Exhibit B

IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

SAN FRANCISCO DIVISION

APPLE COMPUTER, INC.,)
Plaintiff/Counterdefendant,)
)
vs.) CASE NO. C06-00019 MHP
)
BURST.COM, INC.,)
Defendant/Counterclaimant.)

ORAL VIDEOTAPED DEPOSITION

SHEILA HEMAMI

SEPTEMBER 4, 2007

VOLUME 2

ORAL VIDEOTAPED DEPOSITION OF SHEILA HEMAMI, produced as a witness at the instance of the Plaintiff and duly sworn, was taken in the above-styled and numbered cause on the 4th day of September, 2007, from 8:22 a.m. to 2:03 p.m., before Dana Richardson, Certified Shorthand Reporter in and for the State of Texas, reported by computerized stenotype machine at the offices of Weil, Gotshal & Manges, L.L.P., 700 Louisiana, Suite 1600, Houston, Texas 77002, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto.

Job No. 1601-84301

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APPEARANCES

FOR PLAINTIFF:
Mr. Garland T. Stephens
WEIL, GOTSHAL & MANGES, L.L.P.
700 Louisiana, Suite 1600
Houston, Texas 77002
Telephone: (713) 546-5044 - Fax: (713) 224-9511
E-mail: garland.stephens@weil.com
-and-
Ms. Jayna Whitt - (via telephone)
APPLE, INC.
1 Infinite Loop, MS 3-PAT
Cupertino, CA 95014
Telephone: (408) 974-4262
E-mail: jwhitt@apple.com

FOR DEFENDANT:

Mr. Leslie V. Payne
HEIM, PAYNE & CHORUSH, L.L.P.
600 Travis Street, Suite 6710
Houston, Texas 77002
Telephone: (713) 221-2003 - Fax: (713) 221-2021
E-mail: lpayne@hpellp.com

ALSO PRESENT:
Mr. George White, Videographer

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EXHIBITS

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THE VIDEOGRAPHER: Beginning the deposition of Sheila Hemami. It is the 4th of September, year 2007. The time is 8:22. We're on the record.

If the attorneys want to introduce themselves for the record, then we can swear in the witness and go.

MR. STEPHENS: Garland Stephens of Weil, Gotshal & Manges representing the plaintiff, Apple.

MR. PAYNE: Les Payne for defendant, Burst.

MR. STEPHENS: I should also mention that present monitoring the deposition on the phone is Jayna Whitt, in-house counsel for Apple.

SHEILA HEMAMI,

having been first duly sworn, testified as follows:

EXAMINATION

BY MR. STEPHENS:

Q. Good morning, Dr. Hemami.

A. Morning.

Q. I'd like to ask you first about your opinion about the person of ordinary skill in the art as it relates to the patents in this lawsuit. You summarized that opinion in declarations that you filed in support of Burst's opposition to Apple's motions for summary judgment; is that right?

A. I think it only appeared in the second declaration. It certainly was in the second.

Q. Okay. Now, one of the things that you said is that a

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person of ordinary skill in the art at the time of the patent application leading to the '995 patent was filed would have had an understanding of digital communications technologies and their available bandwidths and audio and/or video compression techniques. Do you remember that?

A. Yes.

Q. What kind of digital communications technologies and available bandwidths would a person of ordinary skill in the art at the time the '995 patent application was filed have?

A. So, the digital communication techniques that I had in mind were -- let me start off by sort of giving a -- a very general classification. One would be the types of digital communication techniques that one would learn about in, say, an undergraduate overview course on digital communication. So, various modulation strategies for over-the-air communication, terrestrial and satellite; assorted air control coding that might go with those techniques; and essentially, at a lower level, digital signalling strategies. For example, understanding the PCM in the context of digital communication was a modulation technique. I believe that such a person would also be aware of the various types of landline or cables, physical media, rather than over-the-air propagation media for digital communication, including both copper wire and also fiber optic. So, I guess following up on that, one would understand, one would know available bandwidths, the --

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08:25:07 1 the general availability of these techniques, meaning how
08:25:11 2 would one go about obtaining them or from what service
08:25:15 3 providers would one contract, this type of thing.
08:25:20 4 Q. Okay. So, I'd like to explore that in a little bit
08:25:23 5 more detail. When you talk about physical media for
08:25:27 6 land-based communications, like copper wire, fiber optic and
08:25:33 7 the available bandwidths, would that include, for example,
08:25:37 8 Ethernet?
08:25:38 9 A. I believe that such a person would definitely have an
08:25:4010 understanding of Ethernet. That certainly doesn't fall in the
08:25:4411 category of classical digital communication techniques that I
08:25:4812 studied, but I think one of skill in the art would certainly
08:25:5213 be aware -- aware of that.
08:25:5314 Q. And what bandwidths would a person of ordinary skill
08:25:5615 in the art understand to be associated with Ethernet?
08:26:0116 A. At that time period, the Ethernet range was between 1
08:26:0517 and 10 megabit per second.
08:26:0718 Q. And with respect to copper wire, what kinds of
08:26:1719 communications facilities would a person of ordinary skill in
08:26:2220 the art understand to have been available?
08:26:2521 A. For digital communication in that time frame, ISDN,
08:26:3222 Integrated Services Digital Network, which I -- I believe I
08:26:3523 mentioned in my claim construction report, was seen as a
08:26:4324 up-and-coming or near-future technology that would be broadly
08:26:4925 available to consumers or -- when I say "consumers," I mean

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08:26:53 1 end users, not necessarily -- it wasn't something that sat in
08:26:57 2 the middle of a telecommunications system that the system
08:27:00 3 implementer would only have access to. It would be something
08:27:03 4 that residential and business customers would -- would have
08:27:06 5 access to.
08:27:07 6 Q. Okay. Other than ISDN, what other kinds of
08:27:11 7 communications facilities would a person of ordinary skill in
08:27:14 8 the art understand to be available over copper wire?
08:27:17 9 A. Based on my recollection now, that is the predominant
08:27:2510 digital signalling strategy that I considered that was --
08:27:2711 would be seen as future -- broadly available in the future.
08:27:3112 So, people were designing for it even though you couldn't
08:27:3313 necessarily pick up the phone and call the phone company
08:27:3614 and -- and sign up for it at the time.
08:27:3915 Q. Okay. Would they have been -- would they have been
08:27:4516 aware of, for example, modems?
08:27:4717 A. Oh, yes, of course.
08:27:5218 Q. And what about the higher bandwidths offering that
08:27:5819 large telecommunications companies made available, for
08:28:0220 example, T1 and other types of digital communications lines?
08:28:0821 A. So -- I -- I believe that such a person would know
08:28:1022 that it -- these T1 lines were available to -- I should say
08:28:1523 these T1 lines were -- or T1 and similar lines, potentially
08:28:2224 the aggregate lines that had the higher bandwidths, would be
08:28:2625 available to -- I think it's fair to say business customers,

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08:28:32 1 were they to contract with the -- the service providers. I
08:28:38 2 don't know at the time if it was possible for a person in
08:28:40 3 their home to call up the phone company and -- and get a T1
08:28:47 4 line.
08:28:48 5 Q. But if a large company, for example, wanted a T1
08:28:51 6 line, they could get one from AT&T at the time?
08:28:54 7 A. That -- that is my understanding, yes.
08:28:56 8 Q. And a person of ordinary skill in the art would have
08:28:58 9 understood that?
08:29:0010 A. I do believe that, yes.
08:29:0711 Q. Okay. Any other kinds of communications facilities
08:29:1112 over copper wire that a person of ordinary skill in the art
08:29:1513 would have understood at the relevant time?
08:29:1614 A. Let me just clarify something, going back to --
08:29:1815 you -- you had pointed out modems, which I had omitted. And
08:29:2216 certainly modems were used for -- were and still are used for
08:29:2517 digital transmission but using analog signalling. Just to
08:29:2818 clarify, one does not need a digital facility in order to use
08:29:3319 a modem. One essentially forces what's own -- one's own
08:29:3620 digital facility over the -- over the analog line.
08:29:3921 Q. That raises an interesting point. I think in the
08:29:4222 tutorial, you said that systems designers weren't really
08:29:4523 concerned with the details of the transmission medium. Do you
08:29:4924 recall that?
08:29:5025 A. Certainly somebody -- yes, I do. One is -- who is

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08:29:52 1 designing a system -- I think I was using that in the context,
08:29:56 2 perhaps, of referring to the communication link or the pipe.
08:29:58 3 And the -- the description of the pipe simply involves a
08:30:04 4 bandwidth and potentially the error rate or quality of
08:30:08 5 service.
08:30:08 6 Q. And that would apply to all these different types of
08:30:11 7 communications media we've been talking about, right?
08:30:13 8 A. Certainly for -- for all the media, the system
08:30:15 9 designer could walk around to the other side of the cable or
08:30:1810 whatever the connection is and completely characterize that
08:30:2211 connection that he or she was going to use by the -- the
08:30:2512 relevant transmission characteristics that they were
08:30:2813 interested in for their application, absolutely.
08:30:3114 Q. And that would apply to modems as well as things that
08:30:3615 were digital from end to end; is that right?
08:30:3816 A. Yes. Yes. Well, you know, I guess when we look at
08:30:4117 it that way, of course, you feed the modem digital
08:30:4418 information, you feed the other lines digital information.
08:30:4719 So, it's really what happens on the other side of the --
08:30:4920 Q. And then the modem digital information comes out the
08:30:5121 other end, right?
08:30:5422 A. It comes -- well, it depends what you define the
08:30:5423 "other end" as. Clearly the modem is transmitting to another
08:30:5724 modem which receives the modulated analog signal and -- that's
08:31:0025 the "dem" part of the modem -- and demodulates it back to a --

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a digital signal which it deliveries to its connection.
Q. Okay. And, so, a system designer wouldn't really care about the physical level signalling. All they'd really care about is what kind of bandwidth can I get from the input port to the output port, right?
A. Given that the terms "input port" and "output port" have meaning in this case, I feel a little bit more comfortable if we just sort of call it the -- the link. What -- what kind of -- I think you mentioned bandwidth. There's a secondary issue which is generally of concern which we haven't spoken about much in this case because I think it's not particularly relevant; but just for -- for completeness, the quality of service is also important. Obviously if somebody's trying to sell me a 1 megabit-per-second connection and one out of every two bits is going to be wrong, that doesn't do me a whole lot of good.
Q. Sure. But one of ordinary skill in the art would have understood that with an intermediate error correction protocol, you could trade off the available bandwidth for error correction, right?
A. In -- intermediate, I think that's something that the system designer would have to put in -- into their system. But, yes, that is the whole point of error-correcting --
Q. Okay.
A. -- error-correcting protocols -- or I should say

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error-correcting codes.
Q. Now, you -- well, I just want to make sure I've got completeness on the copper wire part. Are there any other facilities that a person of ordinary skill at the relevant time would have understood to be available over copper wire besides the ISDN modems and T1 and related facilities?
A. Now, here, when you say "copper wire," can you --
Q. Well, that was your term. I -- I --
A. Okay. So -- so, copper wire with respect to ISDN and modems, I was specifically thinking of the public switched telephone network which was -- which was installed. Obviously we could go buy copper wire at the hardware store and -- and switch it however we wanted. So, drawing upon my memory right now -- and I have to say I have not reviewed these items in detail -- I think that we have covered a fair chunk of them.
Q. Okay. Now, Ethernet would be a sort of flavor of copper wire transmission; is that fair to say?
A. Well, certainly, yeah, I think, colloquially, we could call it copper wire. It's certainly not -- you know, our Ethernet cables are not fiber.
Q. Yes. And at the prime, they were probably more often coaxial cable than a twisted pair of copper; is that right?
A. I believe that they were both used at the time, but, yes.
Q. Okay. Now, you mentioned ISDN. That was available

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in a primary rate and a basic rate; is that right?
A. There were -- well, "available" is a -- what did you say, there were available, that was -- that's a generous term. I think that perhaps we should talk about ISDN in terms of what the designers envisioned because the actual implementation of ISDN varied widely, I think, both in the US and also overseas. So, speaking from the standpoint of the system architects, meaning the groups that standardized or got together and tried to put together the whole protocol and -- and so on and so forth, there were basic rate interface which was envisioned as what were called two B lines plus one D line and primary rate interface which was a much greater number of B lines -- but I think that number varied depending on Japan, Europe and the US -- and a signalling D line. I don't have the -- the greater number off the top of my head, but it is double digit.
Q. Okay. Does 26 ring a bell for the United States?
A. It doesn't ring a bell; but I would believe that, if you told me it was true.
Q. Okay. And there was a difference in the bandwidth for the D line between primary rate interface and basic rate interface, correct?
A. That's right. The basic rate interface D channel bandwidth was 16 kilobits per second, and the primary rate interface was 64 kilobits per second.

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Q. On the D line?
A. On the D line, that's right, on the signalling channel.
Q. And for the B lines on both, it was 64 kilobits per second, right?
A. Yes.
Q. What's the relationship between ISDN and T1?
A. My understanding is that there is no relationship.
Q. All right. Did -- did T1 sometimes consist of a plurality of B channels?
A. Well, T1 was partitioned into 64 kilobit-per-second channels. So, it's total bandwidth was 1.544 megabit per second. Some of that was used for framing, essentially synchronization bits, so that the system continued to actually read the ones and zeros out as they were put on. Now, off the top of my head, I don't recall what percentage. I think every 193rd bit may have been a framing bit.
But T1 consisted of some integer number of 64 kilobit-per-second channels; and the origin of the 64 kilobit-per-second was, of course, the spoken voice system. PCM, pulse-coded modulated speech for the phone system, was 8,000 samples per second at 8 bits per sample. So, because T1 was sort of developed as part of the -- the phone system, it was logical to partition it into these 64 kilobit-per-second channels.

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Now, as far as the T1 line is concerned, bits are just bits. So, whether you put a phone conversation into one of those slots or a B channel from ISDN onto one of those slots is transparent to the signalling equipment.
Q. So, one of ordinary skill in the art at the appropriate time would have understood that you could map ISDN on to a T1; is that right?
A. I guess I'm not sure what you mean by "map."
Q. Well, let me phrase it differently. Would it have been a reasonable thing to do, to use a T1 line to deliver a primary rate interface ISDN channel?
A. I don't know if that was done. I just don't know.
Q. Okay. What is a T1?
A. T1 is the acronym that was created by AT&T in contrast to E1, which used twice the rate in Europe, for essentially long-distance, high-speed multiplexing of spoken voice. So, this -- these lines were at, as I mentioned, 1.544 megabit per second. And at origin, my understanding is that, I think, we as an average phone user would not see a T1 line or know a T1 line or even need to know what a T1 line is. It was something that was buried deep inside the phone system as operated by AT&T for their long-distance, high-speed trunking.
Q. And it was one of the primary means for delivering phone calls; is that right?

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A. Well, certainly for great distance transmission, getting phone calls from Point A to Point B. At some point, they came from the home or point of origin to a switching office to a central office. At some point, they got on a -- a common carrier or a -- or a T1 line. In 1988 -- at what point T1 was used for more or less local transmission, I don't know. So, in other words, within Houston, I don't know in 1988 if you would find T1 lines within Houston or if that would be something that would run from Houston to Dallas.
Q. I see. So, in 1988, you may not use a T1 line on a normal phone call within Houston; but there was a fairly high likelihood that you would use a T1 line or some higher rate line if you made a phone call from Houston to Dallas; is that right?
MR. PAYNE: Objection, form.
A. I think that based on my knowledge of T1 use at the time, what you said is accurate. Now, I -- I could go look this up and verify that I was either right or wrong, but my understanding now is that that would be the case and I don't know to what extent T1 penetration had -- at what lower level closer to the user end it had gone.
Q. (By Mr. Stephens) Okay. But the large switches that were used to switch telephone calls between users directly supported T1; is that right?
A. I don't know that for a fact.

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Q. So, you don't know, for example, whether the AT&T 5ESS switch supported T1 interface cards?
A. I can tell you that at some point I did know the answer to that; but right now, I can't tell you that.
Q. Okay. Is it your expectation that it would?
A. If you would give me a little bit of technical information on that switch, I could read it and probably make a reasonable guess.
Q. Okay.
A. Simply stringing numbers together, I couldn't tell you.
Q. All right. Fair enough. So, do I understand correctly, then, that the ISDN B channels had the same bandwidth as a partition of a T1, then; is that right?
A. In terms of the T1 being set up to multiplex multiple 64-kilobit-per-second calls, sure.
Q. Okay. And that would also be true for the primary rate ISDN D line, also 64 kilobits per second just like a T1 partition, right?
A. It's a 64-kilobit-per-second channel. So, being at 64, certainly it could be directly mapped to a -- "mapped" is not a good word, but we don't seem to have a good alternative -- directly transmitted over one of the appropriate slots on a -- on a T1 line.
Q. Okay. So, one of ordinary skill in the art at the

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time would understand that you could use T1 partitions to deliver the B and D channels from a primary rate interface ISDN connection, right?
A. Well, deliver to where? Can you clarify that?
Q. Yeah. Deliver to the other end of the channel.
A. Which channel?
Q. The collection of channels that make up the primary rate interface.
A. Can I ask you to start over again? I think --
Q. Yeah. Okay. So, let me see if I can --
A. Put that all together.
Q. Let me try to put it all together. So, if -- would one of ordinary skill in the art have understood that a telecommunications carrier could use T1 facilities to make a primary rate interface ISDN line available to one of its subscribers?
A. I don't know -- so, I'm going to attempt to rephrase what I think you're asking; and please correct me if I -- if I've misunderstood. I don't know if the service providers -- for one, I don't know that primary rate interface was actually ever delivered to anybody. But notwithstanding that, I don't know if the service providers envisioned providing the primary rate interface by simply sticking a T1 line -- making it available at the point of connection or whether they envisioned some intermediate connection. I don't know that.

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Q. But either was possible, right?
A. Well, many, many things could be possible; but from the standpoint of the -- the service providers, I don't know if they would consider that possible or not. This -- it may or may not have involved laying a lot of extra cable, and I think we know from sort of practice and common sense that any installation that involves substantial upgrade of an existing communication infrastructure in the country is not a trivial operation.
Q. And, yet, that's something that's been done on an ongoing basis from the time that the first telegraph lines were laid in the mid 19th century, right? There's been a continual process of upgrading the data rates -- or bandwidth, maybe, is a better term -- of the -- the physical communications infrastructure in the United States, right?
A. I think, perhaps, I misspoke; and I just have to inject a little piece of information here. It was Ezra Cornell who actually developed the technique for simultaneously laying the lines and digging the trench, and that's why he made all the money and Samuel Morris did not.
So, let me clarify what I meant. Certainly if we look at the initial phone system and the -- the current phone system, we have just tremendous improvement since -- since Day 1. However, I'm referring here to, perhaps, a major infrastructure replacement. So, let me give an example, maybe

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through use of a counter-example.
The reason that ISDN was so anticipated was that if we think about the -- the state of phone service to homes in the United States, homes, business, really, any entity that had a telephone in the US in 1988 and even today, the vast majority of those connections are analog -- analog connections connecting to analog equipment at both ends and copper wire. We can see that in the basement, if you go look at -- if you have an older home, go look at the equipment there. ISDN was really a big deal. People really looked forward to it, started designing all kinds of -- of applications and -- and coming up with things that could be done over it because it provided high-speed digital service to the home over existing infrastructure. There was no need for the phone company or any other service provider to go out and take every single home and re-cable things. Now, ISDN never quite caught on because DSL -- and then later we see cable modem -- came in, and DSL offered high-speed digital connections over the same analog phone line.
Q. Okay. But I want to go back to my other question. You would agree, I -- I think, that -- correct me if I'm wrong. "Would you agree" is a better way to put it. Would you agree that since the laying of the first telegraph cables in the mid 19th century, the telecommunications infrastructure in the United States has undergone a process of constant

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improvement in the bandwidth that was available over the -- that infrastructure?
A. I don't know if I would say the improvement was constant. I suspect that if we go back and -- and -- and lay it all out -- and I think that Steve Wicker's freshman notes probably would do a good job of doing this -- probably it's -- it's much more of a step function as opposed to constant, where as new technologies were developed that required a substantial replacement of a large amount of infrastructure, at some point the decision was made to go ahead and do that. Now, that's clearly not an instantaneous thing. It's not that one day, all of a sudden everybody has a different type of connection. But I -- I don't think that we would see constant same-rate changes over the entire time period for upgrading, for lack of a better word, of the system.
Q. Well, I didn't mean to imply that they happened at a steady rate. In fact, if anything, the rates been accelerating, right?
A. I'm not sure if I -- I think that -- people having no communication to some communication was probably the biggest jump that was ever done, and it's -- I think I would argue, too, that going from Morse to speech to something that one hears and speaks probably is also a quantum leap relative to -- to anything that -- that we have done since. But I think that -- that the point we're arguing is a little bit

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esoteric. Certainly the system has improved, but I think that it -- it --
Q. Maybe I can ask a different question. Maybe that will help.
A. Let's try that.
Q. Is it fair to say that since the inception of the telephone system in the early 20th century or late 19th century, that there have been large numbers of engineers working to increase the bandwidth of the telecommunications infrastructure in the United States?
A. The word "large" being somewhat unquantifiable, I think that's a fair statement.
Q. Okay.
A. I mean, certainly a lot of engineers were employed by both AT&T and the subsequent spinoffs of -- of companies.
Q. And based on that fact alone, it has been foreseeable through that entire period that there would be periodic increases in the bandwidth available over the telecommunications infrastructure in this country, right?
A. I -- I don't think I would agree with that. For many years, engineers believed that they had reached the upper limit of what could be done over the analog phone line. So, I -- I would not say that -- that -- we always constantly assume that there will be tremendous improvements ahead. I think there certainly have been times where people have

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thought this is really -- we've hit the fundamental, theoretical limit of what can be done.

Q. Well, you're talking about the fundamental, theoretical limit of what can be done over one pair of copper wires, right?

A. Well, I'm giving an example; but I don't think that that's the only -- the only situation where people have said, "Oh, we've really banged up against the top, and we can't improve things anymore."

Q. So, can you identify for me a situation where people have said, "Oh, it's not possible to send information faster than a particular rate"?

A. Well --

Q. And I don't mean over a twisted pair of copper wires or a single fiber. I mean from Point A to Point B through any means.

MR. PAYNE: Objection, form.

A. I'm not sure right now, over the -- off the top of my head, I can draw out any particular example. But I'm sure that these exist. I mean, some media just have physical limits that are seen as insurmountable.

Q. (By Mr. Stephens) Again, my question is not about a single media. It certainly has been well understood for a very long time that you could increase the bandwidth by putting parallel media together, right?

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A. I'm sorry, when I said "single media," I meant just the physical characteristics of whatever it is you're trying to transmit over, whether you're going in parallel or -- I mean, you know, that's sort of a -- I wouldn't -- I wouldn't have included that in -- you know, I don't think somebody coming up and saying, "Hey, you could put two of those."

"Oh, my gosh, you're right."

You know, I -- I wouldn't count that as a fundamental block or breakthrough either.

Q. Okay. That's what I'm getting at. That's been known for a very long time, right, that if you can only send data over a given wire at a certain rate, you can put two down and then send twice as much data, right?

A. From a hypothetical standpoint, two is always going to be greater than -- twice as much as one. From a practical standpoint, you may or may not be able to obtain a second channel. It may require physical installation of the second channel. It may be a case of satellite transponders where there just are no more transponders to be purchased or -- or there's no more capacity in the sky. So, from a theoretical standpoint, certainly on a sophomore quiz, if they said, "Put two lines in parallel," that's always a valid answer. I think when we go to actual systems, we're -- we're often hit with constraints that sometimes don't allow such a solution.

Q. Well, those constraints can be overcome, generally, right? You -- you can lay a second cable. You might have to pay a lot of money to do it; but you can do that, right?

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A. Well --

MR. PAYNE: Objection, form.

A. -- this is -- I mean, we're completely sort of discussing this whole thing in the Ether. There's no specific example. You can always lay a second cable. And to -- to make generalizations like that, you know, I think is -- is okay at a very abstract level; but it doesn't necessarily give us any insight as to whether for any particular engineering problem or design solution that turns out to be a valid solution.

Q. (By Mr. Stephens) Okay. Well, I take it, though, from your testimony, that certainly in the mid Eighties it was widely expected that ISDN would deliver a significant increase in the digital bandwidth available to the typical consumer, correct?

A. I think that's a fair statement, yes. Yes.

Q. Okay.

A. That was expected. Yet another great engineering nondelivery.

Q. Well, it was not delivered because something better came along, DSL, right?

A. Well, we as engineers are very poor at predicting the market. That's been shown time and time again.

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Q. Okay. So, we've talked about copper wire. You also mentioned fiber optic as a physical media for land transmission. What would one of ordinary skill at the relevant time have understood to be available or expected in the way of fiber optic facilities?

A. So, for this, I don't have those numbers off the top of my head; but I will say they are in my claim construction report on -- under the section that describes what was available for fiber optic at the time.

Q. Okay.

A. It lays out, also, the progression of how the bandwidths had increased and -- and what had been tested and what was coming.

Q. Do -- do you remember, sort of, order of magnitude?

A. Oh, it was with a "g." These were giga -- gigabits per second.

Q. Now, you also mentioned in your declaration that a person of ordinary skill would have had an understanding of audio and/or video compression techniques. What would a person of ordinary skill have understood about audio and/or video compression techniques at the relevant time?

A. So, one of ordinary skill, first, would have understood the -- the fundamental characteristics of the signal. That audio signal is inherently a one-dimensional signal. Certainly if it's stereo, it's two-channel; but we

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08:55:13 1 still consider it a -- a one-dimensional signal. It -- it is
08:55:15 2 only a signal that varies with time. One of ordinary skill
08:55:19 3 who dealt with audio compression would understand the general
08:55:24 4 statistical characteristics of audio signals and the
08:55:29 5 differences between the various types of audio signals that
08:55:34 6 one might be interested in compressing. One large difference
08:55:40 7 which I've addressed quite a bit is certainly the difference
08:55:44 8 between speech or voice and wideband audio; so, a very
08:55:49 9 specialized signal, which would be speech, as opposed to a far
08:55:5310 more general signal encompassing what is generally considered
08:55:5611 to be an entire range of human hearing up to -- up to
08:56:0012 20 kilohertz. And I think, also, one would understand general
08:56:0513 processing techniques that were reasonable given the
08:56:0914 statistical characteristics of the signal and also the way
08:56:1315 that the -- the human ear perceives sound.
08:56:2016 For video, one of ordinary skill would
08:56:2517 understand the similar items but as they pertain to video.
08:56:3218 That video is a -- a three-dimensional signal that varies with
08:56:3719 both space and time. One of ordinary skill would understand
08:56:4320 the different formats in which raw or uncompressed video could
08:56:5021 be represented and the implications that those formats might
08:56:5322 have on the representation, compression and processing of the
08:56:5823 video, statistical characteristics of the signal -- again --
08:57:0324 and I -- the term "statistical characteristics" is something I
08:57:0825 use to describe both of these signals. The -- what one would

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08:57:13 1 understand of those characteristics, obviously, would be very
08:57:15 2 different for both audio and video -- appropriate strategies
08:57:20 3 for processing, preprocessing and processing and compressing
08:57:25 4 both the video, including various mathematical techniques, and
08:57:30 5 a little bit, also, about how we see and how quality of the
08:57:38 6 video signal might be quantified.
08:57:41 7 Let me back up. Similarly for audio, there
08:57:44 8 would be an understanding with -- with respect to quality.
08:57:48 9 When we talk about compression, I can compress any signal to
08:57:5410 any size. The resulting output may be completely unsuitable
08:57:5811 for anybody or anything. So, there's always a -- a
08:58:0312 understanding that one has to consider, what is, very
08:58:0713 colloquially here, I'm referring to, is the quality of the
08:58:1114 output signals. Is the output signal suitable for the purpose
08:58:1715 for which it was designed or advertised?
08:58:2016 Let me add one thing that would be common to
08:58:2317 both of these skill sets as well, and that would be an
08:58:2718 understanding of various noise lists or entropy coding
08:58:3219 techniques, essentially bit compaction techniques. Once you
08:58:3520 have a sequence of bits, can you make them smaller?
08:58:4021 Q. Anything else?
08:58:4122 A. I'm sure more things will come to me, but I think
08:58:4423 that's a good list for starters.
08:58:4624 Q. Okay. Now, you mentioned that you can compress any
08:58:4925 signal to any size. And I took that to mean that you were

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08:58:52 1 implying that quality is important because of that; is that
08:58:55 2 right?
08:58:55 3 A. Yeah. I mean, an example would be, you know, purely
08:58:58 4 from a theoretical standpoint -- this goes back to what I said
08:59:02 5 before about arguing things from a theoretical standpoint -- I
08:59:06 6 could take a picture of what I see here, you and the
08:59:09 7 videographer and the equipment and everything outside; and I
08:59:12 8 could compress that image, which clearly has a lot of content
08:59:16 9 and information in it, to a single number. Now, a reasonable
08:59:1910 choice would be the average pixel value of everything here.
08:59:2311 And from a rate distortion standpoint -- that is, how many
08:59:2612 bits you're spending for how much distortion you get -- that
08:59:2913 is one point on the rate distortion curve; and I can certainly
08:59:3314 calculate the distortion. It's going to be very large, but
08:59:3715 it's a -- it's a fair theoretical representation. If you want
08:59:4116 this giant distortion, here's the representation of the image.
08:59:4517 Now, that image, it wouldn't even be considered
08:59:4718 an image to anybody except for me, the theoretical compression
08:59:5019 person. So, this is an extreme example, but you -- we could
08:59:5620 consider backing that image up to a point where at some point
08:59:5921 it's decided that that picture is an adequate representation
09:00:0222 of what I saw here today in front of me as opposed to some
09:00:0623 theoretical representation, which doesn't provide anybody any
09:00:0924 information whatsoever. And -- and what is enough is a
09:00:1425 function of the application. If the answer -- if the point of

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09:00:16 1 the picture is to answer the question, how many humans were in
09:00:20 2 my field of view, it doesn't have to be very good. If the
09:00:23 3 question was, how many cars were on the highway, we need a
09:00:26 4 much higher quality image.
09:00:29 5 Q. Okay. I guess what I was getting at was: Is that
09:00:30 6 something that a person of ordinary skill in the art would
09:00:34 7 have understood at the relevant time?
09:00:36 8 A. Yes. Yes.
09:00:37 9 Q. Okay.
09:00:3810 A. This is sort of a fundamental aspect of -- of
09:00:3911 compression.
09:00:4112 Q. Okay. So, a person of ordinary skill in the art at
09:00:4413 the time would have understood that it's possible to compress
09:00:4614 any signal to any size but that you have to take into account
09:00:4915 the quality that you need for your particular application; is
09:00:5216 that right?
09:00:5317 A. Yes. The -- the average person on the street may not
09:00:5518 accept what you've provided as compression and may, instead,
09:00:5819 call it garbage.
09:01:0120 Q. Okay. Now, are there specific audio compression
09:01:0921 techniques that a person of ordinary skill in the art would
09:01:1222 have been aware of?
09:01:1423 A. So, what type of audio are you referring to here?
09:01:1724 Q. Well, let's talk -- well, first of all, would you
09:01:2225 agree that the word "audio" includes both speech and what you

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refer to as wideband audio?
A. Well, it depends what we're -- in the context of what -- I think in the context of what we're -- the litigation that's going on, I would like to delineate wideband audio from speech or narrowband audio and the -- you know, if we can agree on a definition for the term "audio," then --
Q. Well, let's say, for the moment, that I'm just asking about how a person of ordinary skill would use the word "audio" at the relevant time. Would that person have understood the word "audio" to include -- to be a generic term that would include both speech and wideband audio?
A. I think that person would have required clarification as to what the context of the term was. Clearly, you know, there would be a sentence around it. They might be working at some firm that specifically dealt with voice coding strategies or wideband audio compression strategies. So, within that context, I think they would have an understanding of what it was. But were you to just ask somebody, "Well, do you do audio compression, and what do you work on," at some point, they would delineate whether they are a speech coding -- what we colloquially call -- I colloquial -- a speech coding person or a wideband audio coding person.
Q. Okay. Now, would a person of ordinary skill in the art at the relevant time have been aware of that distinction?
A. Oh, yes.

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Q. Okay. And would they have some understanding of both sides of that divide?
A. Certainly there -- there's no question that a speech coding person would know that what they were doing was very, very suited, designed, specially engineered for speech signals and voice signals. And historically that came out of the fact that the phone system dealt with speech, and there was this group of speech engineers at AT&T that -- you know, that was their thing. It was to -- to transmit voice over these lines. So, they -- they worked on speech. Those individuals would also know that what they were doing was unsuited for wideband audio. That's why we saw MP3 came out of a lab in Germany as opposed to the AT&T speech group, which was widely, maybe even universally, regarded as the best speech coding group in the world.
Q. So, let me back up for a second. And before we sort of zero in on audio, were there compression techniques that were not specific to audio or video that would have been known to a person of ordinary skill in the art at the relevant time?
A. Well, I mentioned noiseless or entropy coding, which is a strategy for merely taking sequences of bits and reducing the number of bits in those sequences. Those techniques are blind to where the bits came from. So, those noiseless or entropy coding techniques, just like the disk doubler stuff like we used to run on the hard drives to create more room,

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those techniques are -- are source independent from the standpoint that they don't care where the bits came from. They're just going to try and do the best job they can on compacting them. So, that type of -- of compression technique would be -- would be known to folks who worked both in audio -- any type of audio compression and also in video compression.
Q. Okay. Can you give me some specific examples?
A. So, Huffman coding is one example; arithmetic coding; Lempel-Ziv coding or Lempel-Ziv-Welch coding are -- are dictionary-type techniques. Those are three examples.
Q. Now, you referred to that as entropy coding. Entropy is a measure of information; is that right?
A. Yeah, I think that's a fair statement. In our world. It's not the thermodynamic entropy. Yes.
Q. Understood. And that Claude Shannon is the person who first applied the word "entropy" to measuring information; is that right?
A. I don't know that he was; but, again, if you tell me that's true, I would believe it.
Q. Okay. Well, he certainly did apply it in that context.
A. He did very well, yes.
Q. Okay. And entropy is a measure of the information of a particular, shall we say, piece of content; is that right?

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A. Colloquially, I think that's correct. It -- it becomes a little -- certainly if we're talking about something that I would call an IID Gaussian source. I have a black box and I've rigged it up to spit out numbers according to some probability distribution. Then we know that the numbers coming out of the black box really don't mean anything. They are simply drawn according to some probability distribution; and we can certainly compute various entropy measures, first order entropy, second order, on that data.
Now, when we talk about what is information and we start talking about something that truly is information, for example, the documents in front of you, the picture of the room, the -- the audio transcript of today's deposition, we can convert these signals to numbers, we can digitize them somehow or appropriately represent the text in your documents, but measuring the true information content starts to become somewhat esoteric. Okay. So, entropy is the best we can do numerically. Maybe that's the best way to put it. It's a numerical measure. It may or may not. What is the true information in an image? I don't know.
Q. So, entropy, in a sense, is the best we can do numerically to measure the amount of information in an image or in an audio --
A. Well, I would even modify that to say that -- in fact, in my research group, if we want to try and get the best

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09:07:30 1 bound we can on entropy for an image, what we do is we
09:07:34 2 actually push it through a bunch of compression algorithms
09:07:39 3 because the -- the smallest file, as long as the image looks
09:07:44 4 adequate according to our definition of quality, that's a --
09:07:46 5 that's a representation of the image. And the -- the smallest
09:07:50 6 file is going to give me at least an upper bound on how small
09:07:55 7 I can make that image file and still have it contain the
09:07:58 8 original information. I certainly could not get the number of
09:08:01 9 bits representing that file using any standard measure of
09:08:0710 entropy that we teach in an information theory course because
09:08:1011 what that algorithm does is so sophisticated at squashing
09:08:1712 things and extracting redundancy and packing it well, we don't
09:08:1913 have any entropy measure that that's sophisticated. This may
09:08:2214 be completely incomprehensible to you.
09:08:2515 Q. I --
09:08:2516 A. So, I'm trying -- there's -- there's entropy we can
09:08:2817 compute and it has a definition and a number and then there's
09:08:3118 also, maybe what I should call, experimental entropy which
09:08:3519 is -- I know fundamentally that entropy is a measure of
09:08:3920 information. And if I can represent an image with a file this
09:08:4221 small, I know that the entropy of the image is, at most, that
09:08:4622 many bits even though I may not be able to compute that with
09:08:4923 an equation.
09:08:5124 Q. I think you're going in a direction that -- that
09:08:5325 suggests what I'm after. What I'm -- what I'm really trying

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09:08:55 1 to understand is: Does the Shannon type entropy measure
09:08:59 2 represent the best you can do in terms of compression without
09:09:04 3 discarding information?
09:09:06 4 A. If we are speaking about real information, then I
09:09:11 5 would say no, real information meaning an image, an audio
09:09:15 6 sequence, a video, a seismograph, you know, an EKG trace,
09:09:20 7 anything like that. If we are talking about numbers that we
09:09:24 8 generate using a mathematical algorithm to simply give me
09:09:30 9 random numbers, then we really can't necessarily do too much
09:09:3310 better than that.
09:09:3311 Q. Okay.
09:09:3512 A. Now, we may not, really, be able to compute that --
09:09:3813 compute that entropy measure; but we have an idea of what the
09:09:4214 right way to do it would be.
09:09:4315 Q. Well, but for many distributions, it's a
09:09:4616 straightforward calculation, right?
09:09:4717 A. Well, first order entropy is a straight-order
09:09:4818 calculation; but information theory tells us that if we code
09:09:5219 multiple samples simultaneously, we can actually do better.
09:09:5520 So, instead of coding each sample once -- well, let's talk
09:10:0021 about text because that's easier. Instead of coding each
09:10:0022 letter --
09:10:0123 Q. Well, let me stop you. I'm sorry.
09:10:0224 A. -- code two together.
09:10:0325 Q. Is it fair to say that Huffman coding was the first

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09:10:06 1 asymptotically optical compression algorithim?
09:10:11 2 A. Oh, he -- yes, he certainly -- David Huffman produced
09:10:13 3 the first entropy code that could be proven to achieve first
09:10:23 4 order entropy.
09:10:24 5 Q. And it was very well known for that reason; is that
09:10:26 6 right?
09:10:27 7 A. I don't know if it was well known for that reason.
09:10:28 8 It was incredibly easy to design a Huffman code, which I think
09:10:34 9 probably went a very long way towards its acceptance. It's
09:10:3710 very easy to implement, very easy to explain to people and
09:10:4211 it's not patented, which is another big bonus in use.
09:10:4512 Q. So, you've mentioned Huffman, Lempel-Ziv and
09:10:5013 arithmetic coding as examples of general purpose compression
09:10:5614 algorithms that would have been known to a person of ordinary
09:10:5915 skill. Are there any others?
09:11:0016 A. Oh, I'm sure there are others. I just can't produce
09:11:0417 any names off the top of my head. There were various -- they
09:11:0718 were all -- actually, there are many, many techniques. If we
09:11:0919 go back and look at the transactions on information theory,
09:11:1220 people were constantly coming up with techniques to
09:11:1521 strategically code more efficiently using variable rate. You
09:11:1922 know, Golomb-Rice codes are another example I can think of.
09:11:2323 Q. And why were they doing that? Why were people
09:11:2624 working on producing new compression algorithms?
09:11:3225 A. The simple answer is they had government funding to

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09:11:36 1 do it.
09:11:37 2 Now, here, are you talking specifically about
09:11:39 3 the noiseless coding techniques that we've just discussed?
09:11:43 4 Q. Sure.
09:11:49 5 A. I don't know what the impetus was for the noiseless
09:11:54 6 coding techniques other than simply compacting bits. Now,
09:11:57 7 clearly when these -- I mean, Huffman did his codes in the
09:12:01 8 Sixties, I think. The Lempel-Ziv family of codes was in the
09:12:07 9 Seventies. Disk space and just storage space in general was
09:12:1110 extremely expensive. So, there is a desire -- there was a
09:12:1711 desire to, if we had digital information, which was seen as,
09:12:2112 you know, extremely -- you can create a lot of it in a little
09:12:2713 bit of time, and any savings of the disk space would be a
09:12:3314 substantial help to preserving that disk space and allowing
09:12:3815 one to store more information on it.
09:12:4016 Now, I think, also, that digital communication
09:12:4317 links were not of the tremendous bandwidths that we see today.
09:12:4818 There were -- NASA had to do a lot of communication with the
09:12:5119 stuff that they were sending up. In that case, they have low
09:12:5520 power. You don't necessarily want to signal at a high rate.
09:12:5921 You want to conserve the power on the satellite or on whatever
09:13:0122 is -- is -- you know, you can't re-gas it very easily. And
09:13:0423 then you have a need to make sure that the bits that you send
09:13:1024 are sort of as efficient as possible.
09:13:1225 Q. So, people understood that you could send a given

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09:13:16 1 file, for example, over a given link faster by compressing it
09:13:20 2 first, right?
09:13:27 3 A. Let me rephrase that a little bit. Some of these
09:13:30 4 techniques, there's no guarantee that you actually end up with
09:13:33 5 a smaller file. So, to simply make a blanket statement like
09:13:38 6 that is not true. It's certainly the case that if I have two
09:13:42 7 files and one is larger than the other and I transmit them
09:13:47 8 over the same bandwidth, it's going to take longer to transmit
09:13:51 9 and receive the longer file than it is the shorter file.
09:13:53 10 Q. Right. It's essentially a law of nature that fewer
09:13:57 11 bits takes less time to send over a given channel, right?
09:14:01 12 A. All other things being equal, yes.
09:14:03 13 Q. Okay. And the goal of these general purpose
09:14:07 14 compression algorithms was to take a wide variety of file
09:14:11 15 types and reduce the number of bits needed to represent them,
09:14:15 16 right?
09:14:15 17 A. I don't know if that was the goal of these
09:14:17 18 techniques. I mean, a lot of these people were esoteric
09:14:20 19 information theorists who --
09:14:23 20 Q. Well, let me ask it differently.
09:14:23 21 A. -- I think, happen to be working on the compression
09:14:24 22 problem. And that certainly was an outcome that these
09:14:28 23 techniques could be used to reduce the number of bits to
09:14:32 24 represent a file.
09:14:34 25 Now, let me also just clarify one thing here.

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09:14:36 1 These compression algorithms that we're talking about is --
09:14:39 2 are lossless compression algorithms or noiseless. So -- and I
09:14:43 3 think I had a slide in my tutorial that -- that illustrated
09:14:48 4 this very nicely. If we take a file and we apply one of these
09:14:52 5 techniques to it and, you know, with the caveat that
09:14:55 6 Lempel-Ziv, in particular, and some of the dictionary-based
09:14:58 7 techniques may actually expand it, when we go through the
09:15:01 8 compressor, we end up with an output -- let's call it a
09:15:05 9 compressed file even though it may not be smaller. We go
09:15:07 10 through a decompressor. What comes out of the decompressor is
09:15:11 11 bit for bit equivalent to what went in.
09:15:13 12 Q. I understand that. My question, though, is that
09:15:18 13 implementations of these general purpose compression
09:15:20 14 algorithms were widely used by the mid Eighties on a wide
09:15:24 15 variety of file types to reduce the number of bits required to
09:15:28 16 represent those files, right?
09:15:30 17 A. I -- I honestly don't know if I would say they were
09:15:34 18 widely used. I can certainly tell you that there were seven
09:15:38 19 or eight companies that claimed to have patents on arithmetic
09:15:42 20 coding; and arithmetic coding, to this day, is not very widely
09:15:47 21 used for that reason.
09:15:49 22 Q. Okay. But, for example, the Lempel-Ziv-Welch
09:15:51 23 algorithm was used to compress images in GIFs, right?
09:15:56 24 A. And that, we know, also died because of patent
09:15:59 25 issues. But, yes, the GIF image format used LZW.

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09:16:03 1 Q. Okay. And that was available in the mid Eighties,
09:16:05 2 right?
09:16:05 3 A. In the mid Eighties. That, I don't know. I don't
09:16:07 4 know the -- the -- the birth date of -- of GIF.
09:16:10 5 Q. Do you know whether it was invented at Compuserve?
09:16:14 6 A. I do believe it was but --
09:16:15 7 Q. I mean the GIF image.
09:16:17 8 A. Yeah, but didn't they have -- I thought it --
09:16:22 9 Q. Well, let me just -- let me try to ask it
09:16:22 10 differently. And I don't want to go off on so many
09:16:26 11 sidetracks. We have real limited time here. So, what I'm
09:16:29 12 trying to get at is whether one of ordinary skill in the art
09:16:32 13 would have understood that compression techniques were
09:16:36 14 available, as a general matter, to reduce file sizes?
09:16:39 15 A. One of ordinary skill would understand that there
09:16:41 16 would be lossless techniques and lossy techniques. We've just
09:16:45 17 talked about the lossless techniques. But the lossless
09:16:48 18 techniques --
09:16:50 19 Q. Hold on. Let me stop you for a moment because I
09:16:52 20 don't want to go off on -- on a sidetrack.
09:16:55 21 A. There's one important thing I want to say, though.
09:16:57 22 Q. Okay. Go ahead. Go ahead.
09:16:58 23 A. These lossless techniques, yeah, by virtue of the
09:17:00 24 fact that they had to preserve, bit for bit, what came out the
09:17:03 25 other side was what went in after we compressed and

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09:17:04 1 decompressed, they were substantially limited in the reduction
09:17:08 2 that they could achieve.
09:17:09 3 Q. Okay. But they frequently would achieve some
09:17:14 4 reduction, even if it wasn't a lot, right?
09:17:17 5 A. Yes.
09:17:18 6 Q. Okay.
09:17:19 7 A. There would be -- one would expect on large files --
09:17:25 8 and here, I'm just going to say "large" and not qualify it,
09:17:26 9 but that all of those techniques that we've discussed would --
09:17:31 10 would -- would produce a smaller file size, albeit may not --
09:17:35 11 maybe not even half, perhaps only 20, 30 percent smaller.
09:17:39 12 Q. Okay. But a person of ordinary skill in the art
09:17:43 13 would have understood at the relevant time that that would
09:17:45 14 have taken half or two-thirds or whatever the compression rate
09:17:50 15 was the amount of time required to transmit the uncompressed
09:17:54 16 file over a given channel, right?
09:17:56 17 A. Certainly over -- one could compute the -- the
09:17:59 18 corresponding reduction if -- from a theoretical standpoint,
09:18:04 19 if one were to implement that. Of course, let's never mind
09:18:07 20 that you have to put equipment at both ends and you may or may
09:18:10 21 not be able to do that.
09:18:12 22 Q. Well, it was completely predictable, right?
09:18:14 23 MR. PAYNE: Objection, form.
09:18:15 24 A. What does "predictable" mean?
09:18:16 25 Q. (By Mr. Stephens) Meaning that if you took a file and

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you compressed it and you compared it to the uncompressed version, you knew with absolute certainty that you would have some approximate reduction in the transmission time over a given channel that reflected the difference in the number of bits between the compressed and uncompressed versions, right?

A. Well, from a theoretical standpoint but, also, you know, let me say that, here, we're talking about a theoretical channel. You may have 50 megabit per second, for example -- I think you have a -- and, now, that channel, we may or may not have access to the whole 50 megabits. It may be -- let's --

Q. Let me -- let me just ask you to assume --

A. Wait. Let's just talk about the T1 example. T1 chunks come in 64 kilobits per second. So, if I have something at 65 kilobits per second, I'm a little out of luck because I have to -- I have to get 128 kilobit-per-second channel.

Q. I'm sorry, I'm not asking about whether you -- the rate of the file. I'm asking about a file of a given size and how long it would take to transmit it.

A. So, let me go back.

MR. PAYNE: Wait. Is there a question on the table?

MR. STEPHENS: No. Why don't we take a break and change the tape.

THE VIDEOGRAPHER: Off the record at 9:19.

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(Recess taken)

THE VIDEOGRAPHER: This is the beginning of Tape 2 of the deposition of Dr. Hemami. The time is 9:27. We're back on the record.

Q. (By Mr. Stephens) Dr. Hemami, before the break, we were talking about the person of ordinary skill in the art and what they would have known at the relevant time. Is it fair to say that -- that a person of ordinary skill at the relevant time would have understood that, all of the things being equal, it takes less time to send a given file with fewer bits?

A. All things being equal, given that we compute transmission time according to bits divided by bandwidth, obviously if the numerator bits is smaller, the resulting time is going to be smaller.

Q. Okay. Is it also fair to say that a person of ordinary skill at the relevant under -- relevant time would have understood that the goal of compression is to take a given file and reduce the number of bits required to represent it?

A. I think using the term "goal" is perhaps a little bit vague here. I think one of ordinary skill would understand that compression generally reduces file size.

Q. Okay. So, a person of ordinary skill at the relevant time would have understood that compressing a file is a way to

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reduce the amount of time required to send that file, right?

MR. PAYNE: Objection, form.

A. I -- I'm not quite sure I would phrase it like that. We would -- perhaps, I think it's more accurate to give it as a two-step sequence of events. Compression reduces the number of bits; and by merely computing transmission time, were that file to be transmitted over an identical communication link as the uncompressed file, we would compute the time for transmission would be smaller. I'm uncomfortable putting "goal" in there because this is a -- compression is employed in a system for -- for various reasons.

Q. (By Mr. Stephens) Okay.

A. And the system designer obviously is building the system for whatever the -- the end goal is, and he or she may have various reasons for doing things.

Q. Okay. Now, going back to audio, what kinds of wideband audio compression algorithms would a person of ordinary skill have known about at the relevant time?

A. Okay. So, again, here, let me just start off and say that these were described in my claim construction report. So, to the extent that I missed some, they -- there is a --

Q. Okay.

A. -- outline of these given there.

So, we -- wideband audio, certainly one of ordinary skill would be aware of DPCM, which I think we've

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discussed and that is mentioned in my report. One could also start off with just the basic technique of pulse-coded modulation followed by quantization where the quantization strategy -- PCM does not, itself, provide any compression, but quantization is the procedure by which we throw information away and -- and an appropriate quantization strategy could be employed to achieve compression. And, in fact, what those appropriate quantization strategies were was a topic of research and interest at that time.

Additionally, there were also subband coding algorithms which attempted to -- let me just say, with respect to compression, all of these techniques are assuming that we are starting off with a signal that has been digitized, not starting off with an -- an analog signal. The subband coding techniques segmented the -- or separated the input signal into frequency bands and processed each band and compressed each band separately and independently according to the characteristics of those bands.

Q. Any others?

A. I think that generally covers the -- a wide swath of algorithms.

Q. Are there any others that come to mind?

A. Not that come to mind now, certainly.

Q. Okay. Fine. What analog compression algorithms would have been known to a person of ordinary skill at the

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09:32:53 1 relevant time?
09:32:54 2 MR. PAYNE: Objection, form.
09:32:56 3 A. So, I -- I don't know what an analog compression
09:32:59 4 algorithm is.
09:32:59 5 Q. (By Mr. Stephens) Okay. So, you don't know how you
09:33:01 6 would compress an analog signal?
09:33:03 7 A. I don't even know what "compress" means as applied to
09:33:07 8 an analog signal. I think that you have to give a little bit
09:33:10 9 more detail as to what you're asking.
09:33:1110 Q. What else would you need to know?
09:33:1611 A. Well, certainly in this case, we have a construction
09:33:1712 as compressing referring to reducing the number of bits; and
09:33:2213 an analog signal has no bits.
09:33:2614 Q. Okay. Let me be very clear. I'm not asking about
09:33:2915 compressed as it's used in the Court's claim construction.
09:33:3316 I'm asking about compress or compression as it was used by
09:33:3617 people of ordinary skill at the relevant time, in the mid --
09:33:4018 mid Eighties.
09:33:4019 A. If we're referring -- again, going back to my
09:33:4320 description of a person of ordinary skill, I think this person
09:33:4621 would answer that one cannot compress an analog signal --
09:33:5022 Q. Okay.
09:33:5023 A. -- that that signal would require digitization prior
09:33:5524 to any potential compression operation.
09:34:1625 Q. You mentioned that PCM plus quantization is a form of

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09:34:20 1 compression that would have been known to a person of ordinary
09:34:22 2 skill in the art and that quantization is throwing information
09:34:26 3 away. What about resampling?
09:34:28 4 A. Can you be more specific about what you mean by
09:34:30 5 "resampling"?
09:34:31 6 Q. Yeah. So, for example, if you take a -- a
09:34:33 7 44.1 kilohertz audio signal from a CD and you resample it at
09:34:40 8 40 kilohertz, would that be a form of compression?
09:34:45 9 A. Can you explain the resampling operation?
09:34:4810 Q. Yeah. So, you, for example, interpolate intermediate
09:34:5211 points so that you can reduce the number of samples necessary
09:34:5812 to represent the same audio signal and throw away information
09:35:0213 in the process.
09:35:1214 A. From a theoretical perspective, what you have just
09:35:1615 described actually destroys signal.
09:35:2116 Q. I understand it's a lossless -- I mean, it's lossy.
09:35:2517 A. It's a little bit more than lossy. It's actually
09:35:3118 inducing -- it's really creating signal where there was none
09:35:3519 before and --
09:35:3620 Q. Well, let me make a simpler example, then, to start
09:35:3921 with. What if you just threw away every other sample?
09:35:4422 A. So, generally, I don't believe that that would be
09:35:5023 considered to be compression, independent of the horrible
09:35:5424 things that it's doing to the signal.
09:35:5725 Q. Okay. Well, let me -- let me try again. Are you

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09:35:59 1 familiar with the process of resampling?
09:36:02 2 A. I call it "rate changing," and I teach it in my
09:36:05 3 course.
09:36:06 4 Q. Okay.
09:36:06 5 A. But there's an important step that you left out.
09:36:09 6 Q. What is that, filtering --
09:36:11 7 A. Yes.
09:36:11 8 Q. -- to reduce the bandwidth appropriately?
09:36:14 9 A. Yes, exactly.
09:36:1410 Q. Okay. So, if you do that, you -- what was the word,
09:36:1611 "rate changing," that you used?
09:36:1812 A. Yes.
09:36:1813 Q. Is that a form of compression?
09:36:2114 A. I don't believe that one of ordinary skill would
09:36:2415 consider that to be a form of compression.
09:36:2616 Q. Okay.
09:36:2617 A. Now, having -- and I believe that I also gave some
09:36:2818 examples in my previous deposition along those lines that --
09:36:3319 that this is -- this would not be considered compression.
09:36:3520 Now, having said that, I have certainly seen examples in
09:36:4221 literature where authors or inventors refer to dropping
09:36:5322 samples as compression. It's maybe, perhaps, a little bit of
09:36:5923 an interpretation. In those examples, the -- let's call it
09:37:0524 the reduced information following the -- the rate changing or
09:37:1025 resampling operation, was then subsequently compressed

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09:37:13 1 according to a conventional or -- or compression algorithm
09:37:17 2 as -- as one of ordinary skill would understand compression to
09:37:21 3 mean.
09:37:21 4 Q. Okay. Well, let me -- let me --
09:37:23 5 A. So, I -- it's a little bit -- I think, in general,
09:37:25 6 you could possibly get people involved in a debate on this;
09:37:28 7 but I think, for the most part, most people would come down on
09:37:32 8 the side of that's -- that's -- doesn't fall in the general
09:37:36 9 class of what we consider to be either lossy or lossless
09:37:3810 compression.
09:37:3911 Q. Okay. Is it a technique that would have been known
09:37:4312 to a person of ordinary skill in the art even though it's not,
09:37:4613 as you say, necessarily compression?
09:37:5014 A. Well, I -- I think that the two things that you said
09:37:5315 are sort of independent. Rate changing is certainly something
09:37:5616 that would be known to someone who knew compression from the
09:38:0317 standpoint that in order to understand compression, one has to
09:38:0618 have some background in signal processing; and rate changing
09:38:0919 is a fundamental operation or -- or sequence of events to
09:38:1320 understand from a standpoint of signal processing. So,
09:38:1621 certainly that person would understand a rate changing
09:38:1822 operation.
09:38:1923 Q. Okay. Meaning a person of ordinary skill in the art
09:38:2224 would have understood rate changing as part of their technical
09:38:2525 vocabulary?

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09:38:28 1 A. Yes. That would be -- yes, exactly. You could walk
09:38:29 2 into their office and ask them to diagram it out and explain
09:38:33 3 what happens and so on.
09:38:34 4 Q. Okay. And rate changing a signal to a lower sample
09:38:38 5 rate does reduce the number of bits required to represent that
09:38:41 6 signal, right?
09:38:43 7 A. No, not necessarily.
09:38:44 8 Q. I understand not necessarily, but it can?
09:38:46 9 A. No. I -- in and of itself, no.
09:38:5010 Q. All right. Hold on. Let me ask a different -- a
09:38:5211 different question, then, more specific. So, if you take a
09:38:5512 44.1 kilohertz, 16 bit sample from a CD and you rate change it
09:39:0213 so that it's 40 kilohertz and 16 bits, is it possible to do
09:39:0814 that using rate changing as you've described it?
09:39:1115 A. Well, let's be very -- the -- my concern here is with
09:39:1516 the bits. Okay. So, we start off with 16 bit samples and
09:39:2117 we -- I think we agreed that we would append a filtering
09:39:2518 operation prior to the -- the -- the down-sampling
09:39:2919 operation -- and the process of filtering that signal is going
09:39:3520 to change its dynamic range. So, from the standpoint of --
09:39:4721 there's a little bit more design here involved, I guess is
09:39:5022 what I'm trying to get at so --
09:39:5123 Q. All I'm asking about is whether it's possible to use
09:39:5524 resampling to change a wideband audio signal from
09:39:5925 44.1 kilohertz, 16 bits, like you have on an ordinary CD, to

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09:40:04 1 40 kilohertz, 16 bits. Is that possible to do?
09:40:06 2 A. Well, anything is possible. We could eject 15 of the
09:40:09 3 bits and get it down to a 1 bit signal. We're then back to
09:40:13 4 the quality issue that I had mentioned earlier.
09:40:16 5 Q. Okay. But a person of ordinary skill in the art
09:40:18 6 would have understood that you could down-sample
09:40:21 7 44.1 kilohertz, 16 bit wideband audio signal to a
09:40:25 8 40 kilohertz, 16 bit wideband audio signal, right?
09:40:31 9 A. As you have described it, which would have more
09:40:3410 distortion, never mind the filtering and frequency content
09:40:3711 that we've ejected, but the fact that we've gone from a 16 bit
09:40:4012 representation to a 16 bit representation with some arithmetic
09:40:4313 in between. So, we have -- in this discussion, we have
09:40:4614 completely not dealt with the fact that the filtering
09:40:5015 operation is going to adjust the number of bits that we need
09:40:5316 to represent those samples at a given signal-to-noise ratio
09:40:5817 so --
09:41:0018 Q. It is possible to do, right? It is possible to take
09:41:0319 a 44.1 kilohertz, 16 bit representation and use down-sampling
09:41:0720 to change it to a 40 kilohertz, 16 bit representation, right?
09:41:1221 A. In a -- from a -- again, if I gave this to a student
09:41:1622 on a piece of paper, they can certainly put something together
09:41:2023 that would do that. Now, again, going back to whether this is
09:41:2324 suitable for any particular application, this becomes another
09:41:2725 question.

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09:41:28 1 Q. Okay. But a person of ordinary skill would have
09:41:30 2 understood you can do that, right?
09:41:31 3 A. A boss of ordinary skill may come in and say, "Ah,
09:41:35 4 you've ruined the signal." So, from that perspective, we
09:41:39 5 could certainly put a system together that would do that.
09:41:41 6 Q. And a person of ordinary skill would have understood
09:41:43 7 that, right?
09:41:44 8 A. Again, that falls -- both -- both aspects that we've
09:41:47 9 talked about, both the filtering and resampling as you've
09:41:5010 described it and also the consideration of the arithmetic,
09:41:5411 fall into the category of DSP and that a compression engineer
09:41:5812 would understand.
09:41:5913 Q. Okay. Okay. Now, if you could, give me a list of
09:42:1114 those kinds of speech compression algorithms that you think a
09:42:1815 person of ordinary skill would have known about at the
09:42:2016 relevant time.
09:42:2117 A. So, this is not going to be a exhaustive list of all
09:42:2918 the speech coding techniques that were available, but
09:42:3319 certainly there were -- so, Vector quantization was an
09:42:4020 approach that was in high favor for -- for speech
09:42:4621 applications. There were various waveform coders which
09:42:5222 actually attempted to match the -- the signal, the speech
09:42:5623 signal, characteristics of the speech signal. There were
09:43:0124 coders that -- I'm not sure what the right technical term for
09:43:0725 these coders are, but essentially, their goal was to produce a

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09:43:11 1 signal that sounded like the speech, but -- and I -- I'm
09:43:19 2 delineating sound, then, because if you, for example, were to
09:43:22 3 look at the traces, they would look completely different, but
09:43:25 4 to the -- to the ear, they would sound the same. So, these
09:43:28 5 coders were effectively coders that modeled the generation
09:43:32 6 system and attempted to, based on that model, cause a
09:43:39 7 generation system to produce sounds that were similar enough
09:43:45 8 with what had actually been spoken. Those are several
09:43:51 9 examples.
09:43:5110 Q. Okay. Anything else you can think of?
09:43:5211 A. Oh, I'm sure things will come to me as we go along.
09:43:5612 Q. Is silence compression a speech compression method
09:43:5913 that was known?
09:44:0114 A. I don't know that I would say silence compression was
09:44:0315 a speech compression method because, clearly, speech is not
09:44:0716 silence. Silence compression was -- maybe we could call it a
09:44:1517 additional strategy that could be employed especially in
09:44:2118 two-way, bidirectional conversations where typically we have
09:44:2619 only one party speaking at a time.
09:44:3220 Q. Any other speech compression algorithms that you can
09:44:3621 think of that a person of ordinary skill in the art would have
09:44:3922 been aware of?
09:44:4023 A. Well, we also then have sort of our traditional PCM
09:44:4524 with companding and DPCM techniques.
09:44:5125 Q. Okay. Anything else that comes to mind?

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09:44:53 1 A. Not immediately.
09:44:53 2 Q. Okay. How about video? What kinds of compression
09:44:59 3 techniques would have been known to a person of ordinary skill
09:45:01 4 in the art regarding video?
09:45:03 5 A. So, in video, we can first sort of segregate two very
09:45:09 6 broad classes of -- of video compression. The first class
09:45:13 7 were strategies by which each video frame or field was treated
09:45:18 8 completely independently as if it were a still image and the
09:45:25 9 second was often called intra-frame video coders and I think
09:45:3110 that the scene adaptive coder which I discussed with Mr. Brown
09:45:3711 on my last deposition is an example of that. The other
09:45:4112 category of video coders were what we call inter-frame,
09:45:4813 broadly, inter-frame coders and these coders attempted to
09:45:5714 exploit the gross similarity between any two adjacent video
09:46:0015 frames or fields that, in general, in absence of a scene
09:46:0516 change or a cut to commercial, any two video frames are going
09:46:0917 to be very, very similar and one should be able to exploit the
09:46:1318 similarity for those -- in order to more efficiently represent
09:46:1719 the data. And within both of these types of general classes,
09:46:2420 there were all kinds of approaches to -- to doing these
09:46:2921 things.
09:46:3022 Q. So, there were many different approaches to both
09:46:3223 intra-frame and inter-frame video compression coding that were
09:46:3624 known to people of ordinary skill?
09:46:3825 A. I think for video compression engineers, yes. I

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09:46:40 1 would say that they were aware of the different strategies and
09:46:44 2 the different approaches that -- that people had taken and
09:46:46 3 were developing at the time to move toward video compression
09:46:54 4 strategies.
09:46:55 5 Q. Okay. And -- and they were also aware of techniques
09:46:58 6 that combined the two of them together; is that right?
09:47:00 7 A. Well, it's almost impossible to have an inter-frame
09:47:03 8 coder without some intra-frame coding. So, when I say
09:47:06 9 "inter-frame," I'm using that as a broad class that somewhere
09:47:1010 in there you're going to have some frame that is coded
09:47:1411 completely independently. Even if you rig the system to
09:47:1712 pretend like it's not, it's -- it's still going to end up, at
09:47:2213 some point, being coded independently.
09:47:2514 Q. Okay. Now, would a person of ordinary skill at the
09:47:2915 appropriate time have understood how to use the literature to
09:47:3316 locate other compression techniques besides the ones they were
09:47:3617 already familiar with?
09:47:4018 A. I think that at the time -- now, here -- maybe you
09:47:4419 can explain a little bit more what the "literature" is since I
09:47:4920 think you and I may have different definitions for that.
09:47:5121 Q. Okay. What I mean, for example, are professional
09:47:5422 journals and technical libraries, various source books of
09:48:0223 algorithms and the like.
09:48:0324 A. So, I think that with respect to specifically
09:48:0425 addressing video compression, one of ordinary skill would be

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09:48:12 1 aware of the existence of various IEEE journals, also the Bell
09:48:21 2 System Technical Journal, which was a journal that was
09:48:23 3 published by AT&T Bell Labs at the time, and the various
09:48:30 4 conferences that occurred. And here, I'm referring to, I
09:48:37 5 guess, the technical conferences where researchers and
09:48:44 6 industrial people would publish their papers and exchange
09:48:49 7 ideas.
09:48:51 8 Q. Okay. Anything else?
09:48:55 9 A. The standards organizations did -- I mean, ITU
09:49:0210 certainly had the -- the working groups on the video
09:49:0811 teleconferencing standards in existence, and the ISO -- I
09:49:1412 think the MPEG committee was formed in 1987 or 1988, but those
09:49:2013 committees were not -- I'm sort of thinking out loud here. I
09:49:2514 think that what we've covered is good, those committees. Even
09:49:2815 now, it's sometimes difficult to get information out of them.
09:49:3116 Q. Well, the ITU committees published standards, right?
09:49:3517 A. They do publish standards, yes, they do. They do.
09:49:3818 Q. And they publish draft standards as well, right?
09:49:4019 A. Draft standards do come out of those groups.
09:49:4520 Q. And those are commonly used by people in the
09:49:4721 telecommunications industry, right?
09:49:4822 A. I don't know to what extent they were used. I mean,
09:49:5023 I think you really have no reason for a draft standard unless
09:49:5424 you're going -- it depends what standard it is. There are
09:49:5825 many, many, many standards that these groups put out; and I

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09:50:00 1 don't know to what extent all of them are used. I think some
09:50:03 2 of them are probably way more popular than others.
09:50:04 3 Q. Well, if you wanted your telecommunications system to
09:50:07 4 inter-operate with someone else's, you'd probably want to look
09:50:10 5 at the standards.
09:50:10 6 A. Certainly. Of course. Of course.
09:50:11 7 Q. Now, what about audio, what kind of literature would
09:50:14 8 people of ordinary skill in the art been aware of in audio,
09:50:16 9 meaning either wideband audio or speech compression?
09:50:2110 A. So, in audio, not only would there be appropriate
09:50:2611 technical journals and -- and records of conferences but
09:50:3112 also -- well, I say "also." Maybe it falls in the same
09:50:3813 category. Before, I mentioned IEEE and AT&T journals, which
09:50:4314 are clearly put out by technical organizations. With respect
09:50:4715 to audio, I think the Journal of the Acoustical Society of
09:50:5016 America would also be something that might be known to an
09:50:5317 audio person.
09:50:5418 Q. About the audio engineering society?
09:50:5619 A. Yes.
09:50:5820 Q. Any others?
09:51:0221 A. No, not -- not that I can think of. You know, audio
09:51:0422 was substantially more advanced than -- all audio, speech,
09:51:1023 wideband, much more advanced than video with respect to the
09:51:1424 technical community's understanding of how to process and
09:51:1825 handle the signal.

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09:51:20 1 Q. The ITU also had published a number of standards for
09:51:23 2 audio compression, correct?
09:51:26 3 A. ITU.
09:51:28 4 Q. Like, just for example, G.721?
09:51:31 5 A. Ah, yes. Yes. Thank you. That's right. That's
09:51:36 6 right. Now, the G.721 standard -- now, at this point, I'd
09:51:40 7 like to ask for a copy of my declaration.
09:51:43 8 Q. Okay. Which one?
09:51:43 9 A. The first one.
09:51:44 10 Q. Okay.
11 (Exh.247 marked)
09:51:58 12 Q. (By Mr. Stephens) Okay. I'm handing you what's been
09:52:00 13 marked as Exhibit 247.
09:52:04 14 MR. STEPHENS: A copy -- you got one? Okay.
09:52:06 15 MR. PAYNE: What did you say, 247?
09:52:09 16 MR. STEPHENS: Yes.
09:52:14 17 A. Okay. So, what I wanted to check was the reference
09:52:16 18 that I had looked at on G.722. So, let me say, off the top of
09:52:21 19 my head, I don't know what G.721 is.
09:52:25 20 Q. (By Mr. Stephens) Okay. But G.722 is also an audio
09:52:27 21 compression standard?
09:52:31 22 A. Whether it was adopted as a standard, I don't know.
09:52:35 23 But certainly it was put together by the group and envisioned
09:52:37 24 and -- and evaluated.
09:52:39 25 Q. And at least published as a draft standard, if not a

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09:52:42 1 standard, right?
09:52:43 2 A. At least published as a draft, yeah. People had to
09:52:45 3 know about it somehow.
09:52:46 4 Q. And you can download it from the IT website today,
09:52:50 5 right?
09:52:50 6 A. Today, yes.
09:52:51 7 Q. And you could have gotten it from the ITU with a
09:52:54 8 phone call?
09:52:56 9 A. Oh, I'm sure it would have been, though.
09:52:57 10 Q. But it was a standard process?
09:52:59 11 A. It was. Well, I assume so. I certainly -- I didn't
09:53:02 12 do it at the time.
09:53:02 13 Q. Okay. So, ITU standards are also one of the sources
09:53:05 14 of audio compression information that a person of ordinary
09:53:08 15 skill in the art would likely have known about, right?
09:53:11 16 A. Again, here, we're using "audio" as a general term.
09:53:14 17 722 certainly, which I refer to here, was listed as wideband
09:53:19 18 audio. Actually, it was for wideband speech, as I explained
09:53:22 19 in the -- in the declaration. So, with the caveat that it
09:53:26 20 would be for the appropriate audio for whatever the standard
09:53:29 21 dealt with.
09:53:29 22 Q. Okay. Now, would a person of ordinary skill in the
09:53:32 23 art at the appropriate time have been familiar with computers?
09:53:39 24 A. I think, certainly, one of ordinary skill would have
09:53:44 25 been familiar with, used computers, programmed computers. One

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09:53:50 1 would have been able to implement algorithms on computers for
09:53:55 2 the purposes of verification or testing or development.
09:54:19 3 Q. Would a person of ordinary skill in the art at the
09:54:24 4 appropriate time have understood that you could store
09:54:26 5 compressed audio on a computer's hard drive?
09:54:37 6 A. This is going to sound a little nutty, but can you
09:54:40 7 clarify what you mean by "store"? Simply, the bits resided
09:54:43 8 there?
09:54:44 9 Q. Yes.
09:54:45 10 A. I think that one of ordinary skill, certainly
09:54:48 11 whatever type of audio he or she were processing, would have
09:54:55 12 understood that at least small pieces of that audio, if not
09:54:59 13 the entire digitized audio, could be stored on the hard drive.
09:55:04 14 Q. And -- and, in fact, could be stored on the hard
09:55:07 15 drive in an ordinary file in an ordinary file system, right?
09:55:11 16 A. Well, can you clarify what you mean by "ordinary"?
09:55:15 17 Q. FAT16, FAT32.
09:55:19 18 A. I think that as any other file would be sitting on
09:55:21 19 the file system, sure.
09:55:23 20 Q. Okay. And just to be clear for the record, the FAT16
09:55:27 21 file system is the one that was used by MS-DOS on IBM PCs in
09:55:31 22 that time, right?
09:55:33 23 A. I don't know that.
09:55:33 24 Q. Okay. But what you said would be applicable to the
09:55:37 25 type of file system that was used on ordinary PCs at the time,

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09:55:40 1 right?
09:55:45 2 A. Honestly, I don't think that people would be doing --
09:55:47 3 these people would be doing this on PCs at the time. I think
09:55:50 4 it was more likely it would be done on some type of higher-end
09:55:53 5 work station.
09:55:54 6 Q. Work station?
09:55:55 7 A. Yes, simply from a standpoint of both available
09:55:59 8 software that one might want to use and also computational
09:56:04 9 horsepower that was required.
09:56:07 10 Q. Okay. But a person of ordinary skill in the art at
09:56:10 11 the time would have understood that you could store audio
09:56:13 12 files on a Unix workstation or an IBM PC or an Apple Macintosh
09:56:19 13 at the time, right?
09:56:21 14 A. Certainly that they could be stored. It may not have
09:56:24 15 been trivial to get them on to a particular machine.
09:56:27 16 Q. Okay. But there were hardware devices available in
09:56:31 17 the Eighties that would allow you to digitize sound and store
09:56:34 18 it on a computer's hard drive, right?
09:56:39 19 A. The hardware device itself? You -- I guess if I
09:56:46 20 interpret your question, it sounds like you're saying that
09:56:50 21 there was a hard -- hardware device that sat directly and fed
09:56:53 22 onto the hard drive and took analog audio in.
09:56:54 23 Q. No, no. I just mean --
09:56:54 24 A. Just merely the existence of digitized audio?
09:56:59 25 Q. That's right.

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09:56:59 1 A. Yeah, I think there was equipment that could digitize
09:57:02 2 audio and put that audio on to some type of format or entity
09:57:07 3 such that it could be introduced into the computer.
09:57:10 4 Q. Okay. And persons of ordinary skill in the art
09:57:13 5 understood that at the relevant time, right?
09:57:15 6 A. I think that, certainly, audio compression people
09:57:17 7 would be well aware of that --
09:57:19 8 Q. Okay.
09:57:19 9 A. -- because, otherwise, they would not be very well
09:57:2210 suited to doing audio compression.
09:57:2411 Q. Okay. Now, what about video compression?
09:57:2812 A. Now, video compression starts to become a little bit
09:57:3013 more challenging because one reason that audio was and still
09:57:3514 is so much more advanced compared to video is because it's a
09:57:4015 lot smaller, file-wise. There are many, many fewer samples
09:57:4416 per second required to represent any type of audio, whether
09:57:4917 it's speech, narrowband, wideband, than video, which if we
09:57:5518 just think about sort of VHS quality in North American, is,
09:58:0119 at -- at best, 30 megabits per second. You know, that's far
09:58:0620 greater than the numbers that we've thrown around in this case
09:58:1021 for -- for any type of uncompressed audio. And as a result,
09:58:1722 some frames or portions of frames or cropped versions of
09:58:2223 frames could certainly be stored on a hard disk. But quickly,
09:58:2624 there was a capacity issue. So, if we simply talk about
09:58:3025 storing by video, there -- in terms of what was in an ordinary

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09:58:39 1 Unix workstation or PC or Mac, that disk would have filled up
09:58:46 2 very, very quickly.
09:58:49 3 Q. But certainly people working in the video compression
09:58:52 4 arts were performing video compression on computers of some --
09:58:57 5 some type and storing video sequences in compressed form on
09:59:03 6 hard drives in the Eighties, right?
09:59:06 7 A. I don't know that the compressed sequences were --
09:59:11 8 now we can throw it away, right? We have our Apple. It does
09:59:13 9 iMovie, whatever, you know, the little mini -- mini disk that
09:59:2010 comes in a Handycam. In the Eighties, not only were the raw
09:59:2611 files very large but the compression was not nearly as
09:59:3112 efficient as what we're doing today, too. So, the resulting
09:59:3513 file sizes that people were dealing with were much, much
09:59:3914 larger. So, to say that the whole sequence -- I mean --
09:59:4215 Q. Let me -- let me ask a different question.
09:59:4416 A. I think several frames were compressed, very short
09:59:4617 chunks. I don't think they were all done on a single computer
09:59:5018 at once. They may well have been done in parallel over many
09:59:5419 computers and spooled off on to storage or physically removed
09:59:5820 or written off to magnetic tape, simply because of the shear
10:00:0321 volume of the data.
10:00:0422 Q. I want to ask a question now using the terms as
10:00:0723 construed by the Court -- I mean, as you understand them to be
10:00:1024 unconstrued by the Court. When did it first become possible,
10:00:1325 in your understanding, to store a full motion video work in

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10:00:18 1 compressed form on a hard drive on a computer?
10:00:22 2 A. Well, there's a key piece of information, I guess
10:00:27 3 that -- that is missing in order to answer that question,
10:00:32 4 which is: What is the length of the work? So, let me address
10:00:35 5 that: I understand "work" to be something that's the result
10:00:44 6 of a creative effort. So, I would say that the video of my
10:00:49 7 deposition today -- you may disagree, but it's not -- not the
10:00:53 8 result of a creative effort.
10:00:56 9 Q. I do strongly disagree, but that's okay.
10:00:5810 A. Do you understand what I mean?
10:01:0111 Q. I -- actually, I don't. But that's okay.
10:01:0412 A. Well --
10:01:0413 Q. And I'm -- I'm not asking you to explain that.
10:01:0514 Please just continue with your answer.
10:01:0915 A. Yeah. So -- okay. So -- so, for example, a public
10:01:1516 service announcement, I would say, is not a creative work.
10:01:1917 Q. Look --
10:01:2018 A. But -- but I'm trying to get at length here. Okay.
10:01:2319 So --
10:01:2620 MR. PAYNE: Let's just -- what's the question?
10:01:2821 Q. (By Mr. Stephens) The question is: When did it first
10:01:3122 become possible to store a full motion video work on a hard
10:01:3523 drive?
10:01:3524 MR. PAYNE: Okay. That's -- that sounds like an
10:01:3725 enablement question to me. I mean, you're --

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10:01:39 1 MR. STEPHENS: Look, let her -- if you're going
10:01:39 2 to make your objection, that's fine, make your objection.
10:01:41 3 MR. PAYNE: Well, I might --
10:01:43 4 MR. STEPHENS: Don't coach the witness.
10:01:43 5 Don't --
10:01:45 6 MR. PAYNE: I'm not coaching her. The -- the
10:01:47 7 purpose of the deposition today is to ask her questions
10:01:48 8 about --
10:01:49 9 MR. STEPHENS: I'm trying to find out about the
10:01:4910 scope and content of the prior art. You can't tell me I'm not
10:01:5311 entitled to do that.
10:01:5412 MR. PAYNE: Okay. I'm telling you you're only
10:01:5613 entitled to address issues set forth in her declarations, per
10:02:0114 our agreement.
10:02:0215 MR. STEPHENS: Make your objection and direct
10:02:0316 her not to answer if you --
10:02:0617 MR. PAYNE: So -- certainly. So, you know, I --
10:02:0918 I -- I think you're -- you're arguably going over the line,
10:02:1519 but I'll let her answer.
10:02:1820 MR. STEPHENS: Okay.
10:02:1821 Q. (By Mr. Stephens) When did --
10:02:1822 A. So, can you repeat the question, please?
10:02:2023 Q. Yeah. When did it first become possible to store a
10:02:2324 full motion video work on a hard drive?
10:02:2625 A. So -- okay, let me not pontificate on the length.

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But, first off, we have -- there would be, in making this computation, some length of the full motion video sequence, which would be sufficiently long enough to somehow indicate that it had some type of creative content. And the second issue is: What is the size of the hard drive? The third issue -- if I only said two, I was mistaken -- is: What is the compression algorithm and to what size is -- you know, essentially what is -- the combination of the length of the sequence and the compression algorithm gives us a resulting file size; and that file size, then we want to compare to hard disks. Now, I have -- I do not have hard disk evolution at my fingertips.

Q. So, you don't know the answer, then?

A. That's right.

Q. Okay. Do you know if it was possible by 1988?

A. I know that in preparing for my tutorial, I did verify that the example that I gave was reasonable and feasible. So, I would say, yes, it was possible in 1988.

Q. And the example that you gave was -- how -- how was that constructed?

A. Well, I considered a work of some length and applied -- actually, I think I applied the compression strategy that was directly suggested.

Q. Now, you're talking about the very, very short video that you had available at the -- at the tutorial; is that

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right?

A. That I didn't play?

Q. Right. But you produced it to us at that time.

A. Okay. So -- so, I would -- that -- that was solely -- that -- I would say that was a bit short to be considered a work. I was not -- that length, whatever it was, ten frames or something, no, I would -- I would not say that that's -- that's fair. That -- that video existed simply to show what the video would look like using a compression algorithm. But I did verify, to myself, that for a reasonable link; and I think it was -- it's -- it was a three-minute music video, two-minute music video. It's -- it's on the slides, that that was a fair operation.

Q. And you came out to a over a hundred megabytes in storage space; is that right?

A. I don't remember.

Q. Okay.

A. What I will say is that I -- I wanted to make sure that I represented a fair presentation. So, I did check very carefully.

Q. Now, you're aware that DVI had demonstrated video compression prior to that, right? I think you refer to that in your declaration.

A. Yeah, DVI -- I mean, other people demonstrated video compression prior to that, too. DVI, they had a particular

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proprietary compression algorithm and -- and --

Q. And you could store that on a computer, right, on a disk drive?

A. Well, I think the -- the motivation for DVI was to put it on CDs.

Q. And CDs had relatively low bit rates compared to hard drives, right, bandwidth on and off the disk?

A. Okay. Let me think. CDs have a data rate of 1.4 megabit per second. Yes, yes.

Q. Actually, they have a bit rate of about 150 kilobytes -- okay, right, 150 kilobytes per second.

A. Well --

Q. 1.2 --

A. Yeah. The only reason I remember that is MPEG-1 was designed for video on a CD. So, you have 1.4 megabits per second coming off, and that .4 is basically all error correction. So, that leaves you with 1.

Q. Okay. So -- so, again, just to make the record clear, if you could do video that would play back at a bit rate low enough to be playable from a CD, then it would also play back from a hard drive, right?

A. I -- I don't know the hard drive transfer speeds off the top of my head.

Q. Okay. But they were -- you do know that they were higher than CD-ROMs?

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A. I do believe that. So, provided that you could get the blocks off and all the file management was there, then -- and you could move around that drive fast enough, yes, I do believe that you would be able to play a file off of a hard drive.

Q. So, a person of ordinary skill in the art at the relevant time would have known of compression algorithms that compressed video sufficiently to store it in a file on a hard drive, right?

A. Well, let me say that that -- DVI was proprietary, their compression algorithm. They did not release it. And in order, actually, to get that compression, you had to physically send your stuff to -- I believe it was Intel or whoever was implementing the -- the compression. And, so, I think while one of ordinary skill may have known of the existence of DVI, one of ordinary skill certainly didn't know what DVI was doing.

Q. Okay.

A. Intel was very -- that was very important to them.

Q. Were there any algorithms that would have been known to a person of ordinary skill in the art that such a person would have understood would allow you to compress video and store it on a hard drive?

A. Can you ask that again, please?

Q. Yeah. Were there any algorithms that would have been