needs to be applied to the resource. The adapted resource should be of optimal quality under the given constraints.
5. *Resource Adaptation Engine*: This module performs the selected adaptation of the resource. It can include various sub-modules, ranging from a simple bitstream parser to a sophisticated transcoder.

2.3. Resource descriptions and adaptations considered

The work described in this paper is within the scope of *Resource Adaptation Engine* as shown in Fig. 1. Specifically, the proposed solution applies mainly to adaptations which involve editing a binary media resource. This editing includes removing bitstream blocks and modifying the values of syntactical elements of the bitstream. “Transmoding” of multimedia resources, i.e. adaptations from one media type to another (e.g., text to speech), and transcoding, i.e. adaptations that require the partial or full decoding of a resource (e.g., MPEG-2 to MPEG-4), require detailed knowledge of the specific coding formats involved and are therefore out of the scope of this work.

Given the variety of available multimedia coding formats and adaptation options, an adaptation engine would be expected to incorporate several codec-specific modules for performing even simple adaptations involving removal or modification of syntactical elements of the bitstream. This approach would yield expensive and difficult to maintain adaptation engines, in particular with respect to upcoming coding formats and multimedia types. As an alternative, we propose a generic tool that allows an adaptation engine to transform a multimedia resource without any prior knowledge of the resource’s coding format and therefore without the need to maintain codec-specific modules. With the proposed solution, the resource adaptation engine requires a single processor that uses the XML description of the bitstream syntax to produce an adapted version of the bitstream.

The algorithm behind the adaptation decision engine is an interesting subject of research in itself. MPEG-21 has specified descriptors to assist the decision process (e.g. Choice/Selection in the Digital Item Declaration [13] and AdaptationQoS in DIA [16]), however, the decision-making algorithm itself is implementation specific. It is considered to be beyond the scope of this paper.

2.4. Related work

In the sequel, we give a brief overview of related technologies and standards. On the one hand, several standardisation groups have investigated and standardised capability description schemes which can be used to control bitstream adaptations. IETF has created the Content Negotiation Protocol (CONNEG) [7] that enables protocol-independent negotiation covering both the content and the user. The W3C has built the RDF-based (which can be XML serialised) Composite Capability/Preference Profiles (CC/PP) [21] protocol. The WAP Forum has used the CC/PP to define the User Agent Profile (UAProf) [23] which provides a CC/PP vocabulary describing the characteristics of WAP-enabled devices. MPEG has created the MPEG-7 standard, which specifies an extensive metadata scheme for the description of multimedia resources and user characteristics [11]. Finally, MPEG is currently defining descriptors of user, natural environment, terminal and network characteristics and other resource and adaptation related tools within the MPEG-21 Digital Item Adaptation (DIA) framework [16]. Most of the metadata schemes mentioned above are defined using the World Wide Web Consortium’s (W3C) XML Schema Language [22] and expressed using the W3C’s Extensible Markup Language (XML) [20].

On the other hand, scalable coding formats supporting bitstream adaptations have been the subject of research for many years. The most widely used type of video scalability is temporal, where predicted frames (B- and P-type) may be dropped to reduce the frame rate and consequently the video’s bitrate. For SNR and spatial scalability, a layered approach has been adopted in standardised codecs (MPEG-2, MPEG-4,

H.263), where, on top of a base layer, several enhancement layers may be added to provide an improvement in SNR quality or spatial resolution. A fine granular approach (Fine Granular Scalability, FGS) has been proposed and amended to the MPEG-4 Visual standard [18]. For image compression, the JPEG2000 standard uses wavelet transformation, which provides layered SNR, spatial, and colour scalability [9].

The BSDL approach was originally inspired by XML publishing frameworks such as Cocoon [4] developed by the Apache Software Foundation to publish XML content adapted to the requesting client in a Web context. However, to the best of our knowledge, no work had been done yet to extend these principles to binary multimedia data and to other non-Web-based applications.

Flavor, a language for media representation [5,6], is a technology which has similarities, in some aspects, with the BSDL/gBS Schema approach. Flavor, which stands for *Formal Language for Audio–Visual Object Representation*, was initially designed as a declarative language with a C++-like syntax to describe the bitstream syntax on a bit-per-bit basis. Its aim is to simplify and speed up the development of software that processes audio–visual bitstreams by automatically generating the required C++ and Java code to parse the data, hence allowing the developer to concentrate on the processing part of the software. Unlike the BSD approach, it does not generate a permanent description of the parsed data, but only an internal memory representation in the form of a collection of C++ or Java objects.

Recently, Flavor was enhanced to support XML features (XFlavor) and tools for generating an XML description of the bitstream syntax, transforming the XML description and regenerating the adapted bitstream [6]. There are, however, some fundamental differences to BSDL/gBS Schema, stemming mainly from the original focus of the two technologies. In XFlavor, the schema does not play part in the bitstream parsing and description generation process, which is done by the ad-hoc C++ or Java code generated from the Flavor description. For the bitstream generation, unlike BSDL/gBS Schema which relies on the XML Schema datatype definition, XFlavor uses proprietary attributes declared in the schema and indicating the binary encoding of the element content. A major drawback of this design is that two elements with the same type (e.g. encoded on two bits) will require the same verbose declaration in the schema, while BSDL/gBS Schema will define the corresponding type once, and use it for all elements. Furthermore, using XML Schema native mechanisms for datatype definition and derivation allows validating the value and optimally binarising it with tools such as MPEG-7 BiM [10]. Lastly, in XFlavor, the complete bitstream data are actually embedded in the XML document, resulting in potentially huge descriptions, while BSDL/gBS Schema uses a specific datatype to point to a data range in the original bitstream when it is too verbose to be included in the description. This is why, unlike Flavor/XFlavor, BSDL is rather a *description* rather than a *representation* language, and can describe the bitstream at a high syntactical level instead of a low-level, bit-per-bit basis.

With respect to the gBS Schema approach in particular, the main differences lie in the generic, universal and codec independent format of the corresponding generic Bitstream Syntax Descriptions (gBSDs), and in the introduction of means to mark individual elements in the gBSD in order to enable and simplify complex and semantic-based adaptations. Such marking is not possible with XFlavor.

The principles of BSDL have been described in [1] and an example application of BSDL for MPEG-4 Visual Texture Coding was introduced in [17]. This paper focuses on the generic Bitstream Syntax Schema (gBS Schema) and the harmonised BSDL/gBS Schema approach, which have not yet been presented in the scientific literature.

3. Media resource adaptation using bitstream syntax descriptions

For most binary media resources, a variety of adapted versions can be retrieved from a single bitstream by performing simple operations such as the removal of data blocks. In order to provide interoperability and to avoid the need for multiple codec-specific adaptation modules, it is desirable that a processor that is

unaware of the specific coding format can be used for this task. For this, a generic approach is taken by providing a method based on XML for describing and manipulating bitstreams.

A binary media resource consists of a structured sequence of binary symbols, this structure being specific to the coding format. A bitstream is defined as the sequence of binary symbols representing this resource. XML is used to describe the high-level structure of a bitstream; the resulting XML document is called a *Bitstream Syntax Description (BSD)*. This description is not meant to replace the original binary data, but acts as an additional layer, similar to metadata. In most cases, it will not describe the bitstream on a bit-per-bit basis, but rather address its *high-level structure*, e.g. how the bitstream is organised in layers or packets of data. For this, a specific mechanism is provided to indicate a segment of data in the original bitstream instead of actually including the data since this would make the description too verbose. Furthermore, the bitstream description is itself scalable, which means it may describe the bitstream at different syntactic layers, e.g. finer or coarser levels of detail, depending on the application. The bitstream description itself must also be adaptable in order to properly reflect bitstream adaptations. Lastly, unlike many metadata schemes such as MPEG-7, it initially does not deal with the semantics of the bitstream, i.e. does not provide metadata information regarding the original object, image, audio or video it represents, but only considers it as a sequence of binary symbols.

With such a description, it is then possible for a resource adaptation engine to transform the XML document and then generate back an adapted bitstream. XSLT (Extensible Stylesheet Language for Transformations) [19], which provides a standardised method for transforming XML documents, can be advantageously used for this purpose. In order to provide full interoperability, it is then necessary that a processor that is not aware of the specific coding format can nevertheless be used to produce a BSD, and/or generate a bitstream from its BSD. For this, it will rely on the information on the specific coding format provided by a schema. In this way, communicating devices (e.g., Resource Repository and Adaptation Engine of Fig. 1) will be able to exchange BSDs and transformation descriptions, for example in the form of XSLT style sheets. Based on the concept described above, two complementary technologies have been developed.

- *BSDL*: A new language based on XML Schema, called *Bitstream Syntax Description Language (BSDL)*, was created by Philips Research, France [1,2]. With this language, it is possible to design specific *Bitstream Syntax Schemas (BS Schemas)* describing the syntax of a particular coding format. These schemas can then be used by a generic processor to automatically parse a bitstream and generate its description, and vice versa.
- *gBS Schema*: BSDL provides means for describing a bitstream syntax which relies on a codec-specific BS Schema. This requires a resource adaptation engine to know the specific schema in order to parse the BSD to generate the corresponding bitstream. In some use cases this is not desired, for instance if the adaptation takes place on remote devices with constrained resources, e.g., in proxies. In these cases, a codec-independent schema is more appropriate. Therefore, a *generic Bitstream Syntax Schema (gBS Schema)* was created by the collaborative parties at the University Klagenfurt, Austria, and Siemens AG, Munich, Germany. The gBS Schema enables the codec-agnostic description of the bitstream and introduces means for describing syntactical bitstream units in a hierarchical fashion and addressing means for efficient bitstream access. Additionally, it provides semantic handles to sections of the bitstream (the so-called “markers”) that facilitate semantic-based manipulation or removal of bitstream portions.

The two technologies described in this paper can be applied independently. Each approach carries its own merits and advantages which make it the preferred choice for specific applications. Since their common added value is to be applicable to any multimedia coding format, it is vital to be able to produce such descriptions without having to modify the encoders for each targeted format. BSDL solves this issue by providing a generic way to generate a BSD from a bitstream. For this, a single generic software is required,

exploiting the coding format-specific information provided by the BS Schema. Symmetrically, the same schema is used for producing the adapted bitstream from the transformed description. In the cases where the availability of the specific BS Schema may become an issue, for example on constrained devices, the gBS Schema approach provides a further abstraction level with codec-independent BSDs which are named generic BSDs (gBSD). In this case, the use of a generic, normalised schema along with semantic handles in the gBSDs enables more efficient implementations for both description transformation and bitstream generation processes. Furthermore, the semantic handles provided by the gBS Schema enable semantic and complex adaptations which would otherwise require the use of algorithms that have extensive knowledge of the coding format specifics. The flexibility provided by BSDL (in providing a generic way to generate BSDs from bitstreams) and the processing efficiency provided by gBS Schema (through the use of a normalised schema and marker handles), are thus key to the deployment of this novel multimedia resource adaptation framework based on Bitstream Syntax Descriptions. In an effort to exploit the benefits of both technologies, a joint approach was attempted by defining a harmonised architecture and schema hierarchy. The schema hierarchy is specified in Section 3.1 and the joint architecture in Section 3.2. The BSDL is briefly explained in Section 3.3 and in more detail in [2]. The gBS Schema technology is described in Section 3.4.

3.1. Schema hierarchy

BSDL provides a number of built-in datatypes derived from XML Schema, with specific semantics in the context of generating an adapted bitstream. These datatypes are defined in a schema named *Schema for BSDL-1 Extensions*.

On top of this, BSDL introduces a number of language constructs defining new types of constraints on XML documents. These constructs are added to the XML Schema language by using annotation mechanisms, and are therefore ignored by XML Schema for the validation, but carry specific semantics in the context of description generation. These language extensions are defined in a schema named *Schema for BSDL-2 Extensions*. This schema imports the Schema for BSDL-1 Extensions.

Applications may define Bitstream Syntax Schemas (BS Schemas) for multimedia coding formats. As a BS Schema can define the bitstream syntax for specific codecs and in a level of detail suitable for the specific adaptations, these schemas are application-dependent. It is expected, however, that schemas for common multimedia coding formats (e.g., the various MPEG-4 Visual profiles, JPEG2000) will be defined and be widely used. In order to use the built-in datatypes (BSDL-1) and language constructs (BSDL-2) of BSDL, these codec-specific schemas need to import one or both of the schemas mentioned above. Note that for the description generation, the language constructs (i.e., the Schema for BSDL-2 Extensions) are required, whereas for bitstream generation only the datatypes (i.e., the Schema for BSDL-1 Extensions) are needed. The gBS Schema proposed in this paper uses BSDL datatypes and therefore imports the Schema for BSDL-1 Extensions.

A BS Description is an instantiation of a codec-specific BS Schema, whereas a gBS Description is an instantiation of the gBS Schema.

The different inclusion mechanisms between the schemas explained above are illustrated in Fig. 2.

3.2. Adaptation architecture

Fig. 3 depicts the architecture of one resource adaptation step. The architecture comprises the original scalable bitstream and its BSD, one (or more) description transformations, the adapted bitstream and its BSD and two additional processes, the description generation and bitstream generation processes. The description may be a gBS Schema-valid gBS Description (gBSD), or a BS Schema-valid BS Description (BSD). The output produced in one adaptation step is an adapted bitstream and possibly a transformed

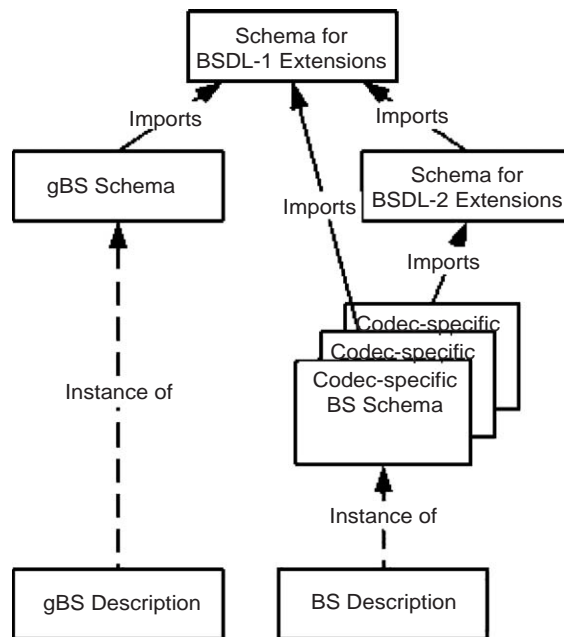


Fig. 2. BSD schema hierarchy.

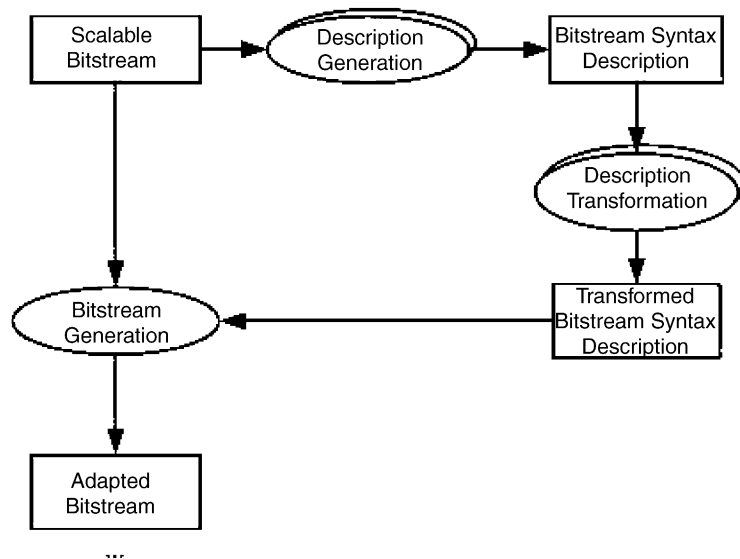


Fig. 3. Adaptation architecture.

BSD that correctly references the new bitstream. This output enables the application of multiple successive adaptations. A walkthrough of the process is given below. Note that Fig. 3 focuses on the resource adaptation engine, therefore other elements of the adaptation framework, like the decision making engine and the constraints description, are not shown here.

The BSDs or gBSDs may be generated in a proprietary way, e.g. during encoding. Alternatively, the BSDL-defined *Description Generator (BintoBSD)*, described in Section 3.3, may be used to parse a bitstream described by a BS Schema and generate its description.

The bitstream and its description are subject to the adaptation. The adaptation decision engine is assumed to determine the optimal adaptation for the media resource, given the constraints as described in Section 2 and depicted in the high-level architecture in Fig. 1. Based on that decision, if the resource is not pre-stored but needs to be derived by adapting an existing resource, then one (or several) description transformation(s) is (are) selected to be applied to the input description. The result of these transformations is a transformed description which is the basis for the generation of the adapted bitstream. The generation of the adapted bitstream is achieved using the bitstream generation process shown in Fig. 3 and specified in more detail later in this section. This *Bitstream Generator* might be a so-called *BSDtoBin* (processing a BSD) or a *gBSDtoBin* parser (utilising a gBSD), as explained below. It should be noted that due to data dropping, some address references (e.g. of elements after a removed data block) in the Transformed BSD might not point to the correct sections of the Adapted Bitstream and therefore need to be adjusted. The address correction process can either be incorporated into the Bitstream Generation process or be applied on the Transformed BSD using an XSLT (not shown in Fig. 3).

3.3. Bitstream Syntax Description Language (BSDL)

This section briefly describes how the Bitstream Syntax Description Language (BSDL), introduced above, is built on top of XML Schema. A more detailed specification may be found in [2,14,16]. The work presented here incorporates the harmonisation with the gBS Schema approach along with the new developments required for the description generation.

The primary role of a schema is to validate an XML document, i.e. to check that it follows a set of constraints on its structure and datatypes. On top of this, BSDL adds a new functionality, which is to specify how to generate an adapted bitstream from its description and vice versa. For this, a number of restrictions and extensions covering structural and datatype aspects of XML Schema are required. This is done in a compatible way such that a BS Schema still conforms to XML Schema and can be used to validate the BS Description. In the following, we name *BSDtoBin Parser* the generic software parsing the BSD and generating the bitstream, and *BintoBSD Parser* the software performing the reverse operation. For their operation, both parsers use the BS Schema specifying the syntax of the coding format. Note that proprietary software may be used instead of the BintoBSD parser to generate the BSD as long as the result conforms to the BSDL specification.

In the XML Schema terminology used below, *component* is the generic term for the building blocks that comprise the abstract data model of the schema; `xsd:choice`, `xsd:sequence`, `xsd:element` or `xsd:complexType` are examples of schema components.

For *BSDtoBin*, the BSDL uses a set of XML Schema components and defines built-in datatypes with specific semantics in the context of the bitstream generation. On the other hand, some XML Schema components should be ignored by the *BSDtoBin* parser because they have no meaning in the BSDL context. This set of extensions and restrictions is referred to as *BSDL-1*, and the syntax of the extensions is specified in the *Schema for BSDL-1 Extensions* introduced above.

The *BintoBSD* parser requires more advanced features on top of *BSDL-1*, including some new language constructs such as variables and conditional statements. In order to remain compatible with XML Schema, these extensions are introduced as application-specific annotations, namely by using the `xsd:appinfo` schema component and adding attributes with non-schema namespaces. This set of extensions is referred to as *BSDL-2*, where *BSDL-1* is a subset of *BSDL-2*. Their syntax is specified in the *Schema for BSDL-2 Extensions* introduced above. In the following, *BSDL* refers to both *BSDL-1* and *BSDL-2*.

The fundamental principle of BSDL is that the successive parameters of the bitstream are included in the XML elements of the description. In the example shown in Document 1, a two-byte parameter with the hexadecimal value FF91 is embedded in the description by the element `<Marker>FF91</Marker>`. Other parameters may be written in a decimal format, depending on their semantics and the application. Furthermore, a type must be assigned to each element in order to specify the encoding scheme of its content. While the function of a datatype definition in XML Schema is to constrain the *value* of an element or attribute content for validation, the datatype specifies its *binary encoding* for BSDL. BSDL datatypes are therefore restricted to those for which a binary representation may be defined. For example, the XML Schema `xsd:integer` datatype represents the mathematical concept for an unbounded integer. No implicit binary representation may be assigned to this type, which is therefore excluded from BSDL. On the other hand, `xsd:int` is derived from `xsd:integer` by restricting its value space to the values that may be represented on four bytes. BSDL includes this type and assigns a binary representation on four bytes. According to this principle, BSDL uses a defined list of primitive XML Schema datatypes, including integer types with a finite number of bytes (`xsd:long`, `xsd:int`, `xsd:short`, `xsd:byte`) and their unsigned derivatives (`xsd:unsignedLong`, ...), floating point numbers (`xsd:float` and `xsd:double`) and binary data (`xsd:hexBinary` and `xsd:base64`). Furthermore, BSDL introduces a new built-in datatype named `bsdl:byteRange` to point to a data segment in the original resource, used when the size of the segment would make the description too verbose. In this case, the description does not actually include the data, but a reference locating the data in the original bitstream.

An example of a BSD and a BS Schema is given in Documents 1 and 2, respectively.

Document 1: Example of a BSD of a JPEG2000 bitstream

```
<?xml version="1.0"?>
<Codestream xmlns="JP2" xmlns:jp2="JP2" xsi:schemaLocation="JP2 JP2.xsd">
  <MainHeader>
    <!--and so on... -->
  </MainHeader>
  <Bitstream>
    <Packet>
      <SOP>
        <Marker>FF91</Marker>
        <LMarker>4</LMarker>
        <Nsop>0</Nsop>
      </SOP>
      <PacketData>155 242</PacketData>
    </Packet>
    <!--and so on... -->
  </Bitstream>
</Codestream>
```

Document 2: Example of a BS Schema of a JPEG2000 bitstream

```
<xsd:schema targetNamespace="JP2"
  xmlns:bsdl-1="urn:mpeg:mpeg21:2003:01-DIA-BSDL1-NS"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  elementFormDefault="qualified">
  <xsd:import namespace="urn:mpeg:mpeg21:2003:01-DIA-BSDL1-NS" schemaLocation="BSDL-1.
xsd"/>
```



```

<xsd:element name="SOP">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Marker" type="xsd:hexBinary"/>
      <xsd:element name="LMarker" type="xsd:unsignedShort"/>
      <xsd:element name="Nsop" type="xsd:unsignedShort"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element name="PacketData" type="bsdl-1:byteRange"/>
<!-- and so on... -->
</xsd:schema>

```

It is important to note that, while a coding format may be specified as a “flat” structure, i.e. as a sequence of binary symbols, these symbols may be grouped in a hierarchical manner in the description, since the inherent tree structure of the XML document has no impact on the bitstream generation process. Furthermore, the choice of tag names is also fully transparent. The design of a BS Schema for a given coding format is therefore not unique and is fully application dependent. For example, Document 6 shows the high-level structure of an MPEG-4 Visual Elementary Stream BSD, where Visual Object Planes (VOPs) are described as a single segment of data and not further detailed, since the adaptation consists of simply removing the B-VOPs. Another application may use finer scalability modes of MPEG-4 Visual and hence require a finer level of details within the VOPs. Depending on the application and typically on the scalability mode used, different levels of details may be required and thus different BS Schemas may be designed for the same coding format.

3.4. Generic Bitstream Syntax Schema (gBS Schema)

The *generic BS Schema* is targeting enhanced binary resource adaptations. The gBS Schema imports the Schema for BSD-L-1 Extensions in order to use the datatypes specified in BSD-L-1. The syntax of a gBSD is generic and codec-independent, therefore enabling the processing of binary resources without the need of codec-specific schemas. Additionally, the gBS Schema provides the following functionality:

- Semantically meaningful marking of described syntactical elements through the use of a “marker” handle.
- Description of a bitstream in a hierarchical fashion that allows grouping of bitstream elements for efficient, hierarchical adaptations.
- Flexible addressing scheme to support various application requirements and random accessing of the bitstream.

The gBSD approach is based on the same general concept as BSD-L. However, the unique functionality that the gBS Schema provides, facilitates complex adaptations. Specifically, the “marking” of elements and the hierarchical structure of the description, can greatly simplify sophisticated bitstream manipulations (e.g., remove an SNR layer from a JPEG2000 bitstream when the progression order is resolution) and semantic-related adaptations (e.g., remove violent scenes from a video sequence). Furthermore, the gBSDtoBin process does not require an application or codec-specific schema, since all the necessary information to regenerate the bitstream is included in the gBSD and the semantics of the gBS Schema elements. This is particularly desired when the adaptation takes place on remote, constraint devices, since it saves bandwidth space and computational resources.

3.4.1. gBS Schema

The gBS Schema is fully specified in the MPEG-21 DIA standard [16]. We restrict ourselves here to introduce the most important elements of the gBS Schema approach. Examples of gBSDs illustrating the concepts described in the following are given in Section 4.

The gBS Schema defines three types of elements:

- *Header*: Contains information about the classification scheme used and sets default values required for resolving the address references in the gBSD. Specifically, the header defines the alias and URI of the classification scheme where the element names used in the gBSD are specified. These names are codec-specific names of the elements represented in the gBSD, thus enabling codec aware adaptation engines to navigate and use the gBSD. For interoperability and extensibility purposes, these names can be stored in a classification scheme which is identified in the Header by its URI. Additionally, the Header defines the default values used for addressing (the URI of the bitstream location, addressing mode (absolute, consecutive, offset), units used (bit or byte)). Only the root and the gBSDUnit may contain a Header. The values of the parameters defined in the Header apply to all descendants of the element that contains the Header. These parameters may be overridden by another Header further down in the description tree or addressing attributes in individual gBSDUnits or Parameters.
- *gBSDUnit*: Represents a section of the bitstream. The size of a gBSDUnit is not limited, so it could be used to represent a single bitstream syntactical element, a group of elements, or a block of data. As the gBSDUnit does not provide the actual value of the element it represents, just its location in the bitstream, it should not be used to represent elements the values of which might need to be modified during adaptation. A gBSDUnit may include one Header and zero or more Parameters and gBSDUnits. A gBSDUnit includes a start and length attribute to point to the section of the bitstream it describes. In addition, the optional addressing attributes open the possibility to override inherited addressing attributes. If these attributes are instantiated, they apply to the gBSDUnit and are inherited to its descendants but not its siblings.
- *Parameter*: Describes a syntactical element of the bitstream. The Parameter can be used to describe elements of the bitstream the values of which might need to be changed when adapting the bitstream (cf. Section 4.1.2). Unlike the gBSDUnit, the Parameter provides the actual value and datatype of the bitstream element, therefore enabling the alteration of the numerical values of bitstream elements in addition to removal. The datatype is necessary for the bitstream generation process (gBSDtoBin) to correctly encode the syntactical element in the bitstream. The Parameter also includes optional addressing attributes, similarly to the gBSDUnit, to allow overriding the inherited values.

A schema has been created to provide a library of basic datatypes for the value of the Parameter. This library includes some of the XML Schema built-in datatypes and others encountered often in existing multimedia coding formats. The library can be easily extended to include new datatypes.

The gBSDUnits and Parameters may carry a “marker” attribute. This attribute marks sections of the bitstream, therefore providing a handle which could link an external description of possible adaptations, using MPEG-7 and MPEG-21 description tools, to the specific bitstream elements that need to be either removed or modified to achieve the corresponding adaptation. The semantic intelligence lies in the MPEG-7 and MPEG-21 metadata as well as their linkage to the marker. The marker value and the resource adaptation engine are therefore semantically agnostic. This handle can be extremely useful in the case of complicated adaptations (e.g., select a specific region in an image) or semantic-related adaptations (e.g., remove violent scenes from a video, when it will be watched by children). The adaptation engine can then easily apply semantic adaptations that would otherwise require extensive knowledge about the resource’s coding format and semantic analysis of the resource.

The gBS Schema provides a flexible addressing scheme which allows specifying and overriding the bitstream location, the addressing unit, and addressing mode. The location of the bitstream is expressed in

the form of a URI, the unit can be either bit or byte and the addressing mode can be absolute, offset, or consecutive. *Absolute* addressing mode means that the element in the gBSD carries a start attribute which gives the absolute position of the element relative to the beginning of the bitstream. *Offset* is similar to absolute; however, the start attribute gives the position relative to the position of the parent element in the gBSD. *Consecutive* means that the position of the element is the next bit or byte after the end of the previous element in the gBSD tree. If the element is the first child, then the previous element is the parent element.

3.4.2. Adaptation process using the gBSD

The architecture shown in Fig. 3 is used to generate a gBSD, adapt it, and then regenerate the adapted bitstream. The process is explained step-by-step in the sequel.

3.4.2.1. gBSD generation. The gBSD may be generated in any proprietary way. Due to the hierarchical structure of the description and the marking of gBSDUnits and Parameters for various adaptations, the production of a gBSD is application-specific. Some anticipated methods for gBSD production include the generation of a gBSD during media encoding by an enhanced encoder and the generation by a codec-specific bitstream parser. The gBSD may also be generated using the BintoBSD parser (cf. Section 3.3), which supports the Schema for BSDL-2 extensions. In the latter approach, a generic bitstream processor (BintoBSD) parses the bitstream using a bitstream-specific schema and an optional formatting XSLT style sheet to generate the gBSD. The XSLT style sheet which is used to transform the BSD generated by the BintoBSD parser into a valid gBSD, is a possible way of giving the gBSD the format that is suitable for the specific adaptations. The XSLT can specify the hierarchical structure and the level of detail of the gBSD and add the marker handles to description elements that could be removed or modified during the adaptation process. This generation method was used to validate and evaluate the gBS Schema approach as described in Section 4.

3.4.2.2. gBSD transformation. An XSLT style sheet may be used to transform the gBSD. The style sheet corresponds to the adaptation option selected by the adaptation decision engine and is input to the gBS Schema-based resource adaptation engine possibly along with input parameters to the XSLT. The changes performed on the description reflect the alterations needed to adapt the bitstream. Some of the most common changes include the removal of syntactical elements (Parameters) or portions of the bitstream (gBSDUnits) and the replacement of the values of bitstream syntactical elements (Parameters). Any other more complicated bitstream operations (e.g. data rearrangement) that can be achieved by transforming the gBSD are also possible.

3.4.2.3. Bitstream generation using gBSD. The gBSDtoBin processor hierarchically parses a gBSD and constructs the corresponding bitstream. The gBSDtoBin uses the addressing information in the description to retrieve the bitstream portions represented by gBSDUnits and it uses the value and datatype of the Parameters to correctly encode these syntactical elements into the bitstream. The gBSDtoBin processor is also responsible to update the addressing attributes that become incorrect after the removal of bitstream elements.

3.4.2.4. Multi-step adaptation. There are cases when a bitstream has to be adapted several times. For example, a JPEG2000 image might need to have its spatial resolution reduced to allow rendering on a PDA screen but it might additionally have to be scaled down in SNR quality to avoid overloading the slow wireless GPRS connection. If the adaptations are to be performed on the same device, e.g. the server, then all adaptations may be applied to the description before it is input to the gBSDtoBin to generate the final adapted bitstream. However, when the adaptations do not take place on the same device, then the bitstream

needs to be generated every time it is transferred from one device to the other, along with its description. It is then required that the description correctly describes the bitstream it references. Therefore, some addressing references in the gBSD might need to be updated during the gBSDtoBin process. A description “correctly describes” a certain bitstream when the gBSDUnits and Parameters of the description refer to actual parts of the bitstream and the addressing (start and length) attributes of the elements point to the correct parts of the bitstream. There is, however, no check on whether the actual values of the syntactical elements in the bitstream are correct with respect to the coding format.

4. Applications of BSDL/gBS Schema: adaptation of JPEG2000 images and MPEG-4 visual elementary streams

Images and videos represent two of the most commonly used multimedia types. JPEG2000 [9] and MPEG-4 Visual [8] are well-known standardised coding formats. Both formats offer various types of scalability and therefore provide suitable test cases for the application of the BSDL/gBS Schema adaptation method. Additionally, an application of BSDL to the MPEG-4 Visual Texture Coding, which also provides scalable features, can be found in [17].

4.1. JPEG2000 images

JPEG2000 [9] is an inherently scalable image coding format. Each JPEG2000 image may be encoded with several types of scalability, including SNR, resolution and colour component. The colour component scalability means that, depending on the colour space, the image may be stripped of one or even all colour components. In order to scale down a JPEG2000 image using any of the three types of scalability, certain packets of the image bitstream need to be removed and some of the header markers need to be modified. The complete adaptation process for a JPEG2000-encoded bitstream named “city.jp2” is described here, first using a BSDL-based approach and then using the gBS Schema method. The bitstream “city.jp2” is an image taken from the MPEG-7 test content set and encoded using a JPEG2000 [9] conformant encoder.

4.1.1. BSDL-based adaptation method

The application of BSDL to a JPEG2000 image is briefly explained here, a more extensive description may be found in [1]. Document 3 shows a fragment of the BSD “city.xml” obtained by running the BintoBSD parser on the “city.jp2” bitstream.

Document 3: Fragment of the “city.xml” BSD

```
<?xml version="1.0"?>
<Codestream xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="JP2" xsi:schemaLocation="JP2 JP2.xsd">
  <MainHeader>
    <SOC>
      <Marker>FF4F</Marker>
    </SOC>
    <SIZ>
      <Marker>FF51</Marker>
      <LMarker>47</Lmarker>
      <Rsiz>0</Rsiz>
```

```

    <Xsiz>768</Xsiz>
    <Ysiz>512</Ysiz>
    <!-- and so on -->
    <Csiz>3</Csiz>
    <!-- and so on -->
  </SIZ>
  <otherSegmentMarkers>
    <!-- and so on -->
    <QCD>
      <Marker>FF5C</Marker>
      <LMarker>35</LMarker>
      <MarkerData>69 33</MarkerData>
    </QCD>
    <!-- and so on -->
  </otherSegmentMarkers>
</MainHeader>
<Tile>
  <!-- and so on -->
  <Bitstream>
    <Packet>
      <SOP>
        <Marker>FF91</Marker>
        <LMarker>4</Lmarker>
        <Nsop>0</Nsop>
      </SOP>
      <PacketData>155 435</PacketData>
    </Packet>
    <!-- and so on -->
  </Bitstream>
</Tile>
<EOC>
  <Marker>FFD9</Marker>
</EOC>
</Codestream>

```

In short, a JPEG2000 bitstream consists of a main header, itself made of several “marker segments”, followed by one or several “tile(s)” containing the payload, i.e. the packets of actual image data resulting from the encoding method. The marker segments give a number of parameters about the image and about the compression method, such as its dimension or the wavelet transformation used. In the JPEG2000 specification, they are referred to as mnemonics such as SIZ for the parameters relating to the image size. In the BSD, the XML elements describing the marker segments or their parameters are named after these mnemonics.

Note that for explanation purposes, all the parameters of the SIZ marker segment have been detailed by the BintoBSD parser (but not all are shown in Document 3), notably the Csiz parameter indicating the number of colour components that will be used by the adaptation process. On the other hand, the QCD marker segment has been left as a “black box” indicating a data segment of 33 bytes with no further details on the included parameters. This example shows that, depending on the application, it is possible to detail some parts of the bitstream and leave some other parts non-detailed.

For simplicity, three different XSLT style sheets have been written for adaptation, corresponding to the three scalability modes used in this application. Document 4 shows the style sheet modifying the SNR quality of the image. The number of data packets is a function of the number of colour components and of decomposition levels, which are indicated by the relevant parameters in the BSD and the number of output layers, which is given as an input parameter to the style sheet. The transformation thus consists of modifying the value of the latter parameter in the BSD and removing the relevant number of packets. An adapted bitstream is then re-generated from the transformed BSD by applying the BSDtoBin parser.

Document 4: XSLT style sheet modifying the number of SNR quality layers of a JPEG2000 bitstream

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:j="JP2" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  version="1.0">
  <xsl:output method="xml" indent="yes"/>
  <!-- Parameter: output number of quality layers, default value = 1 -->
  <xsl:param name="nLayersOut">1</xsl:param>
  <!-- Calculate number of output packets -->
  <xsl:variable name="nResOut">
    <xsl:value-of select="//j:COD/j:SPcod/j:nDecompLevels"/>
  </xsl:variable>
  <xsl:variable name="nCompOut">
    <xsl:value-of select="//j:SIZ/j:Csiz"/>
  </xsl:variable>
  <xsl:variable name="nSOPOut">
    <xsl:value-of select="($nResOut + 1) * $nLayersOut * $nCompOut"/>
  </xsl:variable>
  <xsl:template name="tplAll" match="@*|node()">
    <xsl:copy>
      <xsl:apply-templates select="@*|node()"/>
    </xsl:copy>
  </xsl:template>
  <xsl:template match="j:numLayers">
    <!-- Set numLayers value to nLayersOut -->
    <xsl:copy>
      <xsl:value-of select="$nLayersOut"/>
    </xsl:copy>
  </xsl:template>
  <xsl:template match="j:Bitstream">
    <xsl:copy>
      <!-- do not copy packets with position greater than nSOPOut -->
      <xsl:apply-templates select="j:Packet [position() <= $nSOPOut]"/>
    </xsl:copy>
  </xsl:template>
</xsl:stylesheet>
```

4.1.2. gBS Schema-based adaptation method

The same JPEG2000 bitstream “city.jp2” was parsed using BintobSD and an XSLT style sheet was applied to produce the corresponding gBSD. The style sheet is used to specify the desired level of detail,

hierarchy, and also to mark Parameters and gBSDunits in order to facilitate the adaptation process. A fragment of the gBSD “city.xml” is shown in Document 5.

Document 5: Fragment of the “city.xml” gBSD

```
<?xml version="1.0" encoding="UTF-8"?>
<dia:DIA xmlns="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:dt="urn:mpeg:mpeg21:2003:01-DIA-BasicDatatypes-NS"
  xmlns:gbsd="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:dia="urn:mpeg:mpeg21:2003:01-DIA-NS"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS gBSSchema.xsd urn:mpeg:mpeg21:
2003:01-DIA-BasicDatatypes-NS BasicTypes.xsd">
  <dia:Description xsi:type="gBSDType">
    <Header>
      <ClassificationAlias alias="J2K" href="urn:jpeg:jpeg2000:cs:syntacticalLabels"/>
      <DefaultValues unit="byte" addressMode="Absolute" globalAddress="Content/city.
jp2"/>
    </Header>
    <gBSDUnit syntacticalLabel="J2K:MainHeader" start="0" length="135">
      <gBSDUnit syntacticalLabel="J2K:SOC" start="0" length="2"/>
      <gBSDUnit syntacticalLabel="J2K:SIZ" start="2" length="49">
        <Header>
          <DefaultValues addressMode="Consecutive"/>
        </Header>
        <Parameter name="J2K:Marker" length="2">
          <Value xsi:type="xsd:hexBinary">FF51</Value>
        </Parameter>
        <Parameter name="J2K:Lsiz" length="2">
          <Value xsi:type="xsd:unsignedShort">47</Value>
        </Parameter>
        <Parameter name="J2K:Rsiz" length="2">
          <Value xsi:type="xsd:unsignedShort">0</Value>
        </Parameter>
        <Parameter name="J2K:Xsiz" length="4" marker="R">
          <Value xsi:type="xsd:unsignedInt">768</Value>
        </Parameter>
        <Parameter name="J2K:Ysiz" length="4" marker="R">
          <Value xsi:type="xsd:unsignedInt">512</Value>
        </Parameter>
        <!-- ... and so on (other parameters) ..... -->
        <gBSDUnit syntacticalLabel="J2K:Comp_siz" length="3" marker="C0"/>
        <gBSDUnit syntacticalLabel="J2K:Comp_siz" length="3" marker="C1"/>
        <gBSDUnit syntacticalLabel="J2K:Comp_siz" length="3" marker="C2"/>
        <!-- ... and so on ..... -->
      </gBSDUnit>
      <!-- ... and so on ..... -->
    </gBSDUnit>
  </dia:Description>
</dia:DIA>
```

```

    <gBSDUnit syntacticalLabel=":J2K:COM" start="102" length="33"/>
  </gBSDUnit>
  <!-- ... and so on ..... -->
</dia:Description>
</dia:DIA>

```

This description demonstrates most of the gBS Schema features. The Header, child of the gBSDType Description element, defines the classification alias and its URI as well as the default addressing values which include the location of the bitstream, the mode and unit used for addressing. Subsequently, the hierarchical description of the bitstream syntax follows.

Parameters represent syntactical elements of the bitstream, the values of which might be changed during certain adaptations. Therefore, the numerical value and datatype of these elements are provided through the Value element and the xsi:type attribute. For example, the Parameters with names Xsiz and Ysiz represent the corresponding bitstream elements which specify the spatial resolution of the image. These Parameters need to be adjusted accordingly when the bitstream is scaled down to a lower resolution.

gBSDUnits are used to represent segments of data in the bitstream, as is exemplified by the gBSDUnits with syntacticalLabel J2K:Comp_siz. gBSDUnits are also used to group other gBSDUnits and Parameters, as in the case of the J2K:MainHeader unit.

Note that the gBSDUnit with syntacticalLabel J2K:SIZ has a Header child element that defines a different addressMode attribute. This attribute overrides the addressMode attribute inherited by the gBSDUnit from its ancestors, i.e. the root element. Therefore, the addressMode for all descendants of the J2K:SIZ gBSDUnit is Consecutive.

The names of syntactical elements are also provided (syntacticalLabel in gBSDUnit, name in Parameter). Both of these attributes are optional. The gBSD creator may choose to include them so that the description can be used by adaptation engines that are aware of the encoding format and can adapt the bitstream by using the gBSD as a reference index in order to locate the syntactical elements in the bitstream. These names can be listed in a Classification Scheme, specified in the Header in terms of its URI and the alias used in the gBSD.

Lastly, note that the last three gBSDUnits include a “marker” attribute. The value of the attribute itself is not significant. What is important is the handle that the marker provides to bitstream segments. This handle can provide a link between a description of adaptation options (not given here, typically used by an adaptation decision engine) and the gBSD transformation process. In the example shown, each of the marked gBSDUnits is related to a colour component. Since in this specific image the colour space is YUV, C0 represents luminance, and C1 and C2 represent chrominance. The value of the marker is matched to an adaptation option listed in the metadata describing the content. The marker is also used by the XSLT style sheet to easily identify the elements that need to be changed for a specific adaptation. By marking a description in such a way, possibly offline on a powerful server, the complexity of the adaptation itself may be significantly reduced, which is desirable when the adaptation is expected to take place on a device with limited resources (e.g. network node).

The gBSD was transformed using two XSLT style sheets. The first one removed two of the five quality layers. The second style sheet reduced the spatial resolution from 768×512 to 192×128 pixels. The resulting description “city_adapt.xml” includes the adjusted values for the Parameters and only the gBSDUnits that are needed to produce the adapted version of the image with three quality layers and a resolution of 192×128 pixels.

The adapted image “city_adapt.jp2” was reproduced from the “city_adapt.xml” description and the original image “city.jp2” using the gBSDtoBin process.

The “city_adapt.xml” description was transformed once again using an XSLT style sheet that removes the chrominance to yield a greyscale version of the image. The resulting description “city_adapt2.xml” and

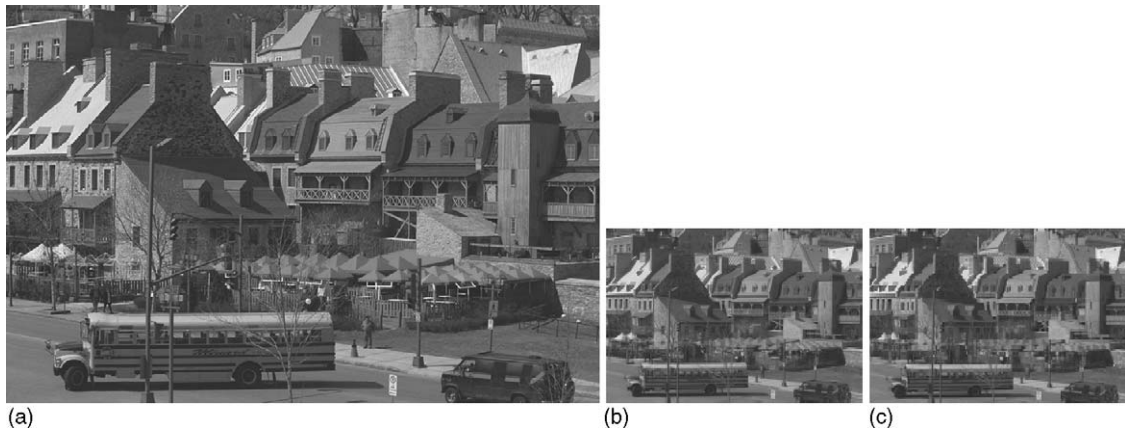


Fig. 4. (a) city.jp2: original image; (b) city_adapt.jp2: SNR, Resolution reduced; (c) city_adapt2 (greyscale): SNR, Resolution reduced, colour components removed.

the “city_adapt.jp2” bitstream were then parsed by gBSDtoBin to produce the final image “city_adapt2.jp2” which is a greyscale image with three quality layers and a resolution of 192×128 pixels.

The three images (city.jp2, city_adapt.jp2, city_adapt2.jp2) are shown in Fig. 4. Images (a) and (b) are in colour, whereas (c) is greyscale.

4.2. MPEG-4 Visual Elementary Streams

MPEG-4 video coding is based on the well-known motion-compensated hybrid DCT coding scheme. Therefore, I-, P- and B-frames are subject to adaptations required, e.g., for temporal scalability. Every MPEG-4 Visual Elementary Stream (MPEG-4 Visual ES) comprises several Video Object Planes (VOPs) classified as different types such as I-, P- and B-VOPs, among others. Each ES is headed by some configuration or header information depending on the ES entry point [8]. The complete hierarchy of an MPEG-4 Visual ES is illustrated in detail in [18]. A famous movie trailer, “Star Wars Episode II—Attack of the Clones”, was selected to demonstrate the BSDL and gBS Schema approaches.

4.2.1. BSDL-based adaptation method

Document 6 shows a fragment of the BSD obtained after applying the BintoBSD parser to an MPEG-4 Visual stream, Advanced Simple Profile. Note that we detail the minimum of information required by the adaptation, namely the parameter vop_coding_type indicating the VOP type (0, 1 and 2 for I-, P- and B-VOPs, respectively).

Document 6: Fragment of an MPEG-4 Visual ES BSD

```
<?xml version="1.0"?>
<Bitstream xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="MPEG4"
  xmlns:mp4="MPEG4" xsi:schemaLocation="MPEG4 MPEG4.xsd" xml:base="Content/starwars.
  cmp">
  <VO>
    <video_object_start_code>00000101</video_object_start_code>
  </VO>
```

```

<VOL>
  <video_object_layer_start_code>00000120</video_object_layer_start_code>
  <VOL_data>8 18</VOL_data>
</VOL>
<VOP>
  <vop_start_code>000001B6</vop_start_code>
  <vop_coding_type>0</vop_coding_type>
  <Stuffing>16</Stuffing>
  <Payload>31 2872</Payload>
</VOP>
<VOP>
  <vop_start_code>000001B6</vop_start_code>
  <vop_coding_type>1</vop_coding_type>
  <Stuffing>17</Stuffing>
  <Payload>2908 59</Payload>
</VOP>
<VOP>
  <vop_start_code>000001B6</vop_start_code>
  <vop_coding_type>2</vop_coding_type>
  <Stuffing>16</Stuffing>
  <Payload>2972 12</Payload>
</VOP>
<!-- and so on -->
</Bitstream>

```

The BSD is then transformed by means of the style sheet shown in Document 7. Note that the transformation is very simple, since it only consists of removing the B-VOPs. The adapted bitstream is then re-generated by the BSDtoBin parser.

Document 7 XSLT style sheet for removing B-VOPs

```

<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform" xmlns:mp4="MPEG4"
  version="1.0">
  <xsl:output method="xml" indent="yes"/>
  <!-- Match all: default template -->
  <xsl:template name="tplAll" match="@*|node() ">
    <xsl:copy><xsl:apply-templates select="@*|node()"/></xsl:copy>
  </xsl:template>
  <!-- Match B.VOP - Overrides tplAll -->
  <xsl:template name="tplB.VOP" match="mp4:VOP[mp4:vop_coding_type=2]"/>
</xsl:stylesheet>

```

4.2.2. gBS Schema-based adaptation method

First, the generic bitstream processor (BintoBSD) is used to generate an intermediate XML representation of the bitstream, a BSD. Second, an XSLT transformation produces a gBSD which is depicted in Document 8. The additional XSLT style sheet adds syntactical labels and the hierarchical

structure, including a “marker” handle designating violent scenes. A description of the syntactical gBS Schema elements can be found in Section 3.4.1.

Document 8: Fragment of an MPEG-4 Visual ES gBSD

```
<?xml version="1.0" encoding="UTF-8"?>
<dia:DIA xmlns="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:dia="urn:mpeg:mpeg21:2003:01-DIA-NS"
  xmlns:gbsd="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS gBSSchema.xsd">
  <dia:Description xsi:type="gBSDType">
    <Header>
      <ClassificationAlias alias="MV4" href="urn:mpeg:mpeg4:video:cs:
syntacticalLabels"/>
      <DefaultValues addressUnit="byte" addressMode="Absolute" globalAddressInfo=
"Content/starwars.cmp"/>
    </Header>
    <gBSDUnit syntacticalLabel="MV4:VO" start="0" length="4"/>
    <gBSDUnit syntacticalLabel="MV4:VOL" start="4" length="22"/>
    <gBSDUnit start="26" length="99983" marker="violent-5">
      <gBSDUnit syntacticalLabel="MV4:I.VOP" start="26" length="2877"/>
      <gBSDUnit syntacticalLabel="MV4:P.VOP" start="2903" length="64"/>
      <gBSDUnit syntacticalLabel="MV4:B.VOP" start="2967" length="17"/>
      <gBSDUnit syntacticalLabel="MV4:B.VOP" start="2984" length="16"/>
      <!--... and so on ... -->
      <gBSDUnit syntacticalLabel="MV4:P.VOP" start="98296" length="1713"/>
    </gBSDUnit>
    <gBSDUnit start="100009" length="68022" marker="violent-5">
      <gBSDUnit syntacticalLabel="MV4:I.VOP" start="100009" length="1825"/>
      <gBSDUnit syntacticalLabel="MV4:P.VOP" start="101834" length="1780"/>
      <!--... and so on ... -->
      <gBSDUnit syntacticalLabel="MV4:I.VOP" start="166802" length="1229"/>
    </gBSDUnit>
    <!--... and so on ... -->
  </dia:Description>
</dia:DIA>
```

A so-called codec-aware adaptation engine that has knowledge about the classification scheme (CS) used to name the syntacticalLabels in the gBSD (in this case an MPEG-4 Visual Elementary Stream CS, specifying MPEG-4 Visual Elementary Stream element names, e.g. I.VOP, P.VOP and B.VOP) carries out the first adaptation. Assuming that the end user’s terminal does not have the capability for decoding B-VOPs, the corresponding gBSDUnits are removed during this adaptation step. The second constraint retrieved from the end user in this example comprises information about user characteristics such as age of the beholder. Due to that fact, the adaptation decision engine decides to remove all gBSDUnits marked as “violent”. An appropriate XSLT style sheet performs each transformation followed by a bitstream generation process which generates an adapted version of the bitstream after each description transformation. Each transformation must ensure to provide a correct bitstream description and

corresponding bitstream for the subsequent adaptation step. This might include additional (XSLT) transformations of the bitstream description after generation of the adapted bitstream—mostly some necessary adjustments of the address information. Specifically the start and length attributes of parents or elements after a removed segment, might need to be updated.

Document 9 exemplifies an XSLT style sheet for the first adaptation step. It comprises two XSLT templates where the first is the default template which copies nodes from the source tree to the result tree without changes. The second template removes all gBSDUnits with syntactical label “:MV4:B_VOP”. Therefore, the template body is empty and nothing is copied from the source tree to the result tree.

Document 9: XSLT style sheet for removing B-VOPs only

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet version="1.0"
  xmlns:gbsd="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:mpeg7="urn:mpeg:mpeg7:schema:2001"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" indent="yes"/>
  <!-- Match all: default template -->
  <xsl:template name="tplAll" match="@*|node()">
    <xsl:copy>
      <xsl:apply-templates select="@*|node()"/>
    </xsl:copy>
  </xsl:template>
  <!-- Match gBSDUnit - Overrides tplAll -->
  <xsl:template name="tplB_VOP" match="gbsd:gBSDUnit[@syntacticalLabel=':MV4:B_VOP']">
    <!-- Do nothing -->
  </xsl:template>
</xsl:stylesheet>
```

In practice, however, XSLT style sheets become more complicated if modifying or removing is carried out in combination with address information adjustments. A fragment of the transformed gBSD is illustrated in Document 10 which is the result of applying the XSLT style sheet from Document 9 on the gBSD from Document 8. Removed gBSDUnits have been replaced with corresponding remarks.

Document 10: Fragment of a transformed MPEG-4 Visual ES gBSD

```
<?xml version="1.0" encoding="UTF-8"?>
<dia:DIA xmlns="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:dia="urn:mpeg:mpeg21:2003:01-DIA-NS"
  xmlns:gbsd="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:mpeg:mpeg21:2003:01-DIA-gBSD-NS gBSSchema.xsd">
  <dia:Description xsi:type="gBSDType">
    <Header>
      <ClassificationAlias alias="MV4"
        href="urn:mpeg:mpeg4:video:cs:syntacticalLabels"/>
      <DefaultValues addressUnit="byte" addressMode="Absolute"
        globalAddressInfo="Content/starwars.cmp"/>
    </Header>
  </dia:Description>
</dia:DIA>
```

```

</Header>
<gBSDUnit syntacticalLabel=":MV4:V0" start="0" length="4"/>
<gBSDUnit syntacticalLabel=":MV4:VOL" start="4" length="22"/>
<gBSDUnit start="26" length="99983" marker="violent-5">
  <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="26" length="2877"/>
  <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="2903" length="64"/>
  <!-- :MV4:B_VOP removed -->
  <!-- :MV4:B_VOP removed -->
  <!--... and so on ... -->
  <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="98296" length="1713"/>
</gBSDUnit>
<gBSDUnit start="100009" length="68022" marker="violent-5">
  <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="100009" length="1825"/>
  <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="101834" length="1780"/>
  <!--... and so on ... -->
  <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="166802" length="1229"/>
</gBSDUnit>
<!--... and so on ... -->
</dia:Description>
</dia:DIA>

```

4.3. Performance measurement

The performance of the BSDL/gBS Schema approach for multimedia resource adaptation was measured for the adaptation sequences described above. The performance was measured with respect to the description size (relative to the resource size) and the processing time for the adaptation of the resource.

4.3.1. Description size

Table 1 summarises the file sizes required for the bitstream descriptions (XML as well as binarised) that were used in the experiments. Table 2 shows the same data after one adaptation step. The data for the XML bitstream descriptions were compressed using the MPEG-7 BiM (Binary Model) codec, with the new string compression functionality ZLib turned on. This functionality is expected to be included in version 2 of MPEG-7 Part 1: Systems [10]. The BSDs could not be compressed with the current implementation of MPEG-7 BiM⁴. It is expected that newer versions of the encoder (starting from version 2) could successfully compress BSDs.

The difference in the XML/Bitstream ratio between the MPEG-4 and JPEG2000 examples is due to the difference in the level of description detail of the two cases. For the adaptation of the MPEG-4 sequence, individual syntactical elements are not modified and therefore not detailed in the descriptions. In the case of JPEG2000 images, however, several elements need to be modified for each type of adaptation and are therefore represented in the descriptions in detail. Note that the size of the description, relative to the resource, is significantly reduced through binarisation.

4.3.2. Processing time

Table 3 shows the processing time (in seconds) measured for each step of one adaptation process. These steps are: BintogBSD (generate BSD from bitstream), BSDtogBSD (XSLT applied to BSD to transform it to

⁴In version 1 of the BiM specification, some XML Schema constructs not used in MPEG-7 are not supported. Accordingly the reference software implementation of BiM does not compress these constructs. It is expected that in version 2 which is currently being standardised, all XML schema constructs will be supported.

Table 1
File sizes of original BSDs and gBSDs for “starwars” and “city” streams

Filename/method	Bitstream size (bytes)	XML descr. size (bytes)	BiM size (bytes)	XML/bitstream	BiM/bitstream
<i>Starwars</i>					
BSD	2,515,959	283,032	—	11.25%	—
gBSD	2,515,959	133,968	12,076	5.32%	0.48%
<i>City</i>					
BSD	240,369	18,088	—	7.53%	—
gBSD	240,369	39,113	3,725	16.27%	1.55%

Table 2
File sizes of adapted BSDs and gBSDs for “starwars” and “city” streams

Filename/ method	Adapted bitstream size (bytes)	Adapted XML description (bytes)	BiM size (bytes)	XML/ bitstream	BiM/bitstream
<i>Starwars</i>					
BSD	1,127,426	94,660	—	8.40%	—
gBSD	1,127,426	44,487	3966	3.95%	0.35%
<i>City</i>					
BSD	151,808	12,917	—	8.51%	—
gBSD	151,808	26,026	2536	17.14%	1.67%

Table 3
Processing times for each step of the adaptation process

Processing step	Proc. time (s)	
	Starwars	City
BintoBSD	5.0	1.6
BSDtogBSD	4.9	2.2
BintogBSD	9.9	3.8
XSLT (BSD)	1.8	1.3
XSLT (gBSD)	1.7	1.6
BSDtoBin	3.6	1.3
gBSDtoBin	6.4	1.4

gBSD), BintogBSD (the aggregated time of the previous two processes), XSLT (application of transformation style sheet to BSD and gBSD), BSDtoBin (parsing of BSD to generate the bitstream) and gBSDtoBin (parsing of gBSD to generate the bitstream). The machine used for this experiment had the following hardware characteristics: Pentium 4, 2 GHz, 512 KB cache, 1 GByte RDRAM.

The description generation is the most time and resource consuming process. This process, however, is expected to take place on the resource provider’s side (most probably on a server) where computing resources will be amply available. In the case of gBSD, in particular, it is anticipated that if the description is properly prepared using the “marker” handle, it can make complex adaptations possible even on low-end devices.

The BSD/gBSD transformation and bitstream generation times vary depending on the length and level of detail in the description. It can be seen that the process for the JPEG2000 image is long relative to the

process for the MPEG-4 sequence, considering that the MPEG-4 bitstream is significantly larger. The reason is the presence of several fine grained syntactical elements in the JPEG2000 bitstream, the values of which are modified during the adaptation and need to be individually encoded into the bitstream (instead of just being copied from the original bitstream).

5. Conclusions

Resource adaptation plays an increasingly important role in the delivery of resources that meet the customer's preferences and constraints. XML technologies provide the tools that facilitate the adaptation of Web content and they are being widely adopted by the multimedia metadata community. In this paper, we presented a concept that uses XML technologies for generic, resource and coding format independent adaptation of multimedia binary resources. The concept is based on the creation of an XML description of the bitstream syntax. This description may be transformed and then be used to generate the adapted version of the bitstream. Two complementary technologies that are based on this concept were described. These technologies can be used independently or complementarily. The flexibility of BSDL allows to automatically produce BSDs from bitstreams in a generic way. On constrained devices, the gBS Schema approach allows efficient implementations of description transformations and adapted bitstream generations. The combined approach described in this paper provides an elegant, flexible and practical solution for adapting multimedia resources.

References

- [1] M. Amielh, S. Devillers, Multimedia Content Adaptation with XML, Proceedings of Eighth International Conference on Multimedia Modeling (MMM'2001), Amsterdam, The Netherlands, November 5–7, 2001, pp. 127–145.
- [2] M. Amielh, S. Devillers, Bitstream Syntax Description Language: Application of XML-Schema to Multimedia Content, Proceedings of the 11th International World Wide Web Conference (WWW 2002), Honolulu, May 6–11, 2002.
- [3] L. Bözörményi, H. Hellwagner, H. Kosch, M. Libsle, S. Podlipnig, Metadata Driven Adaptation in the ADMITS Project, EURASIP Image Commun. J. (Special Issue on Multimedia Adaptation), Fall, 2003.
- [4] Cocoon Framework, <http://xml.apache.org/cocoon/>.
- [5] A. Eleftheriadis, Flavor: A Language for Media Representation, ACM Multimedia Conference, Seattle, WA, November 1997, pp. 1–9.
- [6] D. Hong, A. Eleftheriadis, XFlavor: Bridging Bits and Objects in Media Representation, IEEE International Conference on Multimedia and Expo (ICME2002), Lausanne, Switzerland, August 2002.
- [7] IETF: Protocol-independent Content Negotiation Framework, RFC 2703, September 1999.
- [8] ISO/IEC 14496-2:2001: Information Technology—Generic Coding of Audio–Visual Objects—Part 2: Visual.
- [9] ISO/IEC 15444-1:2000: Information Technology—JPEG 2000 Image Coding System—Part 1: Core Coding System.
- [10] ISO/IEC 15938-1:2002: Information Technology—Multimedia Content Description Interface—Part 1: Systems.
- [11] ISO/IEC 15938-5:2002: Information Technology—Multimedia Content Description Interface—Part 5: Multimedia Description Schemes.
- [12] ISO/IEC 21000-1:2001: Information Technology—Multimedia Framework—Part 1: Vision, Technologies and Strategy.
- [13] ISO/IEC 21000-2:2002: Information Technology—Multimedia Framework—Part 2: Digital Item Declaration.
- [14] ISO/IEC JTC 1/SC 29/WG 11: MPEG-21 Digital Item Adaptation Application Model v6.0. Document N5846, Trondheim, Norway, July 2003.
- [15] ISO/IEC JTC 1/SC 29/WG 11: MPEG-21 Use Case Scenario Document, Document N4991, Klagenfurt, Austria, July 2002.
- [16] ISO/IEC JTC 1/SC 29/WG 11: MPEG-21 Digital Item Adaptation Final Committee Draft. Document N5845, Trondheim, Norway, July 2003, http://www.chiariglione.org/mpeg/working_documents.htm#MPEG-21.
- [17] R. Osorio, S. Devillers, E. Delfosse, M. Amielh, G. Lafruit, Bitstream Syntax Description Language for 3D MPEG-4 View-dependent Texture Streaming, IEEE 2002 International Conference on Image Processing (ICIP 2002), Rochester, September 22–25, 2002.
- [18] F. Pereira, T. Ebrahimi (Eds.), The MPEG-4 Book, Prentice-Hall PTR, Englewood Cliffs, NJ, 2002.

- [19] W3C: XSL Transformations (XSLT), Version 1.0, W3C Recommendation, November 16, 1999, <http://www.w3.org/TR/xslt>.
- [20] W3C: Extensible Markup Language (XML) 1.0, 2nd Edition, W3C Recommendation, October 6, 2000, <http://www.w3.org/TR/2000/REC-xml-20001006>.
- [21] W3C: Composite Capability/Preference Profiles (CC/PP): Structure and Vocabularies. W3C Working Draft, March 15, 2001, <http://www.w3.org/TR/CCPP-struct-vocab/>.
- [22] W3C: XML-Schema. Part 0: Primer. Part 1: Structures. Part 2: Datatypes. W3C Recommendations, May 2, 2001, <http://www.w3.org/XML/Schema>.
- [23] WAP Forum: User Agent Profile Specification, Wireless Application Protocol Forum, November 10, 1999, <http://www.wapforum.org/>.