

1	UNITED STATES PATENT AND TRADEMARK OFFICE	1	REMOTE CONFERENCING DEPOSITION OF MANOS TENTZERIS, Ph.D.	Page 3
2	BEFORE THE PATENT TRIAL AND APPEAL BOARD	2		
3	---oOo---	3		
4	HANSHOW AMERICA INC. AND HANSHOW TECHNOLOGY CO. LTD.	4	BE IT REMEMBERED, that pursuant to Notice, and on	
5	Petitioner,	5	the 16th day of August 2024, commencing at the hour of	
6	V.	6	7:19 a.m., in the respective locations via Zoom, before	
7	SES-IMAGOTAG GMBH	7	me, NICOLE HATLER, a Certified Shorthand Reporter, State	
8	Patent Owner	8	of California, personally appeared MANOS TENTZERIS,	
9	---oOo---	9	Ph.D., produced as a witness in said action, and being by	
10	Case No. IPR2024-00188	10	me first duly sworn, was thereupon examined as a witness	
11	Patent No. 11,405,669	11	in said cause.	
12		12	---oOo---	
13	REMOTE CONFERENCING DEPOSITION OF MANOS TENTZERIS, Ph.D.	13	APPEARANCES ALL REMOTELY VIA ZOOM	
14		14	For the Claimant:	
15		15	CHRISTOPHER J. FAHY	
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1	I N D E X	1	MANOS TENTZERIS, Ph.D.	Page 4
2	PAGE	2	sworn as a witness	
3	EXAMINATION BY MS. KAISER.....4	3	testified as follows:	
4		4	(Exhibits were marked for identification.)	
5		5	THE REPORTER: Good morning. My name is Nicole	
6		6	Hatler, California Certified Shorthand Reporter No.	
7		7	13730. This deposition will be stenographically reported	
8	E X H I B I T S	8	pursuant to CCP 2025.	
9	PAGE	9	EXAMINATION BY MS. KAISER:	
10	PATENT OWNER'S	10	Q. Dr. Tentzeris, this is Jessica Kaiser. I want	
11	Exhibit 1001 U.S. Patent No. 11,405,669.....4	11	to, first of all, make sure that you can hear me all	
12	Exhibit 1002 Prosecution history of U.S. Patent.....4	12	right.	
13	No. 11,405,669	13	A. Yes. I can hear you very well.	
14	Exhibit 1003 Declaration of Dr. Manos Tentzeris.....4	14	Q. Okay. And can you please state your full name	
15	Exhibit 1004 US 20160134930 A1 by Swafford.....4	15	for the record.	
16	Exhibit 1005 US 20170134690 A1 by Masumoto.....4	16	A. It's Emmanouil Tentzeris, but I'm using the term	
17	Exhibit 1008 Certified translation of JP2011-76222A..4	17	Manos, M-A-N-O-S, first name; last name Tentzeris,	
18	By Takashi	18	T-E-N-T-Z-E-R-I-S. So Manos Tentzeris. My official name	
19	Exhibit 1011 Curriculum vitae of Dr. Manos.....4	19	is Emmanouil Tentzeris, E-M-M-A-N-O-U-I-L.	
20	Tentzeris	20	Q. And if I say, Dr. Tentzeris, am I pronouncing	
21		21	that close enough to correct?	
22		22	A. That's correct. That's correct. I mean, if	
23		23	you -- if you don't pronounce the second "T," you're	
24		24	fine. So Tentzeris.	
25		25	Q. Great.	

1 Where are you physically located today? 2 A. I'm in Atlanta, Georgia. I'm at the business 3 room of my high-rise building. So midtown Atlanta, 4 Georgia. 5 Q. And is anyone in the room with you? 6 A. No. Just myself. 7 Q. And do you have any documents with you, any hard 8 copy documents -- 9 A. No. 10 Q. -- first of all? 11 A. No, no, no. I have no documents, apart from the 12 exhibits. 13 Q. And you have electronic copies -- well, let me 14 take a step back. 15 We're going to start today with IPR No. 16 2024-00'188. 17 A. Okay. 18 Q. That is the IPR that involves patent 19 No. 011405669. So I want to make sure we're on the same 20 page there. 21 A. Yes. 22 Q. Okay. And do -- and you have a laptop with 23 documents on it? 24 A. Exactly. 25 Q. And you have the publicly-filed exhibits from	Page 5 1 involved in the past in other cases, but all depositions 2 had to do with IPRs. 3 Q. Have you ever testified -- well, strike that. 4 Let me ask you, for those seven IPR depositions, 5 in all of those, were you testifying as an expert 6 witness? 7 A. Exactly. Yes. The answer is yes. 8 Q. Have you ever testified live at a trial before? 9 A. No, no. 10 Q. Okay. So you've -- you've certainly had some 11 experience with depositions. I want to let you know, 12 I'm -- I'm, unfortunately, still in the process of 13 recovering from COVID. So my voice is a little off and 14 I'm going to be eating cough drops during the deposition. 15 All that is to say that, if for some reason you don't 16 understand a question that I'm asking, will you please 17 let me know so I can state it again? 18 A. Definitely. Definitely. I -- I can -- can feel 19 for you, because most like my daughter has got COVID, 20 and, yes, we did not sleep at all because she had lots of 21 fever and she was coughing the whole time. So I feel for 22 you, definitely. 23 Q. Okay. And as you've been doing so far, I'd ask 24 that, when you answer questions, that you do so verbally, 25 not just with a shake of the head or, you know, a nod.
Page 6 1 the '188 IPR? 2 A. Yes. 3 Q. And the set of exhibits that you have for 4 purposes of this deposition, do they have any notes in 5 them? 6 A. No notes at all. 7 Q. Do they have any highlighting in them? 8 A. Any what? 9 Q. Highlighting. 10 A. No. No highlighting, as well. 11 Q. Okay. So there are clean copies of the exhibit? 12 A. Very clean copies. I mean, I have no -- to 13 know -- to tell you the truth, I have received the 14 compressed file. I checked all of them. I did not see 15 any highlights or any edits, at all, for the exhibits I 16 was given. 17 Q. And you received that compressed file from 18 Counsel? 19 A. Yes. 20 Q. Okay. How many times have you been deposed 21 before? 22 A. Seven times. 23 Q. And were those in IPRs or district court cases 24 or some other kind of case? 25 A. All of them have been IPRs. I mean, I have been	Page 8 1 Do you understand that? 2 A. Definitely, yes. 3 Q. And I think we've been doing a good job of this 4 so far, but I will try and wait until you're done with 5 your answer before I ask the next question, and I'd also 6 ask that you wait until I'm done with my question before 7 you start to answer. 8 A. Yeah. 9 Q. That will just make the court reporter's life a 10 lot easier. Do you understand that? 11 A. Definitely. Definitely. Yes. 12 Q. Okay. And if you feel that I've started a 13 question and you haven't finished your answer, will you 14 let he know so I can give you the opportunity to finish 15 your answer? 16 A. Sure. 17 Q. Your counsel may object to my questions from 18 time to time, but unless he specifically instructs you 19 not to answer, then you still need to answer my question. 20 Do you understand that? 21 A. Yes. 22 Q. And finally, you know, you can let me know 23 whenever you need to take a break. I'll probably try and 24 take a break about every hour, just to give us a chance 25 to mostly, probably for me to drink more water. But if

1 you ask for a break and there's a question pending, I'll 2 ask for you to answer my question before we take a break. 3 Does that make sense? 4 A. Also, are we going to have a lunch break? 5 Q. Yes. We can take a lunch break. And, you know, 6 I know that we're on different times zones. I'm about 7 two hours earlier than you. So maybe when we have the 8 first break, we can talk about when the lunch break will 9 be. 10 A. Great. Great. 11 Q. Okay. I want to see -- again, this is in the 12 '188 IPR. If you can put it in front of you, 13 Exhibit 1011, which is your CV. 14 A. 1011, yes. 15 Q. Let me know when you have that open. 16 A. Okay. Yes. Just open. 17 Q. All right. And is it correct that this remains 18 your current CV? 19 A. There are additional publications that came out. 20 As you know, professors, people publishing -- people are 21 continuously updating the CV. So that's complete up to 22 June 24th, 2023. That's the date listed there. Since 23 the date, there have been more activities, more 24 publications. 25 Q. As you sit here right now, are there any	Page 9 1 feedback on how you can acquire, collect, process, 2 synchronize, and then filter, utilize artificial 3 intelligence to do that. That's activity No. 2. That's 4 not listed there. 5 And also, I have been involved in the variety of 6 some companies and standard committees in this area. So 7 I have participated -- actually, I'm -- what's listed in 8 the CV, I've been the founder and first chair of multiple 9 technical committees, having to do with RFIDs, having to 10 do with internet of things, and having to do with sensors 11 with IPP and -- and would have recently published a 12 variety of these -- a variety of these papers. I would 13 highlight the paper on artificial recalling intelligence 14 service, which is composed by a variety of RF subsistence 15 or RF, as we call, communication titles that have to 16 simultaneously process incoming signals; signals that are 17 very broadband, that are 5G-based. And these broadband 18 signals could consist of audio/video sensing collection 19 data and so on. 20 I would say these are the three major additions. 21 There are another, I would say, 15 publications, and 22 maybe about 10 additional keynote talks. 23 Q. Okay. There was a lot there. So I wanted to 24 make sure that I understood a few points. 25 A. Yes.
Page 10 1 activities or publications that you would add to your CV 2 that are relevant to the technology of the 18 -- or of 3 the patent that's at issue in the '188 IPR? 4 A. I would say one activity for it to do with 5 the -- I will be the chair of the -- 6 (Reporter clarification.) 7 THE WITNESS: I will be -- can you hear me? Can 8 you hear me? 9 Yes. I will be the chair of the newly-formed 10 IPP conference on digital twins that will be held in 11 Atlanta in April 2025, focusing on creating digital 12 twins, utilizing multimedia video, audio, and sensing 13 input to create a digital twins. So I have been selected 14 by IEEE to chair this conference. 15 The second recent event, I was the -- the 16 keynote speaker in IEEE FLEPS conference, FLEPS 2004 in 17 Finland, where I discussed the use of RFID-based 18 technologies or one -- 19 (Reporter clarification.) 20 THE WITNESS: RFID-based technologies and other 21 wireless technologies to realize smart infrastructure 22 encompassing a variety of input data. That was, as I 23 told you, FLEPS conference. I was invited this 24 conference after the CV was admitted. I gave a 25 presentation in front of 1,000 people and gave some	Page 12 1 Q. In the first addition that you raised, you 2 talked about digital twins. Is that T-W-I-N-S? 3 A. T-W-I-N-S, exactly. 4 Q. Okay. And what -- what did you mean by digital 5 twins? 6 A. Digital twins is some IEEE technology that has 7 been investigated, I would say, since 2010 with the 8 proliferation of low-cost sensors or low-cost wireless 9 devices for RFIDs. And this approach aims in creating a 10 virtual representation of the natural word. 11 So, for example, if you have an inventory, if 12 you have a logistic area, if you have some area with item 13 tracking, item localization, and you want to be able to 14 have a real-time idea of what's taken place; then you 15 utilize this collective technology, which is called 16 digital twins. In the sense, digital twins is some 17 collective term, I would say, that combines ideas or that 18 would enable intelligence. 19 So it's an evolution of an internet of things 20 that started in the mid-2000s, and now it moves to whole 21 areas. And I'm sure you have heard the term smart 22 cities, smart infrastructure, and even -- I would say 23 everybody is using the term smart now, smart electronic 24 something. And digital twins, what makes it unique, and 25 that's why I established this conference, that it's not

1 only wireless technology, not only wireless 2 infrastructure, but also it involves multiple signals 3 with different bandwidths, different frequencies, a.k.a. 4 audio signals, pinging signals like the RFID 5 interrogation or NFC reading, broadband videos, videos of 6 low quality, 4K videos, high definition TV videos, even 7 interactive videos. That means videos from multiple 8 sources, and that's the second level. 9 And the third level is have some power efficient 10 processing unit. So you have to do it with low cost, and 11 you are not limited by numbers, in the sense that's 12 highly scaleable and that's highly sustainable. 13 And so, digital twins, I would say, addresses 14 the famous 5S challenge, where it has to do with 15 security, sustainability, scalability, speed, and sensing 16 in an integrated way, and that's for digital twins. 17 Q. Okay. Exhibit 20 -- I'm sorry. Strike that. 18 Exhibit 1011, which is your CV -- 19 A. Yes. 20 Q. -- is 95 pages long. I want you to go to page 21 81. 22 A. Page of 81. 23 Q. And this is in your list of publications? 24 A. Yes. 25 Q. If you look at item No. 527.	Page 13	1 remotely of some landscape or some object started around 2 2007 when you see some modified displayed on tires. In 3 other words, a project we had with Pirelli from Italy. 4 And also random some experiments in Georgia Tech Ireland, 5 what's cumulated in some papers in 2010. And I would say 6 that was the beginning of digital twin. 7 Now we started officially using the term digital 8 twin instead of localization, RFID, multimedia, after 9 2020 because that was when it was officially approved by 10 IEEE. 11 Q. So if I wanted to know what -- which of your 12 publications related to similar technology to digital 13 twins, that wouldn't be every paper that mentioned RF -- 14 RFID, correct? 15 A. RFID and NFC was one of the critical 16 technologies to enable, what I told you before, 17 scalability feature. So that was one of the enablers. 18 Now, to come up with digital twins, it's well-known there 19 were three major enablers. One was low cost 20 communication identification sections. So until 2007 -- 21 or I would say 2005, where we started analyzing the RFIDs 22 in UHS and our team, I would say we are the first team in 23 the world doing that in papers. So until then, RFIDs 24 were utilized just for pet tracking and then smart dogs. 25 Since you live in California, you remember,
1 A. Yeah. 2 Q. Digital twins, do you see that? 3 A. Yes. Yes. 4 Q. And you see that -- that has -- that publication 5 has a date of 2021? 6 A. Exactly. 7 Q. I'll represent to you that this is the first 8 mention of digital twins that I could find in your CV. 9 Does that -- strike that. 10 Does that -- would it be correct to say that 11 your publications related to digital twins began in about 12 2021? 13 A. What I would say is, as you can see, in the 14 evolution of publications, we use terms only after they 15 are officially approved by IEEE. Since I'm a member of 16 different IEEE standardization, I'm extremely careful 17 with using these terms. So before we convert to some 18 definite understanding, I don't use it. So there is a 19 variety of, I would say, previous incarnations of digital 20 twins. And you can see, for example, a variety of 21 localization papers. You can see a variety of 22 identification papers. And as I told you, digital twins 23 is a collective term. 24 So answer is I've been involved in digital 25 twinning, or I would say ways, to experience real time	Page 14	1 like, barely auto -- automatic tolls. So after 2005 when 2 we started extending this to radio frequencies, then it 3 made the cost for identification and localization drop by 4 two or three scales of magnitude. And that's why digital 5 twins started becoming -- started getting utilized by a 6 variety of items, because they figured out it was not 7 just a toy for pets. It was not just an instrument for 8 DOTs, that it could be used for each and every item. 9 So I would say, all papers having to do with 10 RFIDs and NFCs are demonstrating the foundation of the 11 enabled technology for digital twins because these are 12 the first papers showing how the tags can be utilized in 13 complex environment, typically not being equipped with 14 this technology in the past. And the other two enabled 15 technologies, I told you, the other was, like, additive 16 manufacturing, which is not critical for our discussion, 17 and -- 18 (Reporter clarification.) 19 THE WITNESS: Additive -- additive 20 manufacturing, A-D-D-I-T-I-V [sic] manufacturing. 21 And the third one was the invention of -- of low 22 cost materials, like PCB mode. So these were the three 23 major enabled technologies. But I would say RFID and NFC 24 was really, really important. 25 Now, the reason I'm referring to materials is

1 because you may be wondering why do we care about 2 materials, about our discussions today. Typically, all 3 of the main challenges for the low-cost communication 4 sections has to do with the fact that low-cost materials 5 are not very good electronic materials. So cost and 6 performance is not something given whenever you are 7 talking about RF frequencies. And that's why I refer to 8 the proliferation of low cost lab materials. That 9 enabled the collection of not only audio -- because let's 10 recall the time before 2001 we had no cell phones. We 11 had no issue using like the bulky old telephones to get 12 the audio signals. But for the first multimedia 13 carrier -- and I remember the first Nokia phone in 2003. 14 That was, kind of, a plant cell from we first analyzed in 15 our lab, that had to be able to receive not only audios 16 but multiple videos. And then whenever you tried, for 17 example, to process that, it was not a straightforward 18 because they were really bulky. 19 So these three enablers were really critical, 20 and that's what led to the foundation of the digital 21 twin. That has now proliferated. I mean, we're 22 currently working -- in some project we're having with -- 23 (Reporter clarification.) 24 THE WITNESS: Yes. So what I said is these 25 technologies allowed the digital twin principle to	Page 17 1 that fair? 2 A. I would probably disagree. These publications 3 for RFIDs that are listed on my CV are creating digital 4 twins. The tires without the RFIDs were impossible to 5 track, were impossible to position, were impossible to 6 locate. And then add the RFIDs, it was possible to 7 pinpoint very, very accurately where they existed. 8 On the other -- in addition to this, just to 9 give you another reason why this RFID papers are, in 10 reality, digital twins, you will see on a lot of my 11 papers the term RFID enabled sensors. Now -- and you can 12 see -- I cannot recall how many, but it's a lot. It 13 could be maybe 50, could be 60 papers, because we're the 14 first ones coined this term. So RFID enable sensors 15 means devices that do not just give out the ID, or they 16 don't just create some ID for the systems, but they can 17 be utilized for position of this. They can be utilized 18 for tracking critical features of this. 19 So one of the main issues, one of the main 20 challenges was that most of the radio frequency systems 21 before the digital twin generation was, if you 22 interrogated an RF system, you were just getting back a 23 code, or you were just getting back just very small 24 amount of data, but you could not add information. Now 25 utilizing RFID enabled sensors, you could customize the Page 19
Page 18 1 proliferate all over the world. And just to give you one 2 point of the proliferation -- actually, the call I had 3 before this Zoom meeting had to do with Singapore, where 4 they're trying to create a digital twin for the whole 5 city, not only for some department stores or some 6 shopping malls. So that's -- that's where we have 7 reached, all the way from 2005, all the way to today. 8 BY MS. KAISER: 9 Q. So Dr. Tentzeris, I'm going to just object to 10 the vast majority of your answer as being nonresponsive 11 to my question. And I -- I want to -- I'm not doing that 12 to be rude, but I just want to flag I'm trying to ask 13 very specific questions so that I can have an 14 understanding of your -- right now, we're focused on your 15 CV and your experience. And so, for example, I didn't 16 ask anything about materials of RFIDs or anything like 17 that. 18 My question was, if I wanted to know which of 19 your publications related to technologies similar to 20 digital twins, that wouldn't be every paper that 21 mentioned RFID. And I -- so I guess my understanding 22 from your answer, and tell me if this is right, is that 23 the papers that mention RFID may provide some foundation 24 for technology that later became digital twins, but they 25 wouldn't necessarily all talk about digital twins; is	Page 20 1 information for every item. And you could enable all the 2 month additional information that constitutes digital 3 twinning. Digital twinning means you get different 4 amount of information on demand for virtually everything 5 around. So whenever you're talking about RFID enabled 6 sensors, that's digital twin. 7 Q. Okay. So I'm going to move off of digital twins 8 for the moment because I think we're a little bit off 9 track anyway. But I want, as we go forward, to you -- 10 for you to listen carefully to my questions. And if 11 you -- if they're possible to answer in a yes/no format, 12 I'd like you to do that, and then if you have additional 13 explanation, let me know. Okay? 14 A. Okay. 15 Q. So if you can go back to Exhibit 2011. 16 A. Okay. 1011 or 2011? I don't have any 2011. 17 Q. I'm sorry. 1011. 18 A. Oh, okay. 19 Q. Thank you. And if you could go to the first 20 page of Exhibit 1011. 21 A. Okay. 22 Q. You earned your master's degree in 1994; is that 23 correct? 24 A. That's correct. 25 Q. And what was your master's degree in?

1 A. That was in wireless technologies and RF 2 communications systems. My advisor was a -- professor 3 Linda Katehi, he was my advisor also for my Ph.D. 4 Q. What -- what department were you studying in for 5 your Master of Science? 6 A. That was School of Electrical Engineer and 7 Computer Science, then called EECS, from University of 8 Michigan in Ann Arbor. 9 Q. Okay. And then within the EECS department, the 10 focus of your master's degree was in wireless 11 technologies and RF communication systems? 12 A. That is correct. It had additional, like, 13 electromagnetics, and also modeling and design of 14 integrated systems. But I would say these were the two 15 major focal points. 16 Q. Did you complete a thesis as part of your 17 master's degree? 18 A. I believe so. It's quite some time ago. I 19 believe so. You know, the time -- that time 1994, my 20 thesis was more like a report, I would say. Like, 21 30 pages or something like that, but I believe so. 22 Q. Do you recall what the topic of your master's 23 thesis was? 24 A. Honestly, I cannot recall the exact topic. I 25 know that it had to do with RF and wireless systems,	Page 21 1 space environment was, we decided to extend our analysis 2 for longer. And even we came up with the technique to 3 analyze and design the systems out of scraps, which was 4 utilizing wavelengths. And that was a time adaptive 5 system trying to catch these delays for the signals, for 6 different isolated areas of the International Space 7 Station. 8 But I cannot recall the frequency. I made this 9 source quite some time ago. I know the specifics of the 10 landscaping we tried to deal with. 11 Q. As part of your master's thesis work, did you 12 write any software? 13 A. We wrote a lot of software basis. In the sense 14 this software, if I remember correctly, because I did not 15 have the rights to belong to the university. And now I 16 believe University of Michigan licensed some part of this 17 software to some companies performing design of wireless 18 networks, or I would say, arbitrary place wireless 19 modules of communication modules, utilizing 20 electromagnetic technology. 21 Q. So after you finished your master's degree at 22 the University of Michigan, did you then stay at the 23 University of Michigan and continue on to work on your 24 Ph.D.? 25 A. Yes. That all was correct. Page 23
1 design and modeling. I cannot recall the exact 2 applications. Definitely recall that had to do with some 3 master's systems and some other systems for DOD. So I 4 can't recall the exact systems. It's quite some time. 5 Q. Did -- did it have to do with any sort of 6 network topology of the wireless systems? 7 A. It had to do with -- with use interference from 8 implementation of multiple RF systems. Also, it had to 9 do with mapping of -- field mapping with field strength. 10 Because one of the main issues had to do with the fact of 11 how we could simultaneously communicate with different 12 communication modules. If I remember correctly, the NASA 13 system that we had on arise that had to do with interior 14 of supplementary space station, and we had to transfer 15 data to different nodes that were placed in different 16 areas of -- of ISS. And one of the main issues was 17 actually that you had the very significant multipath. So 18 the signal had localized time delay. So in a sense, the 19 same signal was arriving at the different time instance. 20 And my -- my thesis ended up addressing this issue, or in 21 a sense, predicting what the problem was and correct it. 22 And this was -- and the challenging problem actually that 23 extended the Ph.D., because in the beginning, when I was 24 master's degree, I was not thinking about Ph.D. But then 25 thinking about how complicated the communication within Page 22	1 Q. Okay. 2 A. So -- so as I told you, this system design was 3 quite complicated, and we have no simulation tools. On 4 the other side, I wanted to work in academia afterwards. 5 So I decided to stay and get the Ph.D., as well. 6 Q. And that was still in the -- the electrical 7 engineering and computer science department? 8 A. Exactly. 9 Q. And did you do a thesis as part of your Ph.D.? 10 A. Yes. Yes. 11 Q. Do you recall what the title of that thesis was? 12 A. I cannot recall. I know the features. The 13 exact thesis, I have to look at that one. I'm sure you 14 can look it up. But mostly, it had to do with a fact of 15 developing a new multi-resolution suite, multi-resolution 16 M-U-L-T-I-R-E-S-O-L-U-T-I-O-N. In other words, bring new 17 technique, multi-resolution, utilizing wavenet theory to 18 pretty much keep track of the time delays, the fading 19 effects, the -- the blind spots, and also the spacing of 20 different wireless modules that can be seen. And the -- 21 the main advantage of this technique was that if -- you 22 did not need a super computer to do that. You could do 23 that pretty much using a work station. So that was the 24 main point. 25 Q. And when you say you didn't need a super Page 24

1 computer to do that, do you mean modeling 2 multi-resolution to -- to optimize hardware, for example? 3 A. Exactly. Exactly. Now, this technique -- I 4 mean, typically, the modeling techniques, whenever you 5 tried to install some, let's say, wireless devices. So 6 UR, Verizon, or you could be one of these companies in 7 this case. There are two ways to do it. One way to do 8 it is you are -- you're going to send some engineer with 9 some measurement device of electromagnetic interference. 10 And they do an electromagnetic map or your landscape 11 utilizing the bridge. And then you start installing 12 modules from electromagnetic systems in a way that they 13 don't interfere and block each other. 14 Now, our technique would enable people to do 15 it -- 16 (Reporter clarification.) 17 THE WITNESS: To do it E-R-I-O-R-I [sic], a 18 priori, that means in advance. So we could do it in 19 advance without needing an engineer to go there. So you 20 can have the landscape in some other cart, and then in a 21 sense, you were following the wavefront -- front. 22 So, for example, if NASA wanted to add another 23 display at the sleeping compartment of the astronauts, 24 you did not need to send an astronaut to do a walk-inside 25 or some network analyzer to see that. So you could see,	Page 25	1 (Reporter clarification.) 2 THE WITNESS: Even in a cluttered environment, 3 C-L-U-T-T-E-R-E-D. Because that's -- that's a major 4 point. You don't have an open room. You had people 5 walking. You had items on the cells. You had flying 6 objects due to lack of gravity and all these things. So 7 synchronization of the signal was really critical. 8 BY MS. KAISER: 9 Q. And in the answer you just gave, you talked 10 about a cluttered environment. When you have a cluttered 11 environment, would you agree that interference between 12 different devices and antennas is something that you -- 13 you consider in your real-world results? 14 MR. FAHY: Objection. Form. 15 THE WITNESS: Can you repeat the question? 16 BY MS. KAISER: 17 Q. Sure. I'll try and say it slightly better. 18 So I'm just trying to understand what you mean 19 by cluttered environment. And my understanding would be 20 that in cluttered, you're talking about you've got a 21 number of different devices that are transmitting. And 22 so, you can have clutter, for example, from interference 23 between those devices? 24 MR. FAHY: Same objection. 25 THE WITNESS: Can you say that again?	Page 27
1 okay, if you place it at this point, you have a pretty 2 good signal, No. 1, really important. And then you could 3 estimate the delay due to multipath, due to fading, due 4 to the different distance from the gateway. And that -- 5 that was a big deal because that saved lots of time in 6 the optimization of these systems with multiple microwave 7 device close to each other. 8 Also, would call it -- that was the first truly 9 time and space adaptive telephony magnetic tool. 10 Q. So, Dr. Tentzeris, at a really high 10,000-foot 11 level, would you agree that your work, both in your 12 master's thesis and in your Ph.D. thesis, was broadly 13 focused on using simulations to optimize hardware that 14 had transmission antennas? 15 MR. FAHY: Objection. Objection. Form. 16 THE WITNESS: So the answer is no. This is 17 one -- one part of what I told you. Now, the other part 18 is -- is all of these results were tested in real world, 19 were validated with real devices, and they were 20 benchmarked. They were benchmarked for a variety of 21 audio and video and pinging signals and confirming that 22 this approach enables some well-working optimized 23 performance of time and space; calibration time and 24 space, synchronization, even in a cluttered environment 25 like this.	Page 26	1 MR. FAHY: I said, "Same objection." 2 You can answer. 3 THE WITNESS: Okay. So, typically, whenever 4 this term is used in IEEE, it has different meanings or 5 different operational scenario. Clutter, for what we 6 did, the -- 7 (Reporter clarification.) 8 THE WITNESS: When I did my thesis. So I'm 9 referring the context of my thesis for the term clutter. 10 There were different materials around that would 11 affect the propagation of the electromagnetic waves. 12 Now, I stress that in regarding the thesis clutter meant 13 known for space. So you would have boxes. You would 14 have water. You could have humans, who are almost water. 15 And these could have some impact on the strength of the 16 electromagnetic wave going through. 17 So, for example, now, in the '90s, and I would 18 say in the '80s, let me give you some context for this 19 clutter and why clutter was important. I would say in 20 the -- in the '90s, people were interrogating these low 21 frequency -- they would transmit information using 22 infrared, infrared readers. They were low cost. They 23 were operating at 40 kilohertz, 38 to 40 kilohertz, and 24 they were at 40 percent. And that was, I would say, 25 the -- the low hanging fruit. But the problem was the	Page 28

1 limited information and also the limited range. So since 2 that was an issue, people had to investigate RFI wireless 3 technologies. And that's how we tried to see what were 4 the potential challenges of doing that. And we found 5 ways to eliminate these challenges and make the RF or the 6 microwave frequencies the standard to start communicating 7 slowly, and now it's almost everywhere. 8 BY MS. KAISER: 9 Q. Going back to yours CV, which is Exhibit 1011. 10 A. Let me go back. Okay. Sure. 11 Q. After you finished your Ph.D. in 1998, then you 12 become a professor, correct? 13 A. That's correct. That's correct. 14 Q. And you have been a professor since 1998? 15 A. Exactly. 16 Q. So I think my math is right. You've been a 17 professor for about 26 years; is that accurate? 18 A. That's correct. I had my 25-year celebration 19 quite recently. Yes. 20 Q. And have you ever worked in the industry outside 21 of Academia? 22 A. Really important part of our group, and you can 23 see in some acknowledgements, and even in some of my 24 presentations, has been a very broad interaction with 25 industry. So our work, despite been work leading in many	Page 29 1 Have you ever been an employee of a corporation 2 and industry outside of Academia? 3 A. I have never been an employee. 4 Q. Okay. 5 A. I have employee -- actually, we're forbidden to 6 be employees of industry. That's one of the fundamental 7 tenants of Georgia Tech. So I'd have to take a leave of 8 absence to be employed there. 9 Q. So going back to your -- 10 A. If I can say something, just to be 100 percent 11 accurate, I have been a co-founder of a start-up that's 12 run by one of my students that see the founding of this 13 start-up, I've been mostly a scientific advisor. And the 14 name is Athraxon. So the company is still running and 15 utilizing -- 16 (Reporter clarification.) 17 THE WITNESS: Athraxon, A-T-H-E-R-O-X-A-N -- so 18 A-T-H-R-A-X-O-N. And that's run by my student. I'm just 19 advisor now. And that focuses on item localization in 20 trucking in complex electromagnetic environments. 21 (Reporter clarification.) 22 THE WITNESS: In complicated -- complex 23 electromagnetic environments. 4. 24 BY MS. KAISER: 25 Q. And to be clear, did you say trucking?
Page 30 1 areas, we want to validate that in the real world. So 2 I've interacted with, I would say, most of the leading 3 industry in the past, in this area. And, actually, to 4 tell you the truth, my -- my previous Ph.D. students now 5 hold leading positions in a variety of these companies, 6 ranging from Apple and Qualcomm to -- to places like 7 Northrop or Amazon, working in smart inventory, so smart 8 localization, actually. This is one of the -- one of the 9 areas. If you look at my publications, localization 10 tracking position is quite critical. We've come up with 11 different ways of doing that. And that's where my 12 students has developed absolutely the algorithm -- one of 13 the preliminary algorithms for delivery of items with 14 drones. 15 So you may have heard about this, but to do 16 that, the drones have to be able to go, pick up the right 17 stuff, the object, and then deliver it to your home, 18 which means pretty accurate localization tracking, as 19 well. 20 So the short answer is, yes, we have worked with 21 a lot of companies all over the world. 22 Q. Okay. And I understand that, in your research 23 as a professor, that you've worked with companies. 24 A. Yes. 25 Q. My question was a little bit different.	Page 32 1 Like, T-R-U-C-K-I-N-G? 2 A. Yes. Yes. Trucking. 3 Q. And by trucking, did you mean actually 4 transporting items on trucks? 5 A. No. Utilizing the -- the -- the microwave or 6 the radio frequency meaning of trucking. Well -- whose 7 functionalities identity the time varying position of 8 some items. So positional status of an item. That's the 9 main function of the term tracking. 10 Q. Okay. And are you saying -- let me just clarify 11 again. 12 Are you saying tracking, T-R-A-C-K-I-N-G? 13 A. That is correct. 14 Q. Okay. Sorry. I -- I heard trucking with a U, 15 and I wanted to make sure we were on the same -- 16 A. No, no, no. This is -- this is the spelling you 17 used last. 18 Q. Okay. If you go back to Exhibit 1011 -- 19 A. Okay. 20 Q. -- which is your CV. And you go over to the 21 very last page, which is page 95. Let me know when 22 you're there. 23 A. Page 95. That's correct. 24 Q. Do you see the last section on page 95 of 25 Exhibit 1011 is titled, "Expert Witness/Litigation

1 Experience"? 2 A. That is correct. 3 Q. If you look at the first bullet point, do you 4 see at the end you have bolded all claims accepted by 5 IPTO? 6 A. Yes. 7 Q. What is IPTO? 8 A. That was a term -- that was something that was 9 given me by Fish & Richardson. So they said all claims 10 we challenge where accepted by PTO. Now, I -- I asked 11 them about the term IPTO and not just PTO or P-tab. And 12 they said -- release it as IPTO. So in a sense, that 13 PTO. 14 Q. Okay. In your understanding, that's the 15 U.S. Patent and Trademark Office? 16 A. Yes. 17 Q. Okay. In the -- the first bullet point here, 18 the LG versus NFCT matter? 19 A. Yes. 20 Q. Did you represent the patent challenger or the 21 patent owner? 22 A. I represented the challenger. 23 Q. Okay. And then for the second matter, HTC 24 versus NFCT, there, did you represent -- or were you an 25 expert on behalf the patent challenger or the patent --	Page 33 1 that you now remember that the first bullet point -- 2 A. I remember -- 3 Q. -- after the patent -- and if you could let me 4 finish before you start talking. So let me -- let me say 5 that question again. 6 For the first bullet point, since you said all 7 claims accepted by IPTO, and you think that means 8 un-patentability claims that -- 9 A. That -- please. Sorry. Please. 10 Q. That would refresh your memory that you were on 11 behalf of the patent challenger in that matter? 12 A. That meant we were successful. That was the -- 13 that was the whole point. And I -- any time I take the 14 list of all claims accepted by IPTO, the whole meaning is 15 our side was successful. 16 Q. Okay. 17 A. That's -- that's all I can recall. Now, I 18 cannot recall more about this, but that means our team 19 was successful. 20 Q. Okay. And then if you go to the fourth bullet 21 point, it says DeCurtis versus Carnival Cruises. 22 Was that -- was that an IPR matter? 23 A. Yes. 24 Q. And you were deposed in that matter? 25 A. Yes. Page 35
1 A. I believe so. I believe so. 2 Q. You believe -- 3 A. I don't remember 100 percent, but I believe so. 4 Because it's been -- it's like 2014, 2015, so about 5 15 years. So I cannot even recall the specifics of this 6 deposition, to tell you the truth. 7 Q. Okay. But to the best of your recollection, 8 on -- in that second bullet point matter, you were on 9 behalf of the patent challenger? 10 A. I cannot recall. I would say it's likely. 11 Q. Okay. And then the HID versus Morphotrust in 12 the third bullet point here, do you see that? 13 A. I -- I remember I represented the HID, but I 14 cannot recall if it was the challenger or the owner of 15 the patent. Maybe I was the challenger. But I 16 represented HID. 17 Q. Okay. And going back to the first bullet point, 18 when you say all claims accepted by IPTO, when you say 19 "claims," do you mean patent claims? 20 A. So what I meant in this one was actually sent to 21 me by Fish & Richardson. What I meant was all claims 22 challenged by -- by us where -- were accepted by the 23 IPTO. So in a sense, we prove that the claims were -- 24 were obvious. That's what I meant. 25 Q. Okay. And so, it sounds like, then, that --	Page 34 1 Q. Do you recall whether that was one IPR or 2 multiple IPRs? 3 A. I cannot recall. I cannot recall. 4 Q. And do you know what the outcome of that matter 5 was? 6 A. I was never informed. That's why I have not 7 listed anything. In other words, the time just after 8 COVID, I was deposed, and then there was zero 9 communication. So I did not even ask. 10 Q. Okay. And then underneath that -- so this would 11 be the fifth bullet point. It says, "Five additional IPR 12 cases." 13 Do you -- you know in those five additional IPR 14 cases, whether you appeared on behalf the patent owner or 15 the patent challenger? 16 A. I believe it was mixed. 17 Q. Mixed? 18 A. I believe it was mixed. It never reached 19 deposition stage, but it was mixed. 20 Q. Going back to the two -- the first two bullet 21 points, which are the versus NFCT matters, do you recall 22 what the general technology of those matters was? 23 A. I cannot truly recall, but reading NFCT, most 24 likely it had to do something with NFC. So reading the 25 name of the company, NFCT, I guess that was, like, Page 36

Page 37 1 NFC-based technology. May be wrong, but reading the 2 name, I would correlate this possibly with NFC 3 Technologies. 4 Q. Okay. But you're not sure about that? 5 A. I'm not sure. I have to look it up. I mean, 6 it's been, like, more than 10 years ago. So looking at 7 LGHTC and NFCT, mostly, I believe had to do with 8 something in radiofrequencies. LGHTC are major companies 9 in cell phones. And NFCT most likely had to do with NFC, 10 unless I am mistaken. So -- 11 Q. For the HID versus Morphotrust matter, that's 12 the third bullet point. 13 Do you recall the general technology there? 14 A. HID, I can only recall the generic technology, 15 which only had to do with HID cards. I don't remember 16 the details. It had to do with HID cards. 17 Q. If you go up on the same page, so this is page 18 95 of Exhibit 1011, there is a section that's labeled, 19 "Campus Contributions." 20 Do you see that? 21 A. Yes. 22 Q. And the first bullet point says that you were 23 the associate director for RFID and Sensors Research at 24 Georgia Electronic Design Center? 25 A. That is correct.	Page 39 1 box or inside this container. So migrating from the ID 2 acquisition and display in your computer to some much 3 more complete information about the specific item, 4 information how not only to do with its ID, but some 5 video of the surroundings or some sensing content about 6 what's inside, or what's the temperature, what's the 7 humidity. So they collected, initially, about, I would 8 say, 50, 50 faculty. And they thought, Okay, now you 9 have a model building in your building, which is a 10 variety for downtown Atlanta, Georgia Tech is -- so it 11 was quite nice for us. Five-floor building, and you 12 build not only radio frequency sections, but you build 13 whole systems. 14 So let's say you place 50 screens on different 15 levels, and you can even see them today. If I walk by, 16 you can see the screens. How you can stow some 17 information for people visiting these different levels. 18 Because they -- for example, fifth floor has to do with 19 RF and wireless hardware technologies. Fourth floor has 20 to do with -- 21 (Reporter clarification.) 22 THE WITNESS: The fifth floor has to do with RF 23 and microwave technology. The fourth has to do with MEMS 24 accelerometer systems. 25 (Reporter clarification.)
Page 38 1 Q. What did that -- the research during that time 2 at the Georgia Electronic Design Center encompass? 3 And it's a -- just from a 10,000-foot level. 4 A. Okay. So Georgia established this center. 5 Actually, governor of Georgia established that in 2002. 6 And the idea was to create a center, that, for the first 7 time, would integrate faculty from different disciplines 8 to come up with new systems having to do with adding, as 9 they call them, ambient intelligence. In other words, 10 the term that was quite commonly utilized, ambient 11 intelligence. I would say that's quite similar to 12 digital twins nowadays. That was ambient intelligence. 13 Now, ambient intelligence meant you have -- you 14 have a cellphone or you have some -- some computer, and 15 the main -- the main challenge was -- and that was given 16 to us from the governor of Georgia as a directive. 17 Sevana is one of the top three major end reports of 18 containers in the U.S. So can you find ways of 19 installing RF systems to items going all the way from a 20 small box to the size of a container? Can you install RF 21 or microwave systems there that could give you, not only 22 the information of the ID, but additional information? 23 So create real-time video from the place they are stored, 24 just to optimize the start-ups, the port, or to provide 25 more information about the status of what's inside this	Page 40 1 THE WITNESS: Accelerometer, A-C -- 2 (Reporter clarification.) 3 THE WITNESS: The MEMS, M-E-M-S, MEMS, 4 micro electromechanical systems. And the first floor has 5 the demonstrators. 6 So the question was, can you realize some 7 building where somebody would watch some specific 8 information about the floor, because, you know, if you 9 have a visitor from the first floor, he might not care 10 about information from the fifth floor. So go to the 11 first floor and when you show some of the videos that 12 show the achievements in the systems, or point you to 13 the -- to the rooms that the demonstrator is. For 14 example, Room 112 has to do with RFI demonstrators or 15 NFC. Room 115 has to do with flexible wearable robotics. 16 So that was the idea. 17 Before 2002, almost everything was typed. So 18 some pictures of professors or all this. So the idea was 19 to show -- to have some infrastructure -- real 20 infrastructure people would visit that could give 21 customized information utilizing the technologies that we 22 develop. That was, kind of, a live demonstration. And 23 that -- that was a main topic I was the associate 24 director of. So we're trying to coordinate these efforts 25 and do the broad amount of integration analysis of

1 benchmarking. 2 Now, obviously, there was a director on top of 3 me, but the director was also involved in the 4 microelectronics, as well. And that's why I was the 5 associate director for this set of problems. Now, the 6 director was also directing the microelectronics, new 7 electronic devices, such as -- 8 (Reporter clarification.) 9 THE WITNESS: Such as silicon-germanium, S-I-G-E 10 transistors, Gallium Arsenide, G-A-A-S, transistors, and 11 so on. So developing the microelectronic components that 12 would bring down the cost and maintain good performance. 13 And also, there was a third leg for the Georgia 14 Electronic Design Center, which had to do with optics. 15 So the director was advising, not only was supervising, 16 if you could say this term, not only me, but the other 17 two associate directors. And we demonstrated, in a -- in 18 a sense, what we wanted to do was we want to show that 19 there exist not only media lab in MIT, but also there 20 exist an even more successful intelligent building in the 21 south, as well. So that was the other motivation. 22 BY MS. KAISER: 23 Q. Dr. Tentzeris, I just -- for purposes of me 24 understanding your CV, I wanted to ask about a couple of 25 acronyms that are on here.	Page 41 1 on the record. 2 MS. KAISER: Mr. Fahy has filed motions for 3 pro hac vice admission in all three of the IPRs, the 4 '188, the 189, and the 208, I believe. It's my 5 understanding that none of those motions have yet been 6 granted; although, I don't believe that we oppose those 7 motions. I'm proceeding with the deposition with the 8 understanding that, as soon as practical afterward, 9 Mr. Fahy's firm is going to reach out to the board and 10 ask the board to act on those motions. 11 MR. FAHY: Will do. And we appreciate your 12 accommodation. 13 BY MS. KAISER: 14 Q. Okay. So with that formality aside, we'll go 15 back then, Dr. Tentzeris, as to you. 16 Prior to the break, you were talking about your 17 position as the -- 18 A. Georgia Electronic Design Center. 19 Q. Yeah. Associate director for RFID and Sensors 20 Research at the Georgia Electronic Design Center, and I 21 appreciate you giving me more context about what that 22 involved. 23 I wanted to ask, in your experience, either 24 there or otherwise in your career, are you familiar with 25 the term antenna topology?
Page 42 1 A. Great. 2 Q. So is it correct that ECE stands for electrical 3 and computer engineering? 4 A. That's correct. 5 Q. And then RPT, what does that stand for? 6 A. It's Reappointment Promotional Tenure Committee. 7 We evaluate the different faculty and figure out, based 8 on progress, whether we promote it or whether they would 9 not be renewed. 10 You know, Georgia Tech is quite interesting. 11 Faculty do not have 100 percent tenure. So they're 12 reevaluated every three to five years, and that was the 13 committee that's called the RPT Committee. 14 MS. KAISER: Okay. I think we've been going for 15 about an hour. So let's go ahead and go off the record 16 and take a break. 17 (A recess was held from 8:26 a.m. to 8:39 a.m.) 18 BY MS. KAISER: 19 Q. All right. I understand we're back on the 20 record. 21 Welcome back, Dr. Tentzeris. Before we get 22 started again with questioning, I realized that I had 23 talked to Mr. Fahy earlier about something that I 24 neglected to put on the record. Not -- not super 25 relevant to you, Dr. Tentzeris, but I'm going to put it	Page 44 1 A. I have utilized it in a variety of our papers, 2 so the term topology. Now, topology, again, departs from 3 context, to tell you the truth. So I was wondering if 4 you could be more specific topology for -- topology for 5 what? That would be -- 6 Q. Antenna topology. 7 A. Antenna topology. 8 Now, what -- what I would appreciate if you gave 9 me some context for this antenna topology. Because the 10 reason I'm asking is, if you go to the antenna 11 propagation symposium, which is a major IEEE conference. 12 And, actually, I chair this conference in 2019. This 13 term is utilized in different ways. 14 Now, some people may say that antenna topology 15 means the spatial distribution of different antennas. 16 That's one way people are using it, the ITP, APIs 17 society. 18 Another way people could translate it, what is 19 the shape that you mount your antennas. So is it linear, 20 is it trapezoidal, is it cubicle, and so on. 21 Third way of topology, antenna topology, has to 22 do with how you set up some simulation for this, and 23 that's coming out of the mathematical definition of 24 topology. You know, topology is a mathematical term, as 25 it started. And that's a whole section of mathematics.

1 And that's why I ask about the context because, to my 2 opinion, they're different translations of this term for 3 antenna experts. 4 Q. Okay. That's helpful. 5 So if I talked about in the context of a 6 communication network -- 7 A. Again, I would give you these three translations 8 because all three could be valid for communication 9 networks. 10 Q. Okay. Can -- so one of the ways that antenna 11 topology can be used is to refer to the physical 12 locations of antennas at different devices within a 13 communication network? 14 A. Can you say that again? 15 You said antenna topology is different location 16 of antennas on -- because you use the term different 17 twice. That's why I got confused. You were like, 18 different location of antennas on different systems. 19 Q. Okay. I think I actually only used the word 20 different once, but let me -- let me say it again. 21 A. Please. 22 Q. One of the ways that antenna topology could be 23 used is to refer to the physical locations of antennas at 24 different devices within a communication network? 25 MR. FAHY: Objection. Form.	Page 45 1 antenna topology, you would include the location of the 2 base stations as the base stations? 3 MR. FAHY: Objection. Form. 4 THE WITNESS: It -- it could be either way. If 5 you were a field engineer working on a 5G network and 6 cell formation, typically the base station is when -- 7 because that's installed before the rest of the antennas. 8 Then it could release just the antennas of the -- of not 9 the base station, but maybe the peripherals or the 10 mobiles you are holding or some repeaters or some other 11 wireless devices. 12 Now, if you are the -- if you are now the 13 network planner and not a field engineer, talking about 14 topology would mean choosing the position of the base 15 station with respect to the other base stations and also 16 the other antennas you distribute within the cell. So it 17 really depends on the context. 18 BY MS. KAISER: 19 Q. Okay. Okay. That's helpful. 20 In the context of communication networks, are 21 you familiar with the term hub and spoke? 22 A. Hub and spoke? Can you -- can you be more 23 specific? This is a term that I have not heard in my 24 aptitudes standards community. Can you be more specific 25 about what the meaning of hub and spoke? Page 47
1 THE WITNESS: Now, topology, typically, as I 2 told you, has to do with different spatial distribution 3 over -- over an area. Now, correlated with just physical 4 location could -- could be topology or could not be 5 topology. As I said, this spatial distribution, so how 6 you place antennas around in an area. 7 BY MS. KAISER: 8 Q. Okay. I'm -- I'm not quite following how you 9 are using spatial distribution different than I'm using 10 physical location, but let me ask the question a 11 different way. 12 So antenna topology can refer to the spatial 13 distribution of antennas in a physical area in a 14 computer -- or I'm sorry -- in a communication network; 15 is that correct? 16 MR. FAHY: Objection. Form. 17 THE WITNESS: In general, we -- if you have, for 18 example, a 4G, 5G communication networks within a cell, 19 then topology means how you choose, not only the 20 location, but even, for example, the spacing or the mount 21 and orientation of these antennas. So I would say it's 22 something more generic than what you told me. 23 BY MS. KAISER: 24 Q. Okay. So, for example, in a -- in a -- let's 25 take a 5G communication network as an example. In the Page 46	1 Q. So you don't have any understanding in the hub 2 and spoke in the context of communication networks? 3 A. I have heard the term, but I do not know 4 specifics about this hub and spoke. As I told you, I 5 depend on communications that utilize loads of algo 6 language and the specific communications people are quite 7 notorious about inventing new terms every year. I mean, 8 if you check the substance of communication degree, 9 you'll see about 1,000 new terms every year. So that's 10 possibly the reason I have not heard about this term, or 11 I have heard it in a different way. If you can tell me 12 the functionality of hub and spoke, I would -- I would 13 give you a clear answer. 14 Q. How about in the context of communication 15 networks, have you heard the term peer-to-peer? 16 A. Oh, yeah. Peer -- peer-to-peer is -- is quite 17 common because, again, it has different meanings. 18 Peer-to-peer could be utilized from communication from 19 the device to device or it could be utilized for a 20 multi-node forwarding. So peer-to-peer is quite common 21 whenever you have limited range for individual node and 22 still you want to collect information from a large 23 distance. So in a sense, you do multi-hopping. You hop 24 from one device to the other device to the other device 25 to the other device until you reach your end point. So Page 48

1 peer-to-peer, yes. It's quite a common term. 2 Q. Okay. So in peer-to-peer, the end points of 3 communications are nodes at the same level of the 4 communication network. 5 Would that be a fair characterization? 6 MR. FAHY: Objection. Form. 7 THE WITNESS: It could be a characterization of 8 exchange of data between communication nodes of similar 9 modules or dissimilar modules, except in the same 10 standards. So, for example, you could have a really 11 powerful RFID working with -- within different box. So 12 you would have an RFID working to identify 6 megahertz. 13 (Reporter clarification.) 14 THE WITNESS: So -- so you have one multiband 15 RFID tab multi-band means working on different bands. 16 Maybe working at 15.56 megahertz and 433 megahertz. And 17 in the nearby, there is another RFID tab which is a 18 15.456 megahertz. So the multiplied tab could work 19 with some standard that would enable communication with 20 10.56, then you would claim this peer-to-peer, as well. 21 So I would say peer-to-peer represents some larger or 22 equal than, in terms of the capabilities of the two 23 devices communicating. 24 BY MS. KAISER: 25 Q. Are you familiar with the term unicast in the	Page 49 1 protocol that supports unicast? 2 A. Yes. 3 Q. And then are you familiar with the term 4 multicast? 5 A. Multicast is a more generic term. And, again, 6 in general context, because there are different ways to 7 multicast, different ways you can translate this term. 8 Multicast, you transmit to a -- to multiple devices. And 9 this can be done in a secure -- more secure way. It may 10 be done different compression protocols. And multicast 11 could end up by reception even by one. 12 So you -- the intention is to transmit to a 13 variety to -- to numerous nodes. And then based on the 14 responses or based on the protocol, this content can be 15 received by one or more. 16 Q. So would it be fair to say that multicast and 17 the intention is to transmit to numerous nodes, but 18 unicast, the intention is to transmit to one node? 19 MR. FAHY: Objection. Form. 20 THE WITNESS: What I would say is, in a generic 21 context, the term unicast is narrower than multicast. 22 Multicast involves more specifications, more needs in 23 terms of modulation, pinging, exchange of messages. So I 24 would say multicast is generalization of unicast. It's a 25 much more generic term.
Page 50 1 context of network transmissions? 2 A. Yeah. I mean, this is a way of distributing 3 data and also correlating with protocols for 4 communications here. For example, a typical 5 communication protocol could be unicast or directed. So 6 you could have, like, UTP or PCP or there are different 7 protocols. And unicast, I would say, is the more simple 8 to implement but the less secure. And the TCP/IP is more 9 complicated because you need to get some acknowledgement 10 message before you establish communication, but it's more 11 power hungry or more complicated in terms of the 12 algorithms. So it's the typical cost-based performance, 13 unicast via directive transmission. So UTP, TCP/IP. 14 Q. So unicast is where a -- a -- I'm sorry. Strike 15 that. 16 Unicast is where a transmission is directed to a 17 specific recipient; is that accurate? 18 MR. FAHY: Objection. Form. 19 THE WITNESS: In general, whenever you talk 20 about unicast, you could have one server and then 21 transmit with multiple -- to multiple nodes in a way of, 22 kind of, distributing content in a very generic, more 23 secure way. 24 BY MS. KAISER: 25 Q. And you mentioned UDP as an example of a	Page 52 1 // 2 BY MS. KAISER: 3 Q. In the context of network transmissions, have 4 you heard the term broadcast messages? 5 A. Again, these are generic terms. You know, 6 broadcast, because there is -- there has been lots of -- 7 lots of discussions. And broadcast means, in my opinion, 8 based on the IEEE definitions -- and, again, has been 9 translated here due to context. Broadcast on one 10 definition is you have a source of a content or the 11 source of a signal, and then you transmit it out. And 12 broadcast has to do with a transmission of this signal. 13 Now, this would have to do with a generic transmission to 14 all the nodes from one node, or could be transmission 15 from one node to another node. So I would say is 16 transmission of some data of some source. 17 Now, a second -- as I told you, this one could 18 be transmission to multiple nodes or could be 19 transmission to a single node, as well. 20 Now, second way you may translate this term, 21 based on IEEE definitions, is that broadcast would be 22 transmission of a broadband signal. And that's a term 23 being utilized quite often, especially right now, with 5G 24 millimeter wave communications where you transmit a 25 broadband signal where it could be video/audio or

1 something like that, specifically broad enough to include 2 all the information. And I would say the third potential 3 definition of broadcast is to choose some context -- some 4 content, which could be any signal or any data, as we 5 said before, and transmit to the variety of possible 6 receivers with the intention to customize the amount of 7 data to be received by each one of those receivers. So 8 broadcast could be a generic signal that's sent out 9 there. Broadcast could be broadband signal that includes 10 lots of data, and broadcast could be transmission of some 11 signal with specific information on what part is to be 12 received by what receivers. So there are three different 13 ways of broadcast. 14 Q. So I think I heard you say that one possible 15 definition of broadcast could be sending data from one 16 node to a single other node; is that right? 17 A. That would be one case as a subcase of the 18 transmission, generically. So what I said is that's a 19 transmission from one node to another to one node, from 20 one node to multiple nodes without any knowledge of the 21 number. So broadcast does not have a specific number of 22 servers broadcast, has to do with the transmission. So 23 that's -- that's the whole point of the broadcast term. 24 Q. Okay. So it could be received by one other 25 node, but that wouldn't be the intention of the	Page 53 1 // 2 BY MS. KAISER: 3 Q. Would you -- 4 A. If you have -- the reason, if you would allow 5 me, like, one -- one minute, it's the same thing with 6 broadcast TV. Now, you -- you know, like, satellite TV. 7 Now satellite, DIRECTV or Dish Network, the satellite is 8 broadcasting, and everybody in the neighborhood can 9 receive it. On the other side, based on your selection, 10 a.k.a. some information, some unique about your system, 11 then you pick up a specific fraction of this data, but 12 still the broadcasting from the satellite is to 13 everybody. 14 Q. Let me give you a, sort of, layperson 15 hypothetical. 16 A. Okay. 17 Q. When I get, for example, on my phone an Amber 18 Alert -- have you had that happen where you get, like, an 19 alert about a missing child on your phone? And that 20 comes through to every phone, say, in a -- in a cellular 21 network cell, would you consider that to be a broadcast 22 transmission? 23 MR. FAHY: Objection. Form. 24 THE WITNESS: If you are in a specific network 25 near by some base stations that are near the Page 55
1 broadcast? 2 MR. FAHY: Objection. Form. 3 THE WITNESS: Unless specifically defined by 4 some additional data, the transmitting device would 5 not -- would not care about the number. Now, if the data 6 includes specific information about specific servers, that 7 would be considered as part of the broadcast. But, 8 again, I repeat, the fact that broadcast has to do with 9 the transmitter. Broadcast does not have the number of 10 the servers. 11 BY MS. KAISER: 12 Q. Okay. So, for example, a transmission that had, 13 say, a recipient node identified and was intended only 14 for that recipient node, that wouldn't be considered a 15 broadcast by the transmitter; is that fair? 16 MR. FAHY: Objection. Form. 17 THE WITNESS: What is fair is we'll have to see 18 that under context. We said that will be one 19 explanation. You said exactly before you used the verb 20 transmitted. Now, I would say transmission from node to 21 node is much more accurate term. But because 22 transmission involves something, transmitting the data, 23 and then somebody -- some node or some nodes to receive. 24 But broadcast, it really depends on the -- on the 25 context. Page 54	1 disappearance of a person, then this base station would 2 broadcast to everybody some -- some data. Now, based on 3 which county you are in, you may activate or deactivate 4 the reception. But that does not have anything to do 5 with the broadcasting -- with the broadcast of this 6 message, because this message has been broadcasted by -- 7 by the base station to everybody nearby. 8 BY MS. KAISER: 9 Q. Okay. And if, say, I sent you a text message 10 from my phone that was directed specifically to you, that 11 wouldn't be a broadcast message, correct? 12 MR. FAHY: Objection. Form. 13 THE WITNESS: It's -- it's not correct, based on 14 what I told you. Because, again, your phone transmitted 15 some data to the base station, and then the base station 16 determined where am I going to broadcast this data to 17 the -- to the number I included in my SMS. Because SMS 18 we are sending is not just the message you are sending. 19 SMS includes your number, includes three base stations 20 nearby, includes the time you send it, includes a 21 priority, and the date. So it's quite a variety. 22 Now, these three base stations nearby will 23 receive this and send this to your phone. So using the 24 broad meaning of broadcasting -- generic meaning of 25 broadcast the generic meaning, that will be a broadcast. Page 56

Page 57 1 Now, a broadcast that still is going to be 2 received by a specific system. But I would say the base 3 station broadcast that -- there are two ways of doing 4 this. One way is to broadcast to the area that the 5 latest recorded was positioned of the receiving number 6 was it. So the transmitted and since you have the 7 specific number you are sending this to, only this phone 8 will accept the reception of the broadcasted message, or 9 it may incorporate it in the next ping of your 10 reception device. 11 Now, the device to receive this message keeps on 12 communicating periodically with the base station. The 13 base station has this message. And then the base 14 station, at the next ping of the next communication 15 with your device, will also send directly this 16 message. 17 BY MS. KAISER: 18 Q. So it sounds like, in your opinion, any 19 transmission of data is a broadcast; is that fair? 20 MR. FAHY: Objection. Form. 21 THE WITNESS: If -- if you refer to generic 22 communication architectures, one way of translating 23 broadcasting would be to send some data out that's going 24 to be received. 25 Now, obviously, one of the ways to -- to	Page 59 1 or could be one to different nodes. 2 BY MS. KAISER: 3 Q. Are you familiar with the open systems 4 interconnection or OSI model? 5 A. OSI, typically, is a set of rules or layers of 6 communication between components of a network. So OSI 7 defines some specifications of different levels having to 8 do with the hardware being utilized, the power 9 constraints, the potential spatial implementation we 10 discussed, is it going to be -- is it going to be a start 11 configuration? Is it going to be some more distributable 12 configuration than the protocols having to do in terms of 13 modulation, in terms of compression, given the data 14 rates, the power constraints, and the existence or not of 15 different wave propagation issues like fading or 16 multiple. 17 So OSI could cover anything from individual 18 nodes all way up to how the information is transmitted to 19 individual nodes or multiple nodes for some specific 20 network. 21 Q. In the context of the OSI model, are you 22 familiar with the different layers of network 23 implementation, for example, physical layer versus 24 application layer? 25 MR. FAHY: Objection. Form.
Page 58 1 translate that is to -- is to transmit onto a specific 2 node. For example, what we have read before to -- the 3 thing we're doing for NASA during my Ph.D. And the 4 broadcasting -- because there's a way to explain this, as 5 well. Typically, what was happening in this case is we 6 were sending some data or some information to all the 7 nodes. So they were -- this content was broadcasted to 8 the different orders of the space station. Then, 9 obviously, we have to sync everything in this case. And 10 then to do that, some information had to be exchanged 11 from one node to the other node to do the syncing. And 12 the advantage were the nodes were much closer than the 13 gateway that was transmitted. 14 So in this case, one sensing node, the C02, for 15 example, that detected carbon dioxide threshold crossing, 16 was sending a message, was sending some data or some 17 instruction with the neighboring sensor, Please activate 18 and check yourself for C02. Same syncing could be 19 utilized, for example, some data for space walk 20 transmission to all the quarters. 21 So in this case, you would -- we could claim 22 that the -- while this communication module was 23 broadcasting the information to the neighboring device to 24 sync and calibrate its performance or to be on standby. 25 So broadcasting, as I said, could be one-on-one	Page 60 1 THE WITNESS: This is -- OSI, in a sense, is an 2 evolution in the term used in the 20th century as ISDN. 3 That's an evolution. And ISDN had seven or eight layers, 4 if I remember correctly. That was going all the way from 5 physical layer to a network layer, linking layer. So it 6 had different layers. And these layers, having to do 7 with protocols involved in OSI. 8 So talking about these, yeah, I'm aware of the 9 difference between the different layers. Go anywhere 10 from hardware to network implementation, network 11 security, network exchange information, and so on. 12 BY MS. KAISER: 13 Q. So, for example, the antenna itself would be 14 part -- 15 A. Physical layer. 16 Q. -- of a layer? 17 A. It's a physical layer. I would say if you're 18 asking -- let me give you this way, because we had the 19 discussion about this about two months ago in Florence in 20 the antenna propagation symposium in the technical 21 committee about the antenna and the and OSI, that's quite 22 interesting you're asking question. 23 Until recently -- and I would say if you ask me, 24 I would say until 2015, I would say antenna is clearly a 25 physical layer. Now, antenna now is not only physical

1 layer, but now with new modulations schemes or new time 2 variance schemes, could be also translated or could be 3 considered in subsequent layers or in higher layers 4 because layer one, the physical layer, and then you start 5 building on this the upper layers of the OSI 6 infrastructure. 7 So -- but the answer is it's definitely physical 8 layer, but depending on the context, it could be included 9 also in higher layers. 10 Q. And then earlier we were talking about, like, 11 multicast and unicast. Do you remember that? 12 A. Yes. 13 Q. And you brought up UDP as a specific example. 14 A. UDP -- UDP is in a -- you put sorted -- I would 15 say, just to be as generic as I could be, potential in 16 the context, UDP is a -- is a multicast product, and 17 typically, that's utilized -- I would use always the UDP 18 because this is the best one, the most secure one. But 19 whenever you have all these -- these are expensive. So 20 to do the multicast, you either have to have 21 infrastructure of the university or very expensive 22 infrastructure to be secured. You could -- for example, 23 PCP, you could do TCPIP. What you're doing right now is 24 one -- 25 (Reporter clarification.)	Page 61 1 was just directing you to give you context, and I hadn't 2 actually asked the question yet. 3 So I just am saying this because I don't -- I 4 don't think any of us want to do this forever. So if you 5 can -- if I direct you and say do you remember that, and 6 then you can just say "yes" so I'm orienting you, and 7 then I can ask you the question, then I think that might 8 get us further along in the deposition more quickly. But 9 I'll leave that to you. I don't want to cut off your 10 answers. 11 So what I was going to ask you about UDP was in 12 the context of the OSI model and if you would agree that 13 UDP is in the transport layer. 14 MR. FAHY: Objection. Form. 15 THE WITNESS: I would -- I would say UDP, since 16 it's doing multicast -- multicasting of data packets, 17 that covers the transport layer. That covers the 18 transport of data from one to the other node. Now, 19 possibly, UDP could be listed in additional layers. But 20 I would say transport layers are definitely covered by 21 UDP. 22 BY MS. KAISER: 23 Q. Okay. And then in your answer, before you 24 mentioned, I think, TCIP as a different protocol that 25 someone designing a system could use instead of UDP; is Page 63
1 THE WITNESS: Yes. Sorry. Sorry. Lots of 2 initials. So PCP/IP is the most common, I would say, 3 protocol for multicast and so on. Now, the issue is that 4 this requires high cost, and then, in return, gives you 5 high security. And also, it affects the bandwidth of 6 your communication. Because as I told you, you don't 7 have unidirectional communication. You have sometimes 8 bidirectional communication. So you have to send 9 something and then you receive something from the other 10 side, and then you continue the transmission for the 11 PCP/IP. 12 For UDP, this one is cheaper. The cost does not 13 wait for a response from the answer from the other side. 14 Just send it out. And typically, for example, if you go 15 to some internet cafe, you're going to utilize UDP 16 because cost is important. They want all players playing 17 the same game to be more or less in the same frame 18 because otherwise you cannot play against each other. So 19 if cost is your basis and still you have video -- UDP is 20 really commonly utilized for multicast of information to 21 all the players. But if you really want to be secure, 22 broadband, and reliable, you utilize other products. 23 Q. Okay. So, Dr. Tentzeris, I appreciate the 24 information. I think that was helpful and will inform 25 some of the other questions I'm going to ask you. But I Page 62	1 that right? 2 A. That's an alternative separate protocol to UDP. 3 Q. Okay. And I think you said that you would 4 usually use TCPIP for multicasting because it's more 5 secure; is that right? 6 A. That's one of the generic features of TCPIP and 7 how security because of the frame size, because of the 8 structure, and because of the bidirectional exchange of 9 information. 10 Q. Okay. And then I think, in your prior answer, 11 you were talking about unidirectional versus 12 bidirectional communication. 13 Do you remember that? 14 A. Yes. 15 Q. And by unidirectional communication, as I 16 understood your answer, you were referring to a node 17 sending a communication to another node, but not 18 receiving anything back; is that right? 19 A. I mean -- 20 MR. FAHY: Objection. Form. 21 THE WITNESS: In general, this has to do with 22 structure of message exchanges between the two nodes 23 communicating that does not necessitate some return 24 response from the second node. So it's more like receive 25 this video, if the other node is ready to receive or if Page 64

1 it's not ready to receive, that's not relevant to this 2 protocol. Now, for TCP/IP, the idea is you send, first, 3 the question before the data transmit. You have two more 4 steps. So node D, node B, are you ready? And then node 5 B says, Yes, I'm ready. And then node D says, Okay, I'm 6 sending. So that's the difference. 7 BY MS. KAISER: 8 Q. So TCP/IP would be a bidirectional protocol; is 9 that correct? 10 A. The messaging would be bidirectional, the 11 messaging. So the exchange of messages would -- would 12 require both of them to send something. 13 Q. Okay. And then for UDP, the messaging would be 14 unidirectional? 15 A. As far as I know, generically, again, I'm not 16 giving any specific context. But generically, UDP do 17 transmit without waiting, the acknowledgement of 18 readiness from the second node. 19 Q. And so, without having that acknowledgement of 20 readiness, does that create the security issues that you 21 were mentioning previously for UDP? 22 MR. FAHY: Objection. Form. 23 THE WITNESS: In general, if there is some other 24 device nearby the node you have trying to steal some 25 information or some video that could be a possibility.	Page 65 1 there is not sufficient resources to incorporate higher 2 bandwidth than TCP/IP. So you have -- you have to play 3 some tricks in this case to make it work. Some tricks, 4 for example, with the compresssioner, or some tricks in 5 terms of the implementation. 6 BY MS. KAISER: 7 Q. Okay. And you were just talking about UDP and 8 TCP/IP in the context of transmitting video. Do the 9 considerations change when you're using streaming video 10 versus downloaded video? 11 MR. FAHY: Objection. Form. 12 THE WITNESS: Again, I would give a generic 13 concept because I don't know the context. Now, 14 typically, when you are -- I would say streaming 15 incorporates some part of downloading because all of us 16 have experience the buffering issues. So during the full 17 download of the video means you have got either the whole 18 video you want to play on your phone or on your device or 19 you have downloaded a large enough chunk of your 20 multimedia that would allow you to play effectively while 21 you are downloading the rest. 22 So download means inquiring in the sense of 23 either whole or sufficient number of frames to -- to 24 play. And then streaming means that you are continuously 25 receiving content and you are changing the frames on the Page 67
1 Now, it do not say there's no security because, 2 supposedly, part of the UDP has to do with some 3 information about the device to receive it. But the lack 4 of responsiveness from the second node could pose some 5 issues in case somebody steals this identification 6 information or unique identifier and then gets the data 7 acting as node B. So that's what I meant. That -- the 8 lack of acknowledgement, the lack of response could pose 9 a potential issue. 10 BY MS. KAISER: 11 Q. Okay. And then I think earlier in the -- in the 12 answer that you gave about UDP and TCIP, you talked about 13 bandwidth, and I wonder if you could talk a little bit 14 about the relative bandwidth use between UDP and TCP/IP. 15 MR. FAHY: Objection. Form. 16 THE WITNESS: Now, again, it has to do with 17 context, the bandwidth. Because the bandwidth has to do 18 with the quality of the video, for example. So you could 19 have some low quality video, you could have some high 20 quality video. You could have some high definition of 21 the video. And each one of them requires different -- 22 different, possibly, frequencies to allocate this content 23 on or -- and also some very good control of the 24 compression. So the issue is, since UDP does not have 25 some security features that TCP/IP do have, there is no -- Page 66	1 fly based on the amount of frames you have already 2 downloaded. So, typically, streaming, you have not 3 downloaded everything, could happen sometimes. But I'm 4 talking about streaming based on my generic expertise for 5 a buffer means you will receive a finite number of 6 frames, could be 100,000; 10,000 depend on the quality of 7 your video, and you keep on receiving additional one. So 8 that's the idea. 9 BY MS. KAISER: 10 Q. And I guess my question was, you had talked 11 about bandwidth constraints for TCP/IP. If you're dealing 12 with downloaded video instead of streaming video, you -- 13 as a network designer, you would have less concern about 14 using TCP/IP; is that fair? 15 MR. FAHY: Objection. Form. 16 THE WITNESS: What I would say as an expert, in 17 general, is, if I received some video of -- 18 (Reporter clarification.) 19 THE WITNESS: Of some sensitive transaction, 20 maybe some banking video or some board room meeting 21 video, no matter whether it was downloaded or streamed, I 22 would choose TCP/IP over UDP because of security purposes. 23 Now, if it was some TikTok video, I would not care, 24 honestly. So that depends on the priorities you have. 25 Do you care about some okay performance? If you care Page 68

Page 69 1 about some okay performance like internet cafe, for 2 example, I would say I would use UDP both ways. 3 Now, if I cared about some security, I would say 4 TCP/IP would be the same consideration for both of them. 5 BY MS. KAISER: 6 Q. Okay. So then going back to the OSI model and 7 the different layers we've talked so far about the 8 physical layer and the transport layer, are you familiar 9 with the application layer? 10 MR. FAHY: Objection. Form. 11 THE WITNESS: I am. I am familiar, but not 12 extremely clear. But I am familiar with the application 13 layer. 14 BY MS. KAISER: 15 Q. And what do you mean you're not familiar in 16 extended detail? 17 A. In terms of the application layer, there is a 18 variety of new constraints for different applications. 19 That's what I meant. 20 Now, application layer, typically, dictates the 21 specifications in the underlying layers based on the 22 specificities of the application themselves. So you have 23 different constraints if you have audio then having 24 multimedia transmission. So the meaning whether there's 25 such a variety of potential applications that I may not	Page 71 1 standards that will combine with the OSI application. 2 On the other side, the other type of work that 3 we're doing is, for example, for Amazon, or all-comers 4 like this, they come to us and say, Look, there is a 5 standard application with respect for low cost Bluetooth, 6 and just throwing some standard, here BLE or RFID system. 7 Now, is it possible to do this? Is it possible to 8 readjust my inventory to retrofit myself with some 9 devices that will do this work. And in this case, they 10 provide us the application layer specs. And what we have 11 to do is go to the underlying layers and see how it's 12 possible. So it depends on the applications, both on 13 top -- top to bottom. So it really depends on what type 14 of work. 15 So application layer is, I would say, the wild 16 card layer of OSI, if I could call it, quote/quote, "wild 17 card" because this is the layer that can reconfigure to 18 accommodate new leads. 19 So there are some generics. For example, the 20 data rates, the messaging sequence, those will not 21 change. I mean, nothing. These are the common 22 underlying layer, for example, for UDP or TCP/IP for the 23 linking layer. But for the application layer, the big 24 question will be, Okay, can we do it in a one-to-one to 25 get the application? Can we utilize -- what we utilize
Page 70 1 be familiar with some of them. So typically, whenever I 2 am -- whenever I'm giving some specific application, and 3 I have to evaluate or choose specific components from the 4 OSI, I'm given some specific constraints even for the 5 application layer. 6 Q. Okay. So in your work, would it be fair to say 7 that others are specifying the application layer and then 8 your research or your work is focused on informing the 9 lower-level layers for those application specifications? 10 MR. FAHY: Objection. Form. 11 THE WITNESS: It depends on the work -- the 12 parts of my work that you are talking about. We're doing 13 two different types of work as professors. One is the 14 difficult level work. So we set the foundation for new 15 systems, like this between or internet of things or smart 16 objects. 17 Now, in this case, there is nothing preexisting. 18 So we start from the physical layer and then we go to a 19 transport layer, network layer, linked layer, and we 20 start building the steps bottom up. So in a sense, we 21 provide to the Qualcomms, the Apples, the Googles, the 22 specifications for the application. We tell them with 23 existing technology and with existing cost, with existing 24 variety of modulation schemes, that's what you can do. 25 And let's now start going and implementing them to	Page 72 1 for smart inventory for some implanted *, the pacemaker? 2 And the answer is, no, because there are different media, 3 different modulations, and source schemes. So that's 4 the -- that's my point. 5 BY MS. KAISER: 6 Q. Okay. For the application layer -- well, strike 7 that. 8 So we talked about video, I think, in some of 9 your prior answers. And what actually gets displayed, 10 for example, to a user on a screen, that would be 11 considered within the application layer; is that correct? 12 MR. FAHY: Objection. Form. 13 THE WITNESS: One way of displaying this is 14 controlled by the application layer because the 15 application layer will set the requirements. For 16 example, the -- what is possible in terms of frames per 17 second by what you have. Can you see me? Because I see 18 you frozen. Can you hear me, Jessica? 19 BY MS. KAISER: 20 Q. I can hear you. 21 A. Okay. Because you froze. Completely your 22 picture froze. And I get a message your internet 23 connection is unstable. I don't know if you see that. 24 But what I was saying is the way the video is 25 played, one, it's definitely partly by the application

1 layer, but also partly by the underlying layer. So how 2 many frames per second can it be -- are required. We had 3 one -- one issue with that. The reason I'm saying it's 4 controlled by the application layer. You know, the big 5 screens on the big concerts, more or less, the big 6 screens are made out of multiple smaller screens. You 7 know, it's not an individual one. And in the screen, 8 they show the video from the concert, they have to be 9 syncing; otherwise, it will be a mess. Now, if -- varies 10 from predetermined frame per second, but based on the 11 weather, you will have to readjust; otherwise, you will 12 see above-ground, which is green and red and white. You 13 can do it by just recording this from cellphone camera 14 from Apple. 15 So Apple came to us and they were like, Okay, we 16 have multiple videos. And the typical application layer 17 specs out of this, but what we see is our camera is not 18 working. So to do that, you have readjust or you have to 19 compliment the application layer requirement with some 20 lower layer requirement. And to do it frame per second, 21 having to do with the period of synchronization. Having 22 to do with the speed of data exchange between the 23 individual screens, and definitely having to do with kind 24 of term is inoperability. Because in all of these cases, 25 no matter whether the scenes are co-located at the	Page 73 1 in this matter? 2 A. I would say mid-July. 3 Q. Mid-July of 2022? 4 A. Oh, the declaration. So a declaration I'm 5 putting together sometime in -- I have to remember 6 because there are three declarations I put together. So 7 let me check it out. Because the thing is I cannot 8 recall the date. I know I worked on this for about 9 couple of weeks now. I cannot recall the date. I have 10 to go look at my e-mails and give you the date. Do you 11 want me to do that? 12 Q. Well, do you recall, before it was filed, about 13 how long before that you started working on the 14 declaration? 15 A. Before it was filed, I started working about, 16 let's say, three to four weeks -- 17 Q. Okay. 18 A. -- before the filing. Yeah. 19 Q. And just generally, can you describe the process 20 of drafting your declaration in the '188 IPR? 21 MR. FAHY: And I would caution the witness in 22 your answer to not reveal any communications with Counsel 23 or the substance of any communications with Counsel. 24 THE WITNESS: Okay. Okay. So responding if you 25 see that place, give me the word again. So I -- I Page 75
Page 74 1 concerts and whether the screens are not co-located like 2 Apple, then you have to readjust. So application layer 3 is one, but I would say underlying layer also play a very 4 significant role given the application and the 5 environment. 6 You want to have a break, short break? It's 7 12:40. 8 Q. Sure. We can take a break. 9 A. Sure. 10 Q. Go off the record and take 10 minutes again. 11 Come back around 12:50. 12 A. 12:50. That's right. 13 Q. Okay. 14 (A recess was taken from 12:40 p.m. to 12:52 p.m.) 15 MS. KAISER: We can go back on the record. 16 BY MS. KAISER: 17 Q. Welcome back, Dr. Tentzeris. Can you hear me 18 okay? 19 A. Yes, I can hear you. 20 Q. Okay. Perfect. 21 When were you retained for the IPR as to the 22 '669 patent, that's the '188 IPR, to be clear? 23 A. Sometime in 2022. I cannot recall the exact 24 date. 25 Q. And when did you start drafting your declaration	Page 76 1 started combining the information from the -- from the 2 prior art I considered relevant to the patent under 3 discussion, and then I started putting together the -- 4 the sections addressing the individual claims. And then 5 we have general communications with the counsel about the 6 forma, about legal terms, about structure, about 7 organization. But the opinion was -- was mine, and I 8 took the lead of that. So I would say that was the 9 generic process. 10 BY MS. KAISER: 11 Q. Did you find the references that are in the 12 un-patentability grounds in your '188 declaration? 13 A. It was a -- it was a combination. So I had some 14 of my references, you know, and I had some generic terms. 15 We discussed with the lawyers that provided some other 16 references, and then I reviewed and selected that. So 17 that's -- that's how it works. 18 Q. Okay. And to be clear, I'm talking about the 19 primary references that appear -- 20 A. Yeah. 21 Q. -- in patentability grounds. 22 A. So that was the generic approach. I mean, this 23 was a combination. 24 Q. Did you draft the first draft of your 25 declaration or was a first draft provided to you?

1 A. I drafted the technical section, and then it was 2 a back and forth for the rest. 3 Q. Okay. For the '188 IPR, do you have your 4 declaration, which is Exhibit 1003? 5 A. I couldn't hear what you said. 6 Q. For the '188 -- 7 A. Yep. 8 Q. -- IPR, do you have a copy of your declaration, 9 which is Exhibit 1003? 10 A. Yes. Let me try to open it. Okay. Yes. 11 Q. Okay. And I also put it in the Zoom chat, in 12 case you have any -- 13 A. Sure. I have it in front of me. Sorry. 14 Q. All right. In your declaration, I want you to 15 go to page -- page 4 of the declaration. That's the 16 first section that's titled, "Qualifications and 17 Professional Experience." Let me know when you're there. 18 A. Page 4, declaration or page 4 of the PDF file? 19 Q. Page 4 of the PDF. 20 A. Page 4 of the PDF. Yes. Yes. 21 Q. And you see at the top, it's section 1, 22 "Qualifications and Professional Experience"? 23 A. Exactly. 24 Q. In this section, did you summarize your 25 qualifications and professional experience that you felt	Page 77	1 frequencies? 2 A. You may recall the discussion before, the 3 topologies depend on the context and the different ways 4 you may translate antenna topologies. I would compliment 5 that with the term multiband, because the definitions I 6 told you before about the term antenna topologies -- the 7 only addition is multiband, which means antennas 8 operating in multiple frequency bands. So you will have 9 antennas operating at 2.4 gigahertz, you will have 10 antennas operating at 6.5 megahertz, and so on. So the 11 frequencies we discussed before works for antenna 12 topologies. The only difference is the extra feature of 13 multiband. 14 So instead of talking topologies in general -- 15 and the reason I use multiband is because antenna 16 topologies, even for single band, are quite challenging. 17 Multiband adds another level of complexity. And that's 18 why I won lots of awards. And so, changing as little as 19 possible topologies, but introduction of additional 20 frequency bands of the antenna are widening. 21 Q. Okay. And then what did you mean by integrated 22 RF modules up to sub-THz frequencies? 23 A. Okay. This is actually the collective term RF 24 modules, and this is a question people ask me in all my 25 distinguished lecture talks. I give -- you see I've	Page 79
1 were most relevant to your opinions in the '188 IPR? 2 A. Yes, I did for the time the declaration was 3 submitted. Since then, my position has changed. My new 4 position is ed and path joint chair professor and 5 attendance in the school of electrical computer engineer. 6 But the time this declaration was submitted, that was the 7 previous position. 8 Q. If you go to paragraph 6 of your declaration, 9 let me know when you're there. 10 A. Yes. 11 Q. So if you look, it's towards the bottom of page 12 6 of the PDF, page 3 of the declaration. I'm going to 13 the last sentence of that page that starts, "I have won 14 awards." 15 Can you let me know when you see that? 16 A. Sure. I can see that. 17 Q. So do you see it says, "I have won awards for my 18 contributions in developing various technologies, 19 including numerous multiband antenna topologies operating 20 at different frequencies and integrated RF modules up to 21 sub-THz frequencies"? 22 Do you see that? 23 A. Yes. 24 Q. Can you tell me what you meant by numerous 25 multiband antenna topologies operating at different	Page 78	1 given, like, 140 distinguished talk awards. 2 So the first question is what is an RF module? 3 And my answer is, that depends on the function. So RF 4 modules are modules utilizing RF microwave frequencies. 5 Now, modules means, in reality, they're defined by 6 functions. So -- and they perform a communication. They 7 are communication modules. And even the term 8 communication is partially translated in terms of 9 context, because communication means communicating with a 10 single device, communicating -- for example, downloading 11 some content. And that's what I typically discuss in my 12 distinguished lecture talks, communicating with other 13 nearby modules, so in a sense, it's unicasting, 14 multicasting, or syncing, in a sense. So these are the 15 three typical functions, I would say, for communication. 16 Then you could have modules where the 17 functionality of sensing. You could have modules with a 18 functionality of identification, and you could have 19 functions or the functionality of localization. So the 20 module is translated in terms of functionalities. 21 And the typical functionalities I told you are 22 these. If you see most of the subjects of my talks, I 23 explicitly define them. So communication RF modules, 24 sensing RF modules, localization RF modules. But the 25 main thing I can say is RF modules, they are modules	Page 80

1 operating radio frequencies. AKA frequencies going 2 above, I would say 135 kilohertz, which are the lowest 3 frequencies of RFIDs. So that's the low -- the low end 4 point of radio frequency, 135 kilohertz, and going all 5 the way up to terahertz or sub-terahertz frequencies. 6 And then the modules can do different things, and you may 7 have to define it explicitly. 8 Q. And by integrated RF modules, did you mean 9 integrated into the -- 10 THE REPORTER: I'm sorry. I can't hear. 11 MS. KAISER: Let's take a pause for a second. 12 We're getting some interference. Okay. 13 THE WITNESS: Okay. Better. 14 So -- so integrated -- 15 (Reporter clarification.) 16 BY MS. KAISER: 17 Q. Okay. Let me re-ask it. 18 Dr. Tentzeris, in paragraph -- we're still on 19 paragraph 6 -- 20 A. 6. 21 Q. -- of your declaration in the '188 IPR. And my 22 question is: You -- you mentioned here integrated RF 23 modules, and I was wondering if that means integrated 24 into devices or something else. 25 A. It is. Integrated history according to --	Page 81 1 silicone or a different substrate, and that's integrated 2 RF. So in a sense, you have integrated RF, and then the 3 term modules. 4 And then the third thing of integration, which 5 is actually getting a lot of traction nowadays with the 6 sect, have to do with existence of multiple components, 7 multiple electronic components operating in RF under the 8 same enclosure or packaging. Because packaging used to 9 be, kind of, neglected or a closer place around them was 10 a node. Nowadays -- and actually, that's something we 11 have started working on since the time at the packaging 12 research center. And I listed I was associate director 13 of the NSA packaging resource center until 2009. 14 Integrated under the context of electronic packaging was 15 a set of RF components existing under the same enclosure 16 of packets. Actually call integrated system, not 17 packets. These are the definitions of integrate. 18 Q. If you go in your declaration, which is 19 Exhibit 1003, to paragraph 2 -- 20 A. Two. 21 Q. -- the third sentence, it says, "As a professor 22 of electrical and computer engineering, I have taught 23 courses relating to antenna and electromagnetic 24 technologies." 25 Do you see that? Page 83
1 (Reporter clarification.) 2 THE WITNESS: Integrated history, meaning 3 depending on the context utilizing IEEE technical society 4 definition. First definition, integrated means you have 5 put together on the same substrate different components. 6 And typically, the components for these RF modules 7 includes some critical parts, and then some, I would say, 8 more critical parts. So talking about integrated 9 modules, typically that means you place on the same 10 substrate some microprocessor, integrated circuits. You 11 place some antenna, if you utilize RF, because that's the 12 way to communicate. And you place some interconnects 13 that allow the transfer of data between the 14 microprocessor and the antenna. These are the critical 15 parts. There are also more critical parts, which are 16 called matching components because, based on the 17 frequency, some part of your data you transmit on the 18 interconnect bounce back, and then you lose data or you 19 reduce the signal. You could have some resisters, 20 compassators, and so on, and you have some peripherals. 21 Now, that's the first, utilizing integrated. 22 The second translation of this term is 23 co-existing in some microprocessors or integrated 24 circuits. Now, integrated circuit means you try to embed 25 multiple functionalities within a really tiny waiver of Page 82	1 A. Yes. 2 Q. What do you mean by antenna and electromagnetic 3 technologies? 4 A. That means are classes that either mean we 5 design and modeling and optimizing antenna. And the 6 electronics making use of electromagnetic principles, 7 that means wireless technologies. So that either deals 8 with them as an individual components or combination of 9 them or applications that are a result of the 10 incorporation of antenna technologies, like my class 11 ECU4350, which is entitled electromagnet applications. 12 And the class ECU4390, which is making use of radar and 13 RFID and NFC technologies to add intelligence to 14 different objects and systems and make them smart 15 objects. 16 Also, in 2007 -- if I remember correctly, 2006 17 or 2007, I have to check back. I taught class ECU4803, 18 which was the first RFID and NFC-related class taught in 19 the U.S., addressing the issues having to do with -- with 20 the application of RFID and NFC technologies in practical 21 systems. And, actually, it was a fun class. That's why 22 I'm stressing this because part of this class was 23 relying on industrial feedback of -- for RFID systems. 24 Now, in the -- in Douglas County, even in smart 25 inventory and smart logistics, utilizing information from Page 84

1 then existing living companies, for example, it was 2 Honeywell it was Pureli, it was pricer for smart cells. 3 So there were lots of comments supervising feedback for 4 this one. 5 Now, another thing I would like to stress before 6 I close, since we're in the coursework section at ECU4350 7 that I'm teaching right now, the electromagnetic 8 application, this is a class where fundamental -- 9 (Reporter clarification.) 10 THE WITNESS: Sure. So class ECU4350 11 electromagnetic applications, I'll be teaching even this 12 semester, the fall semester. The fundamental part of the 13 class, after covering the principles of wireless 14 technologies and antennas, has to do with implementation 15 of digital twins, as well as wireless multimedia 16 transmission. And this culminates in a final week 17 presentation by the senior students about practical 18 systems. So it's not very rare to see students presented 19 in this class real systems like smart cities, smart 20 logistics, smart audio console, smart warehouses as part 21 of this class. 22 Q. Dr. Tentzeris, if you could go to paragraph 14 23 of your '188 declaration, which is Exhibit 1003, let me 24 know when you're there. 25 A. Yes.	Page 85 1 A. As I told you, I was looking for the technical 2 detail, so I was drawing from .1 to .3. I did not go one 3 by one. It's big, and I didn't understand most of this, 4 to tell the truth. 5 Q. If you go to paragraph 41 of your declaration. 6 A. Okay. Let me see. 7 Q. It starts on page 24 of the PDF, if that helps. 8 A. Yes. 9 Q. You're there? 10 A. Yes, I'm there. 11 Q. And this is the portion of your declaration 12 where you summarize the prosecution history of the '669 13 patent? 14 A. Yes. So I summarized the graphing date, 2022, 15 the file date, and some statement by the examiner that 16 gives some technical information. So that's what it 17 translates. Focus on that information. So that's what I 18 wanted to see, to evaluate if there was prior art 19 disclosing, I wanted to see what were the justification 20 by the examiner. 21 Q. You mentioned three office actions during the 22 prosecution of the '709 application. 23 Do you see that? 24 A. Yes. 25 Q. But you don't describe those office actions in Page 87
1 Q. So paragraph 14 lists the materials that you 2 considered in forming your opinions in the '188 IPR; is 3 that correct? 4 A. Yes. That's correct. 5 Q. Okay. And if you look at -- there's a sentence 6 that starts, "I have reviewed the '669 patent, 7 Exhibit 1001, and relevant excerpts." 8 Do you see that? 9 A. Yes. Yes, I do. 10 Q. And it says you reviewed relevant excerpts of 11 the prosecution history of the '669 patent? 12 A. Yes. 13 Q. How did you determine which excerpts were 14 relevant? 15 A. I was clear in the beginning, and I have focused 16 on technical points. So I wanted to see what previous 17 claims, technical points, in the list. I did not pay 18 attention to legal things because of the understanding. 19 So I -- pretty much, I looked at some technical points 20 skimming through the prosecution case. 21 Q. How much time did you spend reviewing the 22 prosecution history? 23 A. I cannot recall. I guess it was a couple of 24 days utilizing PDF and looking for technical detail. 25 Q. Did you review all of Exhibit 1002? Page 86	1 detail, do you? 2 A. No, I did not. Because as I told you, I was not 3 an expert in legal terms. So mostly, I enumerated them, 4 counted them. So in legal -- I focused on the conclusion 5 and the technical aspects. 6 Q. Okay. Are you aware that the examiner applied 7 certain prior art references in those office actions? 8 A. I remember the -- the -- they listed some prior 9 office actions. I'm aware of that. 10 Q. Did you review any of the references that the 11 examiner applied in his office actions? 12 A. The time I was checking the 1002, I -- I read 13 some of this. I read -- I read the reference that we 14 released in the conclusions -- excuse me -- by the 15 examiner. So I -- I believe we reviewed the references 16 that were listed there. 17 Q. Okay. Do you have Exhibit 1002? 18 A. Let me see, 1002. Prosecution history, yes. 19 Q. I put it in the chart in case you or your 20 counsel need it. But do you have -- were you able to 21 open Exhibit 1002? 22 A. Yes. 23 Q. Okay. Can you go to page 162 of the PDF? 24 A. 162 of the PDF. Okay. 25 Q. And you see here on page 162, starts a European Page 88

1 application with the number EP 2 461 582 A1. 2 Do you see that? 3 A. Yes. 4 Q. And if you look down, you see that the inventor 5 has the name Asami, A-S-A-M-I. 6 Do you see that? 7 A. Okay. Inventor Asami Tomonobu. Okay. 8 Q. Did you review the Asami reference? 9 A. As I told you, I skimmed through. 10 Q. Hold -- hold on. Let me finish my question, 11 Dr. Tentzeris. 12 Did you review the Asami reference in your 13 analysis of the prosecution history of the patent in the 14 '188 IPR? 15 A. I took a quick look on this reference. Now, 16 it's been quite some time, so I have to refresh my memory 17 about the details. 18 Q. Okay. 19 A. There was no other reference I used in my expert 20 report. So I have to refresh my memory. So I remember I 21 reviewed -- I reviewed that, but right now, I cannot 22 recall the details because it's been a long time. I did 23 not included in my expert report. So if you -- if you 24 want me to review again this reference, that will be fine 25 for me.	Page 89 1 A. 136. Okay. 2 Q. And you see that page 136 starts a document 3 that's titled, "Response to Office Action Under 37 CFR 4 1.116"? 5 A. Okay. 6 Q. And if you go to page 144 of the PDF, that is 7 Exhibit 1002. 8 A. Yes. 9 Q. You see that this response is dated 10 September 13th, 2021. 11 A. Okay. 12 Q. Did you review the September 13th, 2021, office 13 action response in Exhibit 1002 in forming your opinions 14 in Exhibit 1003? 15 A. First of all, that was a previous set of claims. 16 And the -- if I recall correctly -- and I have to check 17 it back. They were set of these claims were rejected by 18 the Court, and that's how '709 has modified the claims. 19 So that's -- that's what I -- that is what I reviewed. 20 So the idea was check the previous claims, see the 21 response for the previous claims. In a sense, take a 22 look at the information of the claims and how it ended up 23 with the claims listed in '709. 24 Q. Okay. I'm going to give you a new exhibit just 25 to help with our discussion. I'm putting it in the chat.
Page 90 1 Q. Okay. Well, we'll see if you -- if you feel 2 like you need to do that to answer my questions, we 3 can -- we can do that. But let's -- let's see. 4 Can you go back to your declaration in 5 Exhibit 1003? 6 A. Okay. 7 Q. And paragraph 41. 8 A. In paragraph 41. Yes. 9 Q. So you mentioned here the three office actions 10 during the prosecution of the '709 application. 11 A. Okay. 12 Q. But you don't mention the applicant responses; 13 is that correct? 14 A. That is correct. I mean, I focused on the 15 examiner's conclusion. 16 Q. Did you look at the applicant statements in 17 reviewing the prosecution history? 18 A. The applicant statements, can you be more 19 specific? 20 Q. Sure. Let's go back to Exhibit 1002. 21 A. Okay. 22 Q. And if you can go to page 136 of the PDF, and 23 let me know when you're there. 24 A. Sure. 160 of the PDF. 25 Q. 136.	Page 92 1 And the document in the chat is titled "'188 Claim 2 Listing." I'll mark it for the purposes of this 3 deposition as Exhibit 2001. 4 Let me know when you have that and you're able 5 to open it. 6 A. Okay. 7 Q. So I'll represent to you that Exhibit 2001 is 8 the listing of challenged claims from the petition filed 9 by ** in the '188 IPR. And it has the same claim element 10 shorthand as in your declaration. 11 A. Okay. 12 Q. So I'd like for you to have Exhibit 2001 13 available, and then also in the Exhibit 1002, if you go 14 to page 137 of Exhibit 1002. Let me know when you have 15 that page. 16 A. 137, okay. 17 Q. So 137 is the listing of the claim -- excuse me. 18 Hold on. Apologies. 19 Page 137 of Exhibit 1002 is the listing of 20 claims that were pending at the time of the 21 September 13th, 2021, response to office action. 22 A. Okay. 23 Q. So I think, in a previous response, you said 24 there may have been some difference between the pending 25 claims and the issued claims. So I want to have you --

1 A. Yeah. This -- the complete idea of what I said. 2 So I reviewed these claims, and I showed the conclusion 3 that they were preliminary rejected. So that was my 4 conclusion. That in the response, they were rejected. 5 But please, go ahead with your question. 6 Q. Sure. So if you go to Exhibit 2001 and look at 7 claim element 1.0. 8 A. Okay. 9 Q. That claim element is video playback system 1 10 comprising. 11 Do you see that? 12 A. Give me a second. Because for some reason my -- 13 my computer -- my PDF froze. So let me go back to 137. 14 Okay. 15 Q. And you agree with me that claim element 1.0 and 16 issued Claim 1 also appears in pending Claim 1 as of the 17 September 13th, 2021, applicant response? 18 A. Play book and video and then -- 19 (Reporter clarification.) 20 THE WITNESS: Okay. Okay. I'm just checking. 21 So -- so am I comparing 1.0 to 1.3, is this the question, 22 Jessica? 23 BY MS. KAISER: 24 Q. No. So my question is, if you look at -- so 25 Exhibit 2001, which is the listing of challenged claims,	Page 93	1 identical, but that's a system that preexisted of this 2 patent and definitely does not differentiate, 3 individually, the patent to previous prior art. Still I 4 agree with you. It exists in both documents, but also I 5 have to stress that video playback systems existed before 6 this patent and then perform the function of video 7 playback. 8 Q. Okay. And, Dr Tentzeris, I understand that you 9 may have things that you want to say, but I want you to 10 make sure that you listen to my question and answer my 11 question. 12 Right now, I'm just asking you about the 13 comparative content between these two different -- the 14 issued claim versus the pending claim. So we have 15 established that 1.0 appears in both. I now want to look 16 at 1.1 in Exhibit 2001. Issued claim element 1.1 is a 17 number of playback devices 6A, 6B playback video on their 18 screens 5. 19 Do you see that? 20 A. Yes, I do. 21 Q. And then if you look at Exhibit 2 -- I'm 22 sorry -- Exhibit 1002, page 137, the Claim 1 that was 23 pending as of the September 13th, 2021, applicant 24 response, you agree that claim element 1.1 also appears 25 in pending Claim 1, correct?	Page 95
1 provides you with the language of issued Claim 1. 2 A. Yeah. 3 Q. I'm going to go through by elements. 4 A. Yes. 5 Q. I'm going to go -- sorry. So strike that. Let 6 me start over. 7 Exhibit 1 -- 2001 gives you the language of 8 issued Claim 1. Exhibit 1002 at page 137 gives you the 9 language of pending Claim 1 at the time of the 10 September 13th, 2021, applicant response. So what I'm 11 asking -- and I'll ask the question again. But what I'm 12 asking is for you to compare, and let me know, if element 13 1.0 in issued Claim 1 that's shown in Exhibit 2001 also 14 appears in pending Claim 1 as of the September 13th, 15 2021, applicant response. 16 A. So 1.0 in video playback system 1 comprising by 17 video playback system 1 comprising. So only the two 18 documents -- in the two documents, 1.0 -- so I can see 19 it's listed in both documents 1.0. 20 Q. Okay. Thank you. 21 A. But this is the video playback system 22 comprising, which is not No. 1, which is not a critical 23 component. No. 2, as I have listed in my -- in my 24 report, there have been tremendous amount of prior art 25 talking about video playback systems. So it may read	Page 94	1 A. I can see this in both documents. 2 Q. Okay. And then in Exhibit 2001, element 1.2 3 reads, "Each playback device 6A, 6B comprises a memory to 4 store video data 9 representing the said video." 5 Do you see that? 6 A. I see that. 7 Q. And you agree that claim element 1.2 also 8 appears in pending Claim 1 as of the September 13th, 9 2021, applicant response, correct? 10 A. I can see both document -- I can see that in 11 both documents. 12 Q. Okay. And then if you go to element 1.3 in 13 Exhibit 2001 in issued Claim 1, element 1.3 reads, "In a 14 communication stage to communicate data with each other 15 wherein the device is 6A, 6B are designed to transmit 16 video playback progress data via the communication stage 17 to the other device 6B, 6A, and to determine, based on 18 the received progress data, whether it is in synchronous 19 or asynchronous playback progress with the other devices 20 6B, 6A." 21 Do you see that? 22 A. Yes, I see that. 23 Q. And you agree that limitation 1.3 in issued 24 Claim 1 also appears in pending Claim 1 as of the 25 September 13th, 2021, applicant response, correct?	Page 96

1 A. I agree that 1.0 to 1.3 of the new exhibit you 2 showed me, they exist on -- they're listed in 3 Exhibit 102, but there is an additional limitation 1.4 in 4 the produced product. 5 Q. Right. And so, an issue -- would you agree, 6 then, the issued Claim 1 in Exhibit 2001 is the same as 7 pending Claim 1 as of September 20th -- I'm sorry -- 8 September 13th, 2021, applicant response, except that 9 issued Claim 1 has limitation 1.4? 10 MR. FAHY: Objection. Form. 11 THE WITNESS: There is an additional limitation 12 that differentiate the final patent by the patent in 13 2020 -- '21. And the limitation 1.4 is actually a really 14 important limitation that applies these generic claims, 15 1.0 to 1.3, the specific set of environment products and 16 so on. We discuss before that application states or the 17 limitation of the systems really relate to the 18 environment you place them. Now, by just saying I have 19 an antenna, I have a video playback device, and have 20 communication between these, that's quite generic and 21 actually lots of people have done that in the past. 22 Playback video was invented in 1980s on the airway. And 23 the -- I would say there were demonstrations for the four 24 limitations you referred to well before 1970s. The main 25 point of this patent, and I'm sure the main reason that	Page 97 1 THE WITNESS: Okay. Just answer your previous 2 question. I am giving my answer for the complete 3 knowledge of POSITA and make it clear in terms of the 4 person of ordinary skills perception of what's given in 5 the claims of the product. 6 So I consider a claim as some combination or 7 enablement for all these pitches released in the claim. 8 Now, in my opinion, and that would be the opinion of any 9 person of ordinary skills in the area of ESLs. And, 10 actually, that would be an answer even for people with 11 below the level we discussed in this patent. Even a 12 sophomore student will say part of Claim 1 in the claim 13 listed in the document you gave me is listed in some 14 section of 1002, but a critical intent of the claim is 15 missing. So that's -- that's my answer. 16 BY MS. KAISER: 17 Q. If you go to page 140 of Exhibit 1002, let me 18 know when you're there. 19 A. Okay. 140. Okay. 20 Q. Okay. So this is still on the context of the 21 September 13th, 2021, applicant response in the 22 prosecution history of the '669 patent. You see here 23 that the applicant is responding to the examiner's 24 rejection of the pending Claims 1 through 9 and 11 to 16 25 as being an anticipated by Asami. Page 99
1 the owners went for a patent, is 1.4. 2 And, actually, 1.4 in your claim listing, I do 3 not see anything about this in the Exhibit 1002. This is 4 the critical point differentiated the system under 5 discussion to other prior art have been utilized for 6 everything. It's like saying, Okay, I have a car with 7 four tires, and this one drives great. And then if I get 8 this one and use it in a country road, it's fast. So 9 1.3, they agree with you, in this 1002 document lacks 1.4 10 that was added to the final patent. And that, actually, 11 is a critical limitation missing from the Exhibit 1002 12 preliminary filing. 13 BY MS. KAISER: 14 Q. Okay. So, again, most of what you said was not 15 responsive to my question. So I'll object to your answer 16 as nonresponsive. 17 My question was not about whether you thought 18 1.4 was a novel feature or whether it was in prior art or 19 anything like that. My question was a simple comparison 20 question. So I'll ask it again. 21 You would agree with me that issued Claim 1 in 22 Exhibit 2001 is the same as pending Claim 1 as of 23 September 13th, 2021, applicant response, except that 24 issued Claim 1 add limitation 1.4; is that correct? 25 MR. FAHY: Objection. Form. Page 98	Page 100 1 Do you see that? 2 A. Yes, I see that in the bottom. 3 Q. And so, the pending Claim 1 here that was 4 rejected as anticipated by Asami -- Asami -- sorry -- 5 included as we discussed before, the limitations of 6 issued Claim 1, 1.0 to 1.3, correct? 7 A. 1.0 to 1.3. Okay. So what's written is the 8 proposed document by Asami does -- okay -- does not 9 display subject matter or regionally presented. That's 10 what I read here. Okay. That's -- that's the response 11 of the owner. Okay. 12 Q. And before I ask you specific questions about 13 the applicant's response, I'm just orienting us. And so, 14 I'm making sure that you agree, as we've discussed 15 before, that the applicant is responding to the 16 examiner's rejection of pending Claim 1 as anticipated by 17 Asami and that pending Claim 1 at the time included the 18 limitations of issued Claim 1, 1.0 to 1.3. 19 A. So Claim 1 include the specifications of 1.0 to 20 1.3, that's correct. 21 Q. Okay. If you go to the bottom of that page. 22 A. Okay. 23 Q. So this is page 140 of Exhibit 1002? 24 A. Okay. 25 Q. Can you see under the heading Claims 1 to 9 and

1 11 to 16, the applicant says, "The proposed document by 2 Asami does not anticipate the subject of Claim 1 as 3 originally presented?" 4 Do you see that? 5 A. Does not represent -- yes. That's what I read 6 now. 7 Q. Okay. And then in the paragraph that follows on 8 page 140 of Exhibit 1002 to the beginning of page 141 of 9 Exhibit 1002, here the applicant is discussing the 10 limitations of Claim 1. 11 Do you see that? 12 A. Yeah. I have to read it. I have to read it 13 because now I need to spend some time reading it. I 14 mean, it's not something I can respond before I even read 15 it. 16 Q. Okay. 17 A. I mean, as I told you, I skimmed through that. 18 Q. Why don't you go ahead and review from that 19 paragraph to the end of that section, which is on page 20 142, and let me know when you've had a chance to review 21 that. 22 A. Okay. Yeah. I review the response. Then for 23 Asami, that's a document I just skimmed through two years 24 ago. So if you want me to comment on Asami, I have to 25 review also Asami document again.	Page 101 1 declaration my expert opinion. 2 So the answer is, yes, I did review it. Now, if 3 I need to comment to specific reference details, address 4 some subset of claims of the new patent, then I would 5 need to review this prior art again in light of the old 6 claim formulation and then give you the answer. 7 Q. Are you familiar with the process of claim 8 construction in -- in patent law? 9 A. I'm familiar with genetic process of claim 10 construction and claim translation for a person of 11 ordinary skills. 12 Q. Okay. And if you go to your declaration, 13 Exhibit 1003 and paragraph 42, let me know if you're 14 there. 15 A. Yes. 16 Q. And in paragraph 42, you describe your 17 understanding of the process of construing the words of a 18 claim in a patent; is that correct? 19 A. That's correct. There -- this -- this case is 20 about interpretation of the patent claims, yes. 21 Q. Okay. And you understand that it can be 22 relevant to consider in deciding what the words in a 23 patent claim mean; the words of the claims themselves, 24 the specification of the patent, and its prosecution 25 history, correct? Page 103
1 Q. Okay. So I -- my questions are going to be 2 directed at the applicant's arguments. So why don't you 3 go ahead and review from the bottom of page 140 to the 4 top of page 140. 5 A. But still, unless I review as Asami thoroughly, 6 I don't feel -- I don't feel as an engineer I will be 7 able to give a very thorough answer to he provide correct 8 information from POSITA. So if you ask questions about 9 Asami, you're giving me some comment and response for 10 Asami. So before I -- I could even express some opinion 11 about the owner's response, I have to review or read the 12 Asami in detail. And after I read Asami in detail, I can 13 express an opinion about the response. You're -- you're 14 asking me to comment on a response on a document I 15 skimmed through two years ago out of tens of documents. 16 So I will need to review Asami before I even respond to 17 your questions for response of the owner. If you want me 18 to review Asami and review the response, I'll be happy to 19 do so, but I will need to review it thoroughly. 20 Q. The office action response that I'm asking you 21 about right now, the September 13th, 2021, applicant 22 response, did you review that applicant response in 23 forming your opinions in Exhibit 1003? 24 A. I have reviewed the response. I did that two 25 years ago, and I have clearly identified in my Page 102	1 A. Yes. So understand the words of a claim are 2 first given the plain meaning that those words would have 3 to one of ordinary skill at the time of the alleged 4 invention, and that's why I paid attention to all the 5 dates. And also, I also understand that the structure of 6 the claims, the specification and file history, may be 7 used to better construe a claim insofar as the plain 8 meaning of the claims cannot be understood. 9 Q. Okay. And you have a number of patents 10 yourself, right, where you're a named inventor? 11 A. That is correct. 12 Q. And so, do you understand, also, that the 13 inventor can define terms in the specification itself? 14 MR. FAHY: Objection. Form. 15 THE WITNESS: In general, if these terms have 16 multiple meanings or if this claims are not clear to a 17 person of ordinary skills, then I may be able to -- 18 patent owner may be asked to give more specifications 19 that will make them understandable by a person of 20 ordinary skills. So if there is lack of clarity or if 21 this term is not commonly used, then it is possible. And 22 on the other side, there are terms that are sometimes 23 impossible to define. And then in this case, you'll have 24 to explain. 25 BY MS. KAISER: Page 104

1 Q. Okay. Well, let me ask you this question based 2 on your understanding. If there's a claim -- or strike 3 that. 4 Based on your understanding, if there is a term 5 and a patent claim that has a plain meaning to a person 6 of ordinary skill in the art, but the specification of 7 the patent includes a clear definition of that term, what 8 controls, the plain meaning or the definition? 9 MR. FAHY: Objection. Form. 10 THE WITNESS: In general -- and I'm not talking 11 about legal problems because I told you I'm not a lawyer, 12 so I'm an -- I'm an engineer. So typically, you -- the 13 first -- the most important point is the specification 14 and the context of the patent. So the terms are 15 interpreted, according to the patent. Now, typically -- 16 and I have not come across any case in my rather limited 17 experience with patent. There is no clear contradiction. 18 It's more, kind of, a narrowing down in the way of 19 understanding of claims for specific patents. And that's 20 why specifications of the patent are really important. 21 But, for example, you asked me a question before 22 about the 1.4. And that's the expert specification. So 23 there are devices that can be used for everything. I 24 mean, your cellphone can be utilized from anything; 25 talking, sensing, pretty soon monitoring your biosignals.	Page 105 1 A. -- determines that. So that's what I said. I 2 read '669 patent. I went through the claims, and I went 3 through the teachings. And given the specifications in 4 this patent, then I reached the conclusion that 5 everything called in this patent is obvious based on 6 prior art. 7 Q. Okay. 8 A. So I did not start with some generic IEEE 9 general interpretation. I read the patents. I 10 understood what the claims were. I understood how the 11 patent owners utilized these terms. And then after doing 12 that, I reached the conclusion, based on my experience, 13 that this was new, and the prior art were disclosed. 14 Q. Okay. And so, we've talked about the 15 specification. Now, my next question is going to be 16 about the prosecution history. And do you have an 17 understanding about the use by the applicant of the claim 18 terms in the prosecution history, how that can affect the 19 interpretation of claim language? 20 MR. FAHY: Objection. Form. 21 THE WITNESS: Can you say that again? Because 22 these are -- there are lots of legal terms. So say that 23 again, please. 24 BY MS. KAISER: 25 Q. Sure. Page 107
Page 106 1 So the listing of a cellphone in a patent is not specific 2 enough. And then the patent adds specifications for the 3 people to understand and provide clear understanding of 4 the claims. So specification of the patent is really 5 important. 6 BY MS. KAISER: 7 Q. Okay. And I think my question was a little bit 8 different. So I understand your testimony that the 9 specification of the patent is important, but I 10 understand that you've provided opinions here about 11 whether certain prior art references meet certain 12 limitations of the claim, and I'm trying to understand 13 your -- your knowledge or approach to interpreting 14 claims. 15 So my question is, if there's a term in a patent 16 claim that has a plain meaning to a person of ordinary 17 skill in the art, that the specification of the patent 18 includes a clear definition of that term, say a clear 19 definition that's totally different than the ordinary 20 meaning, what controls, the plain meaning or that 21 different definition in the specification? 22 MR. FAHY: Objection. Form. 23 THE WITNESS: The specification of the patent -- 24 BY MS. KAISER: 25 Q. Okay.	Page 108 1 So in -- you know -- you understand what I mean 2 by prosecution history? 3 A. Right. Yeah. 4 Q. Okay. And you understand, as we've been talking 5 about that the examiner during the prosecution history, 6 can issue rejections based on prior art, right? 7 A. Yes. 8 Q. Then you understand that the applicant can 9 respond to the examiner's objections and explain why, for 10 example, the applicant thinks the examiner is not 11 correct? 12 A. Okay. Yes. 13 Q. So my question is, do you have an understanding 14 of how the applicant's explanations, in responses to 15 office actions in the prosecution history, can -- are 16 taken into account or considered in determining the 17 interpretation of claim terms? 18 MR. FAHY: Objection. Form. 19 THE WITNESS: I do not know the specifics of the 20 process. What I can say, as an engineer reading these 21 steps and also as a patent owner, that whenever some 22 patent, in general, some claims are rejected, you may 23 arrive the claims or you may add some specifications that 24 would address POSITA reasons of rejection and make it, 25 and pretty much put them together or setting the

1 foundation for a challenge or rejection. So if you have 2 objection of a specific set of claims, you may have more 3 specifications, narrow down scope in some cases by you 4 have seen. And then you can go back to POSITA and say, 5 Please, reexamine things and see whether you can allow 6 this new set of claims with old and all the new 7 specifications be acceptable. 8 That's my -- that's my expertise and the way I 9 could understand the process based on my personal 10 experience. I'm not a huge expert in this. I only have 11 about 20 patents. So it's not like I have hundreds and 12 thousands of patents. Just from my limited experience 13 and based on some feedback of -- with some meeting or 14 request and reexamination, that's what I have seen 15 happen. 16 BY MS. KAISER: 17 Q. So you talked about, for example, an applicant 18 can narrow the scope of a patent claim by amending that 19 claim during prosecution, right? 20 A. That's quite generic. So that would be one way. 21 Q. Okay. 22 A. One way of doing that, based on information I've 23 been given by -- by patent lawyers in the past for our 24 patents. So that was one way of doing it. 25 Q. And another way that an applicant can narrow the	Page 109 1 it much more thoroughly. 2 Q. So I want to go back, then, to Exhibit 1002 -- 3 A. Okay. 4 Q. -- and have you look, again, at the bottom of 5 page 140 to the top of page 142. 6 A. Yes. 7 Q. And my the question -- the questions that I'm 8 going to have are going to be in the context of what the 9 applicant was arguing about the scope of the claims. So 10 can you review it in that context? 11 A. Again, I will get back to my previous point. 12 We're commenting on a reference Asami that I have not 13 reviewed thoroughly, and I have to refresh my memory. So 14 even if you going to ask me questions about the patent 15 owner's view or translation of the patents, unless I have 16 reviewed thoroughly the Asami reference, I would not be 17 able to provide a fair opinion to POSITA. I would have 18 to review the Asami patent thoroughly, read it, 19 understand it, and then after I do that, I could read the 20 response from the patent owner. Otherwise, I see here to 21 have document by Asami. And then a couple of pages of 22 response. But before I review the Asami document, I 23 don't feel I have the right to provide the owner's 24 information. I have to review Asami, and then I will 25 review these two pages, and then you can ask me Page 111
1 scope of a patent claim during prosecution is by arguing 2 that the pending claim has a narrower scope than the way 3 that the examiner is interpreting it. 4 Do you understand that? 5 MR. FAHY: Objection. Form. 6 THE WITNESS: I'm not a lawyer, but I -- I 7 trusted her opinion. 8 BY MS. KAISER: 9 Q. Okay. Did you -- in -- in reviewing the 10 prosecution history in this case, which is in 11 Exhibit 1002, did you consider whether any of the 12 applicant's arguments were that the scope of the claims 13 should be narrower than the way the examiner was 14 interpreting them? 15 MR. FAHY: Objection. Form. 16 THE WITNESS: As I told you, I did not read 17 line-by-line. I focused, technically, to the -- to the 18 claims. And in a sense, I did something similar to what 19 you did. So I went through the preliminary claims and 20 the final set of claims and see how they evolved. So 21 since I've been in this area for quite some time, it 22 was -- it was clear to me that, for example, the scope 23 was under discussion. And the way the examiner was 24 transmitting scope and all this, now, for details, I 25 cannot -- I cannot give you clear answer before I review Page 110	1 questions, if you want me to. 2 Q. So I think before you said that you gave 3 Asami -- I don't remember the exact language you used, 4 but you reviewed it briefly when you were forming your 5 opinions in this case; is that fair? 6 MR. FAHY: Objection. Form. 7 THE WITNESS: I skimmed through that. I skimmed 8 through all these documents. And that was very, very 9 quick review. And that took place 2022. 10 BY MS. KAISER: 11 Q. Okay. 12 A. So I do not recall details. That's why I have 13 to review again this reference. 14 Q. Okay. And so, when you reviewed the prosecution 15 history before, is it fair to say that you didn't think 16 it was important to thoroughly review Asami to understand 17 the applicant's statements? 18 MR. FAHY: Objection. Form. 19 THE WITNESS: As we said before, when I 20 reviewed this document, which is, like, 305 pages full of 21 legal terms, what I did was I went through the 22 references, and I did not see any reason for me -- after 23 a quick review, I did not see any reason that could 24 change my opinion from my expert report. So I skimmed 25 through that, compared claims. So how claims were Page 112

1 modified, took a quick look in the references. And -- Page 113 2 and I did not think any way of translation from. I 3 didn't think there was any around this translation. 4 Now, if you want me to explicitly focus on Asami 5 reference, talking about specific details and specific 6 paragraphs, because I see here just one line -- lines -- 7 column 7 lines 10FF or paragraph 007. If you ask me the 8 specifics, then I will need my time to review Asami and 9 provide the clear opinion, specifically, with respect to 10 these prior reference. 11 BY MS. KAISER: 12 Q. So to be clear, the paragraph at the bottom, 13 that starts at bottom of page 140 of Exhibit 1002, that 14 paragraph and then the first full paragraph on page 141 15 of Exhibit 1002, don't mention Asami at all. 16 Do you see that? 17 MR. FAHY: Objection. Form. 18 THE WITNESS: What I see is page 141 includes 19 the term Asami or Asami's patent more than five, six, 20 seven times, so I can see Asami's name quite a few times. 21 BY MS. KAISER: 22 Q. Sure. 23 A. Okay. The first sentence, saying the proposed 24 document by Asami, so even the first sentence that sets 25 the tone for the whole paragraph starts by document by	1 were explicitly given there. Then I was given the Page 115 2 prosecution's history. I skimmed through that to see if 3 there was a major issues that would made me think of '669 4 different way. Nothing changed. And I formed my opinion 5 based on my '669 reading, identified prior art due to 6 that, and that's what I'm raising in my expert. 7 MS. KAISER: Okay. We've been going for more 8 than an hour, so this would probably be a good time to 9 break for lunch. 10 THE WITNESS: Sure. Sure. Okay. 11 MS. KAISER: One question is, do we want to take 12 a little bit longer lunch so that you have time to review 13 the Asami reference, or do that when we get back? 14 THE WITNESS: I would like do to it after lunch 15 because this is not something I can do during lunch. So 16 after we start again, I will start reviewing the Asami. 17 MS. KAISER: Okay. So how long -- well, let's 18 go off the record. 19 (A recess was held from 11:09 a.m. to 12:06 p.m.) 20 BY MS. KAISER: 21 Q. Welcome back, Dr. Tentzeris. Can you hear me 22 all right? 23 A. Yes. I can hear all right. 24 Q. Upon reflection, I think I'm going to shift 25 gears and go back to your declaration in this case, which
1 Asami. So you are commenting that this specific Page 114 2 reference or specific paragraph does not anticipate the 3 subject matter. That's why I'm saying I need to review 4 it, have my time to review, because even the first 5 sentence sets the tone for the whole write-up, says 6 Asami. 7 Q. So am I understanding your testimony earlier 8 that you formed your opinions in Exhibit 1003, and then 9 you went back and looked at the prosecution history to 10 see if it conflicted with the opinions that you had 11 formed? 12 A. I never said that. 13 MR. FAHY: Objection. Form. 14 THE WITNESS: I never said that. So as I said 15 previously, I read the patent, '669, and I read it 16 quite -- I read it very thoroughly going through all the 17 terms, all the patents there. And then I identified some 18 prior art that would clearly obviating the patent claims. 19 The way they were talking this patent, what I said was 20 one or two written took place before my prior 21 identification. So I read '669. Then I reviewed 1002. 22 And then I came up with some paragraphs. And what I said 23 is reviewing 1002 did not make any difference in my 24 formed opinion. So that's what I did first. I read 25 '669. I read the claims. I read the specification that	1 is Exhibit 1003. Page 116 2 A. Okay. 3 Q. So if you could pull that up. 4 A. Sure. 5 Q. Let me know when you have it. 6 A. Let me open it. Okay. 7 Q. Can you go to page 21 of the PDF, which is page 8 18 of the declaration itself, and let me know when you're 9 there. 10 A. Okay. 11 Q. Right. And just to orient you, I'm pointing you 12 to the portion of your declaration where you talk about 13 the overview of the '669 patent. 14 Do you see that? 15 A. Yes. Yes, I do. 16 Q. Okay. And if you scroll down, can you go to 17 paragraph 38, please. 18 A. 38. Okay. Okay. 19 Q. So if you see -- you see here that you're 20 quoting from the specification of the '669 patent? 21 A. Yes. 22 Q. And if you look at the second full sentence, it 23 says, "In block 12, each device 6A and 6B, attends the 24 lapse of one second of its own clock. After one second 25 has lapsed, the respective device 6A, 6B transmits the

1 playback progress data, which represent the frame number 2 of the correctly used frame in the respective device 6A, 3 6B. The transmission of the playback progress data of 4 the device 6A is received at the device 6B and vice 5 versa." 6 Do you see that? 7 A. Yes. Yes, I do. 8 Q. And it's your understanding that vice versa at 9 the end of that quote means that 6A transmits its 10 playback -- playback progress data to 6B, and 6B 11 transmits its playback progress data to 6A, correct? 12 A. Vice versa, yeah. That's the meaning. So 13 transmission playback progress-data of the device 6A is 14 received at the device 6B and vice versa, yeah. 15 Q. Okay. And then the next sentence after that, it 16 says, "The devices 6A, 6B compare the received frame 17 number with the frame number currently in use in its own 18 playback progress." 19 Do you see that? 20 A. Yes. 21 Q. And that means that each device compares the 22 frame number received from the other device with its own 23 current frame; is that right? 24 MR. FAHY: Objection. Form. 25 THE WITNESS: Device 6A, 6B compare the received	Page 117	1 us on -- 2 A. Give me a second. 51. 3 Q. For me, that's on page 31 of the PDF. 4 A. Yes. File 51. That's page 28. 5 Q. Yes. And here in paragraph 51, do you see that 6 you're talking about figure 9 of Masumoto? 7 A. Yes. 8 Q. And you've reproduced an annotated version of 9 figure 9 in your paragraph 51. 10 A. Okay. 11 Q. Do you see that? 12 A. Yes. 13 Q. So in figure 9 -- well, let's -- do you have 14 Masumoto in front of you? 15 A. I'm trying to open it. 16 Q. 1005. 17 A. I'm trying to open it. Okay. 18 Q. And in Exhibit 1005, I'll also point you to 19 Masumoto's description of the fifth exemplary embodiment 20 that starts at paragraph 102. Let me know when you're 21 there. 22 A. 102. Okay. 23 Q. And in Masumoto, the fifth exemplary is 24 described in figures 9 and 10. 25 Do you see that?	Page 119
1 frame number with the frame number currently in use in 2 its own playback process. So they compare the received 3 frame number to the frame number currently in use in the 4 playback of this device. So, for example, 6A compares 5 the received frame number from 6B with a frame number 6 currently in use by 6A in its own playback process. 7 BY MS. KAISER: 8 Q. Okay. That's helpful. And -- and likewise, 9 then, 6B would compare the frame number received from 6A 10 to 6B's current frame number in its own playback process; 11 is that right? 12 A. That's right. 13 Q. And -- okay. Okay. I want to direct your 14 attention to paragraph 51 of your declaration. But maybe 15 before we go there, just to give you context, if you go 16 to page 26 of the PDF. 17 A. 26 of the PDF. Okay. 18 Q. So I just want to orient you that I'm taking you 19 to ground 1 of your opinions. 20 A. Yes. 21 Q. This is your opinion that, "Claims 1 through 15 22 are rendered obvious over Swafford in view of Masumoto." 23 Do you see that? 24 A. Yes. 25 Q. Okay. And then if you go to paragraph 51 with	Page 118	1 A. Figures 9 and 10, okay. 2 Q. Okay. And if you go to paragraph 108. 3 A. Okay. Let me pull up there. Yes. 4 Q. This actually starts at -- at paragraph 106, but 5 this -- in this portion of Masumoto, it's describing the 6 operation of the fifth exemplary embodiment with 7 reference to the fluid chart of figure 9. 8 Do you see that? 9 A. Yes. 10 Q. Okay. And then on paragraph 108, it says, "One 11 display requests other displays to notify the frame 12 number or time stamp of the video signal displayed on 13 each of the other displays." 14 Do you see that? 15 A. Yes. 16 Q. And if you continue on in paragraph 108 at the 17 top of the next column, do you see the sentence that 18 says, "In the exemplary embodiment for convenience?" 19 A. Okay. Let me see. My computer is slow. So 108 20 in exhibit -- "Display requesting this notice is called a 21 master display, and display D240 is the master display in 22 the following description." 23 Q. Okay. And then do you see the last sentence 24 says, "A method of determining the master display is 25 described later"?	Page 120

1 A. Yes. 2 Q. If you scroll down to paragraph 120. 3 A. Paragraph 120. Okay. 4 Q. Do you see that paragraph starts, "Figure 10 is 5 flow chart illustrating the operation of determining 6 master display in multi-display apparatus. One, in the 7 exemplary embodiment"? 8 A. Okay. Yes. 9 Q. Sorry. 10 A. Yes. 11 Q. I didn't mean to cut you off. 12 A. It's 120. That's right. 13 Q. Hold on. 14 A. No problem. 15 Q. So in the fifth exemplary embodiment in 16 Masumoto, is it your understanding that figure 10 shows 17 the process of determining which of the displays is the 18 master display? 19 MR. FAHY: Objection. Form. 20 THE WITNESS: Let me read it. Let me look at 21 the tab section. So figure 10 is a flow chart, within 22 120, "Illustrating the operation of determining the 23 master display in the exemplary embodiment. This master 24 display communications with all other displays, and 25 continuously executes predetermined arithmetic	Page 121 1 that discloses the configuration of the operation of the 2 master display. Figure 10 is one example of how this 3 master display could be utilized. That's one example, 4 one demonstration. There are different ways of doing 5 that. And that's denoted even in the -- in the patent. 6 If you read, that's given in paragraph 0029, which says, 7 "Figure 10 is a flow chart illustrating the operation of 8 determining the master display in accordance with the -- 9 (Reporter clarification.) 10 THE WITNESS: Again, paragraph 0029, "Figure 10 11 is a flow chart illustrating the operation determining a 12 master display in the multi-display apparatus in 13 accordance with the fifth exemplary embodiment." Yeah 14 that's one example of flow chart illustrating the 15 operation. 16 BY MS. KAISER: 17 Q. But the -- 18 A. How they choose master. 19 Q. In the fifth exemplary embodiment, are there any 20 other examples of how to determine the master display 21 other than what's shown in figure 10? 22 A. Let me go back and read the fifth exemplary 23 embodiment. Fifth exemplary embodiment is referenced in 24 both figures 9 and 10 as given 0102. So let me take a 25 look. The fifth exemplary 0125, they refer to the case,
Page 122 1 processing. Its processing load is thus heavy compared 2 to other displays. Accordingly, a display with the 3 highest capability is said as the master display." 4 (Reporter clarification.) 5 THE WITNESS: Yeah. At 0120 paragraph, it says, 6 "Figure 10 is a flow chart illustrating the operation of 7 determining the master display, in multi-display 8 apparatus one in exemplary embodiment. The master 9 display communicates with other displays and continuously 10 executes to determine arithmetic processing." 11 Okay. So figure 10 shows an example 12 illustrating the operation of determining the master 13 display as is within paragraph 0120. And also 14 illustrated in 53 paragraph of my declaration in the 15 exemplary embodiment for convenience, a display 16 requesting this notice is called a master display, as 17 it's given in paragraph 0108. And after that figure 9 18 master display, display D240 and when any of the 19 different displays starts the requests, any of the 20 different displays, may be the master display here for 21 convenience. That's in paragraph 53. 22 BY MS. KAISER: 23 Q. Right. You don't talk about figure 10 in 24 paragraph 53, do you? 25 A. I am talking first about figure 9. That's --	Page 124 1 "A rule should be further provided to reset the master 2 display if none of multiple displays notify other 3 displays of the master display." So there is a ruling 4 advance. So in one way of defining master display. But 5 then for 0125, you could change the selection of master 6 display based on the circumstances. So figure 10 shows 7 one way to define a master display. 8 Q. And I'm sorry. What paragraph were you pointing 9 to in your answer? 10 A. I'm pointing to 0125, talking about the reset of 11 the master display. So it says -- "A rule should be 12 further provided to reset the master display." 13 (Reporter clarification.) 14 THE WITNESS: I'm reading from 1005 Masumoto, 15 paragraph 0125. And it says, "A rule should be further 16 provided to reset the master display if none or multiple 17 displays notified other displays of the master display." 18 Which means, there are circumstances that a master 19 display selection can be reset and a new master display 20 can be found under some conditions. So that's one 21 example. 22 Figure 10 at paragraph 0120 sets some conditions 23 for this example. It is a flowchart saying this master 24 display communicates with all other displays and 25 continuously executes to determine the arithmetic

1 processing. So in this example, they are showing an 2 example of one arithmetic processing that's shown a 0125. 3 There are other criteria in the selection of this master 4 display in case of lack of notification by the displays 5 of the master display. 6 Q. If you look at paragraph 0124 of Exhibit 1005. 7 A. 0124. Yes. 8 Q. Do you see the top of the right-hand column, the 9 last sentence of that paragraph says, "By providing this 10 kind of rule in advance, only one master display can be 11 set in multi-display apparatus 1? 12 A. I'm trying to find it. So you said paragraph 13 124? 14 Q. Yes. 15 A. "By providing this kind of rule, only one master 16 display can be set in multi-display apparatus 1." That 17 is correct. 18 Q. Okay. And so, is it your understanding that, in 19 exemplary embodiment 5 in Masumoto, at any given time, 20 the system has only one -- one display set as the master 21 display? 22 MR. FAHY: Objection. Form. 23 THE WITNESS: Can you -- can you say that again? 24 BY MS. KAISER: 25 Q. Sure.	Page 125 1 declaration, you see that the transmission of the data 2 talk place at different time instance for each one of 3 these devices. They attend the lapse of one second of 4 its individual clock, which is not exactly the same time 5 for all the clocks. Typically, clock drift is one major 6 issue in these systems. So I would say Masumoto does not 7 teach No. 1 via existence only of a single master node 8 because you would have at least two nodes with the same 9 processing power that both of them would operate past the 10 nodes, and in reality, in a smart cell environment, 11 actually all of them or most of them have the same 12 processing. So either of them could be master node 13 collecting the information and sending synchronization. 14 That's point No. 1. 15 Point No. 2, that could talk place -- this 16 change of master and slave could take place at different 17 time instance. So there is no reference of the time node 18 would be the master. You would have either one of these 19 nodes would be master at some time. And that's in 20 accordance to '669 patent, which says that the 21 transmission and the reception of the data -- the 22 transmission of the data for the frame is taking place 23 one second at individual clocks, which means the 24 existence of communication between two nodes for 25 synchronization purposes could take place at different Page 127
1 A. Yeah. Please ask the question again. 2 Q. Is it your understanding -- 3 A. Okay. 4 Q. -- that in exemplary embodiment No. 5 in 5 Masumoto, at any given time, the system has only one 6 display set as the master display? 7 MR. FAHY: Objection. Form. 8 THE WITNESS: So in this case, there is no -- on 9 this patent, there is no definition of time constraint 10 because time has to do with individual clocks, and 11 despite the fact that there is no time reference in this 12 one, even if you go to the '669 patent in the paragraph 13 38 of my declaration, the one paragraph you pointed me 14 to, if you go to the first line of page 23 or page 20 of 15 the PDF, you can see here saying in block 12, its device 16 6A and 6B attends the lapse of one second of its own 17 clock, and then you have the transmission. So talking 18 about the lapse of one second of its own clock means that 19 you could have transmission and reception at different 20 time instance. The clock is not common for all the 21 devices. So it's the same question for '669 about 22 timing. Timing is not disclosed. It's not taught in any 23 of these patents. 24 I mean, '669 -- the way I read '669, for 25 example, and that's clearly shown in paragraph 38 of my Page 126	1 time instance. So number-wise, time-wise, no details are 2 taught in 105. Every node could be the master node that 3 could change from second to second or from communication 4 to communication, especially if the processing power of 5 this criteria is not beyond the criteria for the 6 selection for the master node. 7 BY MS. KAISER: 8 Q. So, Dr. Tentzeris, I understand what you just 9 said, but if you could go to paragraph 124 again of 10 Masumoto and look at the sentence that starts, "If the 11 measurement result of its own processing capacity," and 12 let me know when you're there. 13 A. Yes. So based on the result -- 14 Q. I haven't asked you a question yet. 15 A. Sure. 16 Q. So that sentence says that, "If the measurement 17 result of its own processing capacity and the measurement 18 results of processing capacity of other displays are the 19 same, a display notifying the measurement result of 20 processing capacity first, or a display whose power is 21 turned on first, is set as the master display." 22 So doesn't Masumoto disclose that even if 23 multiple displays have the same processing capability, it 24 still has a rule to identify only one master display? 25 MR. FAHY: Objection. Form. Page 128

Page 129 1 THE WITNESS: Again, I don't agree with this 2 comment because it says -- determines itself to be a 3 master display if the measurement is out of its own 4 processing capacity is the highest. Now, that assumes 5 that, for this example, one of the measurement results 6 will be the highest. It is not unlikely in this type of 7 environments to have measurement results that are 8 identical. So in the case that -- in modular case, the 9 measuring result of the processing capacity is the same, 10 then you need to change the presence of master display 11 accordingly. That's what I call this to be just one 12 example. This is not an exclusive criteria. Because 13 even in what's taught in 0124, you could have measuring 14 results of their own processing capability to be 15 identical. So in this case, different criteria can be 16 utilized. 17 BY MS. KAISER: 18 Q. I understand that different criteria can be 19 utilized. It says, for example, in the quote that I read 20 that you could either look at which one notified its 21 result first, or which one is powered on first. So I -- 22 I hear what you're saying about there can be different 23 criteria utilized, but isn't the end result that only one 24 of the displays is designated as the master display? 25 MR. FAHY: Objection. Form.	Page 131 1 No. 2, the devices on the displays playing the role of 2 master nodes could change as a function of time. Even 3 '669 patent, this communication exchange is not taking 4 place at the same time. It takes place at different 5 times. So device 6A could collect at time of 1.1 second. 6 And based on the clock of 6B, this communication or this 7 collection could take at 1.102 seconds. 8 BY MS. KAISER: 9 Q. So Dr. Tentzeris, I want to be clear that I'm 10 not asking you about the '669 patent right now. I'm 11 asking you about Masumoto. 12 So I'm asking you specifically about Masumoto's 13 exemplary embodiment No. 5. And can you point me to 14 where, in Masumoto's exemplary embodiment 5, that 15 Masumoto discloses having multiple master displays? 16 MR. FAHY: Objection. Form. 17 THE WITNESS: Let me know -- so the fifth 18 exemplary is represented by figures 9 and 10, and that's 19 given the patent description of the fifth exemplary. In 20 figure 9, Step S21, as at least in my declaration, the 21 massive display request frame number to other displays. 22 Other displays send frame number to the master display. 23 The master display receives frame numbers from other 24 displays and corrects the difference. So this gives an 25 example of the function of communication between two
Page 130 1 THE WITNESS: Give me one second. Let me go to 2 read this. So as I have disclosed in paragraph 53 of my 3 declaration, the master display in this exemplary 4 embodiment for convenience, a display requesting this 5 notice is called a master display. And the master 6 display request for a notice in Step S21. So when any of 7 the different displays starts the requests, any of the 8 different displays may be the master display here for 9 convenience. There is no teaching in 1,005 that -- about 10 the number of the master displays or in general about the 11 number of displays requiring the frame number from the 12 other displays. The way I can read this is quite similar 13 to the '669 patent having transmissions and 14 communications of different time instance taking place 15 once everyone settled in their local clock. So the way I 16 can translate this, and as I include in the declaration, 17 is at some time instance, you will have at least one 18 master display. You could have more. There is no 19 teaching about the number of massive displays. And at 20 different time instance, the way I read '669 21 corresponding to one second for other device's clock, 22 they could become master displays, as well. So this 23 collection process, in the sense, takes place at specific 24 time intervals for individual time clocks, which means, 25 No. 1, there could be more than one master nodes. And	Page 132 1 screens, two displays. Now, in this case, it discusses 2 about the communication process for figure 9. As we 3 discuss before, and as I disclosed in my declaration, any 4 one of these displays could be a master display at any 5 given moment based on a variety of criteria. One is 6 shown in figure 10 as an example. There are different 7 criteria we show for seven of the display in the last 8 paragraph of the fifth embodiment. And literally, all 9 displays cooperate as master displays, collecting 10 information and synchronizing at some predefined internal 11 for the clock. So here, it says, The master display, 12 that's an example, and that's for simplicity of 13 understanding. 14 Easily, you would have different master 15 displays. There's nothing saying in the patent one 16 master display. And the other point is that figure 10 17 that discloses one criteria, and clearly there are other 18 criteria, as we discussed before, that shows the 19 selection of some display as the master display. There 20 is nothing in the patent saying the only or the exclusive 21 master display. At least I cannot identify the single 22 master display teaching in this patent. Unless I have 23 missed it, there's nothing in the patent denoting a 24 number of master display. There is a criteria for one 25 display to be considered or chosen as a master display.

1 And figure 9 showing that each one of these individual of 2 master displays could do. So there is nothing in this 3 patent say -- given a number. 4 BY MS. KAISER: 5 Q. How about in paragraph 125 of Exhibit 1005, 6 which is the Masumoto reference, that says, "A rule 7 should be further provided to reset the master display if 8 none or multiple displays notify other displays of the 9 master display." 10 Doesn't that suggest that you would only have 11 one because you don't want to have none or multiple? 12 A. Actually, the way I read this is -- it says 13 provided to reset a master display, not the master 14 display. So that's why I say that this one does not 15 disclose a specific number. It says, a rule should be 16 provide -- "Should be further provided to reset a master 17 display." Now I would expect to, say, a rule should be 18 further provided possibly to reset the only master 19 display, if they -- if they really wanted to note a 20 single master display. But this is a generic statement 21 saying that possibly one out of many master displays 22 could be reset, if none or multiple displays is notified, 23 the display of the master display. That's how I would 24 read it. 25 Q. So still looking at the fifth exemplary	Page 133 1 processes in the flow chart, which means that every 2 controller could play the role described in this flow 3 chart. Then as an example for convenience, what's shown 4 here is just one example for one display, but every other 5 display could execute the process in the flow charts 6 similarly. 7 BY MS. KAISER: 8 Q. Okay. And -- and I understand that that's your 9 testimony. I'm trying to understand how this flow chart 10 would work when it's the D -- excuse me -- D240 acting as 11 the master display in the method. So assume for me that 12 we're in operation of the fifth exemplary embodiment, and 13 that D240 is acting as the master display. Okay. 14 A. Yeah. 15 Q. So then in figure 9, if you look at the flow 16 chart in figure 9 in Step S21, D240 would send a request 17 for the frame numbers to the other displays which would 18 be A210 to C230, correct? 19 A. Correct. 20 Q. Okay. And then A210 to C230 in Step S22 would 21 send their frame numbers to D240, correct? 22 A. That's the Step 22 -- that's the Step 22? 23 Q. Right. 24 A. And it is even also in paragraph 0110, yes. 25 Q. And then Step -- in Step S23, D240 would receive Page 135
1 embodiment in Masumoto, which is Exhibit 1005, you agree 2 with me that the description here from paragraph 108 3 through 119 describes operation where display D240 is the 4 master display, and displays A210 to C230 are non-master 5 displays; is that accurate? 6 MR. FAHY: Objection. Form. 7 THE WITNESS: Again, if you read paragraph 018, 8 it says, "The exemplary embodiment for convenience, a 9 display requesting this notice is called a master 10 display. And the display D240 is a master display of the 11 former description. The exemplary embodiment of the 12 frame number is used as an exemplary of information 13 invited to the video signal." 14 So, first of all, that's clearly saying that 15 this is expressed in convenience. A -- No. 2 from 16 paragraph 0106, it refers to operation of multi-display 17 apparatus 1 in the fifth exemplary embodiment. Figure 9 18 is a flow chart illustrating the operation of 19 multi-display apparatus in this embodiment. So 20 controlling its display from A210 D240 executes the 21 processes in the flow chart. 22 And then at 0108, "One display requests other 23 displays to notify the frame number of time stop." So as 24 you can see here, paragraph 01067, the controller in 25 every display, from A210 to display D240, executes the Page 134	1 the frame numbers from A210 to C230, correct? 2 A. Okay. 3 Q. And then in Step S24, D240 would look to see if 4 there was a difference? 5 A. Okay. 6 Q. And if you look back at the description -- 7 A. Okay. 8 Q. -- I'm looking -- 9 A. Paragraph 210? 10 Q. Looking, for example, at paragraph 113. 11 A. 113. Okay. 12 Q. And so, here, if you look at paragraph 113 13 through 117 -- 14 A. Okay. 15 Q. -- D240 is looking at the frame number that it 16 received from display A210 in determining whether there 17 is a difference between the actual frame number of A210 18 and the desired frame number; is that correct? 19 A. Okay. 20 Q. Yes. 21 A. They compare -- let me just read it from here. 22 I think that's part of 116. Let's see. So display D240 23 calculated the desired frame number at specific time 24 notified in Step 21, and compares the calculation of the 25 frame number received in Step S23 for its display to Page 136

1 determine any difference. That's Step S24 listed at 2 paragraph 0113. 3 Q. Okay. And so, that -- the calculation in S24 is 4 specific to the difference for display A210 from its 5 actual frame number to the frame number desired? 6 A. For display A210, you're talking about the 7 information received from display A210, is this? 8 Q. And then the calculation that master display 9 D240 is performing is specific to the difference for 10 display A210? 11 A. That's a data that's combining some data 12 concerning the display A210 on the video signal that has 13 been received from A210. 14 Q. And here in Step S25 in figure 9, display 240 15 notifies A210 of a correction quantity that it 16 calculated? 17 A. That's the frame correction quantity. That's 18 S25. 19 Q. And here in the example in paragraph 118, that 20 frame correction quantity is 10 frames. 21 Do you see that? 22 A. Yeah. 23 Q. So that means that D240 is telling display A210 24 to -- to correct by 10 frames. So, for example, the skip 25 ahead 10 frames; is that fair?	Page 137 1 controller most likely utilized a comparator. And 2 comparing this number to zero could have been pretty much 3 an actual gate determines whether it needs to modify the 4 video playback frame or not. So in a sense, A210 5 determines, by itself, whether it's synchronized or not 6 synchronized and readjust the video playback performance. 7 Q. Where does it say in the fifth exemplary 8 embodiment that A210, after it receives the frame 9 correction quantity from D240, makes a further 10 determination about whether its in synchronous or 11 asynchronous playback? 12 A. You're asking me a question about 13 determination -- further determination. I did not see 14 anywhere at D240 about a first determination of 15 synchronous or asynchronous operation. I saw just a 16 calculation of a frame correction quantity. 17 Now, A210 plays the video signal, and it's 18 obvious. It's going to be obvious to everybody who's an 19 expert in this that the playback process or the number of 20 the frame that each one of these screens plays determined 21 by the controller. Now, if you just have a number, a 22 correctional number of frames, that does not say anything 23 about the playback process of any display. This 24 information has to be processed by the controller of this 25 monitor. And then based on this number, readjust the
Page 138 1 A. That says, to my opinion, that the determination 2 of -- that the devices for the screens are in 3 synchronization play that is taken -- is determined 4 independently from the server. So everything is taking 5 place on the displays. We don't need interruption with 6 the video server. So what's -- the only thing I can 7 understand from this is the displays, by themselves, 8 determined that they are in a synchronization play, but 9 without the need for any information from the video 10 distribution center. 11 Q. Okay. So my question didn't have anything to do 12 with the video distribution center. 13 My question was 118, paragraph 118 of Masumoto, 14 which is Exhibit 1005, says that display 240 is notifying 15 display A10 of a correction quantity, which here in this 16 example is that A210 should skip ahead by 10 frames; is 17 that accurate? 18 A. That's correct. Yeah. This information is sent 19 to A210. So the A210 receives the information from D240. 20 And then the controller of A210 decides whether it's 21 synchronization or not synchronization to skip some 22 frames. So display A210 receive some number from display 23 D240 from -- so A210 receives this frame correction 24 quantity from display D240. And then A -- this 25 information goes to the controller of the A210. Now, the	Page 140 1 frame plate. I mean, if you just send a number to any 2 display, this number, without the use of controller, 3 would be absolutely useless. Okay. Say it's the number 4 10. Okay. So number 10 could mean 10 frames, could mean 5 delay 10 seconds, could mean execute the command 10. So 6 based on the whole package or the whole information 7 accompanied in this frame correction quantity and its 8 processing by the controller or the microprocessor of 9 A210, the determination of synchronization or 10 a synchronization is taking place. I mean, the fact that 11 there is a framed correction is just a number. 12 Q. And -- 13 A. Now, this number has to go through some 14 processor to readjust the playbook. 15 Q. Doesn't paragraphs 118 and 119 of Masumoto just 16 say that A210 adds the frame correction number to its 17 current frame number and then displays that corrected 18 frame number? 19 A. So let me see in step -- in paragraph 0118, 20 "Display D240 notifies delayed display of the frame 21 correction quantity calculated in Step S2, display A210 22 receiving the frame correction quantity displays a video 23 signal of frame number after displaying the frame 24 correction quantity received." And then there is an 25 example of different correction methods. And skipping.

Page 141 1 And if there is -- if you go to paragraph 0119, it 2 explicitly says, "If there is no difference, no Step S24 3 24 as Step S24, controller 214 of display D240 ends 4 without processes in Steps S25 and S26." Clearly S25 and 5 S26 are actions the controller will take whenever this 6 number is not zero. So this is a flag. This correction 7 frame number is a flag for the controller 214, at least 8 paragraph 0119. And based on this, the controller will 9 determine synchronous AKA no difference or asynchronous 10 Steps S25 and S26. And then all the decision is taking 11 place at A210 display. 12 Q. Well -- and what you just read in 119, paragraph 13 119, it's the controller of display 240 that ends without 14 processes in S25 and S26, right? 15 A. This is D240, but this one here shows what has 16 happened for the transmitting case. Now, a similar 17 situation will take place for A210. So whenever there is 18 no difference, controller 214 of display A210 will end 19 without processes of readjustment, even if you go at 20 0118, display A210 will have a similar controller 214. 21 That's why I stress the term controller because every 22 display has a controller 214. Display 240 has a 23 controller. Display A210 has a controller here. 24 Now, Step 226, as given in paragraph 0118, the 25 display A210 will receive the frame correction quantity	Page 143 1 we take a 10-minute break or should we go on? 2 Q. Oh, we can take a break. That's fine. 3 A. Okay. Let's take a break. 4 Q. All right. Let's go off the record. 5 A. Sure. 6 (A recess was held from 1:06 p.m. to 1:19 p.m.) 7 BY MS. KAISER: 8 Q. Dr. Tentzeris, before the break, I had asked you 9 to get Exhibit 1004, which is the Swafford reference. 10 Do you have that one? 11 A. Yes, I do. 12 Q. All right. And Swafford is related to 13 simultaneously playing different portions of streaming 14 video; is that correct? 15 A. Yes. 16 Q. And -- and Swafford mentioned streaming video in 17 the abstract on the first page. 18 Do you see that? 19 A. See -- go back to that first page. Yes. 20 Q. And the last sentence of the abstract, it says, 21 "Each of the displays may simultaneously output a 22 different portion of the streaming video." 23 A. That is correct. 24 Q. And I think earlier today you talked about 25 problems with streaming video, like the need to -- or,
Page 142 1 display a video signal of the frame number. Now, it 2 receives the frame correction quantity. Then the 3 controller 214, which exists in all different displays, 4 will receive this frame correction quantity and will 5 readjust the video performance based on the frame number 6 difference. So the decision takes place in the 7 controller 214 of A210. 8 There is nothing in the Masumoto patent saying 9 anything about a final decision taken. It's just the 10 transmission of a flat quantity, which is a frame 11 correction quantity. This flat quantity has to be 12 processed by a controller similar to 214. And that will 13 affect either the maintenance of the video, which means 14 synchronous, or a new frame to be projected, which is 15 asynchronous. A flag number is not a determination. 16 Q. Okay. I'm going to switch gears for a second 17 and go to your declaration, which is Exhibit 1003. 18 A. Okay. 19 Q. Actually, let's go to the Swafford reference, 20 which I believe is Exhibit 1004. 21 A. I got it. Okay. So I have 1004. 22 Q. Okay. Hold on. I'm just going to move it into 23 the chat for the court reporter, as well. 24 Okay. I think 1004 should be in the chat now? 25 A. Before we start this set of the questions, can	Page 144 1 like, having buffering delays. 2 Do you remember that? 3 MR. FAHY: Objection. Form. 4 THE WITNESS: They need -- they -- they need to 5 be synchronized, if you play them. If you play streaming 6 on an individual device, then it's quite important to 7 have some buffering information to allow for the 8 efficient playing of this streaming video. So for 9 individual devices, yes, you need to have a buffer of 10 sufficient number of frames to -- to play reliably and 11 effectively. 12 BY MS. KAISER: 13 Q. Sorry to backtrack. I want to go back to 14 Masumoto for one minute. 15 A. Okay. 16 Q. And, actually, can you go to your declaration, 17 Exhibit 1003? 18 A. Okay. 19 Q. And paragraph 76. 20 A. Okay. 21 Q. Can you just review paragraph 76 and 77, and 22 then I'll have a question for you. 23 A. "Masumoto teaches the displays can communicate 24 data with each other and the displays are designed to 25 transmit specific information of a video signal displayed

Page 145 1 on one display to the other display and to determine 2 synchronization or asynchronization based on the specific 3 information. Masumoto teaches the specific information 4 on a video signal displayed or on one display as the 5 video playback progress data in 1.3. 6 Furthermore, Masumoto teaches the specific -- 7 (Reporter clarification.) 8 THE WITNESS: Sure. Yes. I read 76 and 77. 9 BY MS. KAISER: 10 Q. And so, is it your opinion that in -- that 11 Masumoto teaches the video playback progress data in 12 Claim 1 of the '669 patent -- strike that. Let me ask 13 the question differently. 14 Is it your opinion that Masumoto's frame number 15 or time stamp teaches the video playback progress data in 16 Claim 1 of the '669 patent? 17 A. It teaches the specific information of video 18 signal display on one display as the video playback 19 progress data. So let me read again the claim -- Claim 20 1. Yeah. This is video playback progress data. 21 Q. So it's your opinion that Masumoto's frame 22 number or time stamp teaches the video playback progress 23 data of Claim 1 of the '669 patent? 24 A. The frame number for the time stamp are video 25 playback progress data.	Page 147 1 memory storing address location and display data location 2 data. 3 Do you see that? 4 A. Yes. 5 Q. You'd agree with me that neither of those are 6 video data representing the said video, correct? 7 MR. FAHY: Objection. Form. 8 THE WITNESS: This is -- this is not correct. 9 Because if you read the rest of paragraph 66, and that's 10 paragraph 0265 of Swafford, display data, location data 11 may be used by processor 27101 to format data to be 12 displayed or display 27111. So this is data having to do 13 with video based on the location, and I think I have 14 included that in my declaration. Give me one second. 15 In paragraph 68, I say, "It is my opinion that 16 Swafford teaches that continues display includes one or 17 more memories to store display data location data may be 18 used to format data to be displayed on display." So 19 Swafford data location data may be used to format data to 20 be displayed, has to do with video by the term video 21 data. 22 Typically, video data is not just the video 23 itself. As we said before, video is made out of frames, 24 and frames have information not only about the picture 25 that is going to be projected and may be interlaced over
Page 146 1 Q. Okay. 2 A. Yes. And also, that's communicated, as I say, 3 in paragraph 76. So the displays can communicate data 4 with each other. And the displays an example of specific 5 information of video signal, which could be the time 6 stamp or the frame number, as it's listed in paragraph 7 0107 of Masumoto. 8 Q. If you go back to your declaration again and go 9 to paragraph 65. 10 A. Okay. 11 Q. This starts the section where you're talking 12 about limitation 1.2. 13 Do you see that? 14 A. Yes. 15 Q. And that limitation is each playback device 6A, 16 6B comprises of memory to store video data or 17 representing said video. 18 Do you see that? 19 A. We talk about the memory. Yeah. Comprise 20 memory to store video data represented in the same video. 21 Yes. 22 Q. Okay. And in paragraph 66, you talk about 23 Swafford's disclosures? 24 A. Yes. 25 Q. And in paragraph 66, you talk about Swafford's	Page 148 1 a variety of frames, but also information about the 2 timing, information about accompanying audio, and even 3 information about what device would play. 4 What -- I refer to the beginning of -- of our 5 discussion about unicast, multicast. I mean, unicast is 6 typically one source, one receiver. Multi-cast is one 7 source, multiple receivers. Now, it's -- it's a 8 fundamental part of the video data to include some 9 information that's going to be easily identifiable about 10 the potential receivers or the potential displays that 11 have to project this specific video. And this 12 information can be given with different configuration. 13 One information could be specifically the IP address or 14 some address, if you utilize UDP. So that's one 15 information. 16 The second information has to do with generic 17 address location. And I believe the stowed address 18 location that Swafford is talking about is addressing 19 exactly this issue. So you have some transmission from 20 the -- from the server and there could be different 21 protocols. And the location that you intend the video to 22 play, and that's obviously video data, is going to be 23 giving us an IP address if you have PCPIP or generic 24 location address if you address protocols like UDP. 25 Now, this video data is quite important for the

1 data to be played at the right playback device. Now, if 2 you have one device that's not really necessary. But if 3 you have a multiplicity of playback devices and you want 4 each one of these devices to play the video, a 5 fundamental part of this video data has to do with this 6 address location either explicitly IP, implicitly some 7 other form for UDP, or even some ID number for the 8 location you have stored in some server. 9 So I believe what Swafford is talking, it's 10 video data, as well as it will be critical for the 11 selected projection of video at specific displays. 12 BY MS. KAISER: 13 Q. Okay. So I understand your position that 14 location data of the video teaches video data, but my 15 question to you, is it -- is it your opinion that 16 location data such as that disclosed in Swafford teaches 17 video data representing said video? 18 A. Can you say that again? 19 Q. Sure. 20 A. You said video data representing -- 21 Q. The limitation of claim -- or 1.2 -- sorry. 22 Strike that. 23 Limitation 1.2 recites video data representing 24 said video. So I understood, in your answer, that you 25 are talking generally about video data. My question is,	Page 149 1 utilize. And then a fourth set has to do with the 2 identifier of the compression. 3 So these are the four sets. The raw data with 4 the content, the data with a destination, the data for 5 the playback speed, and the data of compression, 6 decompression. These are the four groups of data 7 represented in a video. 8 It's the same thing we are doing with YouTube, 9 exactly the same principle. There are infinite videos on 10 YouTube, and then when you choose one, you don't download 11 just the video, but all these identifiers that have been 12 recorded at YouTube server as memory. 13 Q. In your work as a technical expert in patent 14 cases, have you run across the concept of inherency? 15 MR. FAHY: Objection. Form. 16 THE WITNESS: I cannot recall this term of 17 inherency. Can you provide the specific explanation 18 about inherency? That's a legal term. 19 BY MS. KAISER: 20 Q. Sure. 21 A. And I'm not aware what the meaning of inherency. 22 Q. Sure. 23 If a reference doesn't explicitly disclose a 24 claim limitation, have you ever opined that that 25 limitation is necessarily present in the reference?
Page 150 1 is it your opinion that the location data in Swafford 2 teaches video data representing said video? 3 A. But the -- that's exactly what I said about 4 the -- the location data. This one represents a specific 5 video because you will have, for example, a Nike video 6 played in one specific playback device. The next video 7 you have an Adidas video. And data representing Nike 8 video will have to do with the projector you have to use. 9 If there is no location information for this video, there 10 is no location information representing this video, then 11 how are you going to show the correct video on each 12 playback device. I'll say location is actually one of 13 the major groups of data that represents video because 14 that gives a unique specification for the recipient. 15 Q. So is it your opinion that any video data that 16 identifies the video represents the video? 17 A. My opinion, as a person with ordinary skills 18 would think, is video data that represent the video 19 consists of different groups of data. Now, once it has 20 to do with the frame themselves, that your have to play 21 consecutively. This is like JPEG, MP3, any picture. 22 Second group of data represented in a video has to do 23 with location that it's intended for. And the third set 24 of video data represented in the video has to do with the 25 play rate, how -- what the frame per second you going to	Page 152 1 MR. FAHY: Objection. Form. 2 THE WITNESS: In typical -- in typical cases I 3 have been involved, I -- I translate the terms as a 4 person of ordinary skills of art the time of invention 5 and with this type of knowledge. Now, there are some 6 terms that are not explained in the patent, and there are 7 some terms that are typically taught -- taught in even 8 undergraduate classes. 9 Now, the moment that these terms are not 10 explained, for example, like video playback device, or 11 video or memory, you don't need to see an explicit 12 reference or explanation of these terms in the patent. 13 If there are no disclosures, no specific teachings, no 14 specific limitations, I would think of them as having the 15 fundamental meaning. For example, video, video is a 16 typical sophomore term data signal processing classes. 17 You may -- you may walk around to every campus and you 18 may ask students what's video data? Tell me what a 19 typical video consists of and what is the data that 20 represents this video. That simple question. And I 21 could bet you could have maybe 99.9 percent giving you 22 the answer I gave you about the -- the four different 23 groups. That's one example that I don't infer anything. 24 I pretty much -- I translate this term, such as 25 representing video, data representing video. I translate

1 this term the way some person of ordinary skills would 2 translate it. I'm not going to add anything to the 3 patent. The patent claims are written. I'm not going to 4 define the patent. I am just understanding the terms 5 that are not otherwise taught in the patent the way that 6 some person of ordinary skills would do. 7 So that's my answer. I never have additional 8 meanings, additional limitations, or infer any 9 limitations not listed in the patent. I read the patent. 10 I see what is taught. No patent will explain each and 11 every term because terms are well-known -- fundamental 12 terms are well-known to the expert or even undergraduate 13 students. And in this case, I gave them the plain 14 meaning that's been utilized by any engineer. So my 15 answer is I'm not adding or inferring any limitations. 16 I'm not doing anything in the patent. 17 BY MS. KAISER: 18 Q. Okay. My question was a little bit different. 19 So let me give you an example from your declaration. Can 20 you go to Exhibit 1003, which is your declaration. 21 A. Sure. 22 Q. And in paragraph 88. 23 A. 88. Excuse me if I don't understand correct the 24 legal terms. I mean, I'm not a lawyer, so I appreciate 25 any feedback on this. 88. Okay.	Page 153 1 streaming video as potential options to serve the purpose 2 of this patent. 3 And then looking at the figure 43 at Swafford to 4 reference in talking about product 1, product 2, that 5 could be some specific information about product, most 6 likely pricing information about the product and so on. 7 And combining or displaying both static and streaming, 8 dynamic advertisement could combine with this static 9 information to serve the form of advertising. So the 10 term inherently had to do with the combination of terms, 11 dynamic and advertising, as well as the purpose of 12 Swafford saying teaching that display, the example 13 display, both static images and streaming video. And 14 that's how I use it. The term inherently has not to do 15 with legal definitions or legal approach. That had to do 16 with the two terms dynamic and advertisement and looking 17 at figure 43 designed to serve -- to serve this purpose. 18 And that's why I say -- at least at the end of paragraph 19 88, I'm saying it's my opinion that the dynamic 20 advertisement 4304, this is the virtual electronic shelf 21 labors because this displays production information or 22 product price-related information, which would be the 23 static part within a section overlapping with a 24 background video or substitute the background video 25 content of the overlap section. Page 155
1 Q. If you go down to -- towards the bottom of the 2 page, do you see a sentence that says, "The dynamic 3 advertisement 43004 may inherently include same content 4 as the streaming video displayed in the backgrounds of 5 displays 43002 and 43003 by virtue of advertisement." 6 Do you see that? 7 A. Yes. 8 Q. Okay. So you use the term inherently here. Do 9 you see that? 10 A. Yes. 11 Q. What did you mean by inherently? 12 A. So I meant -- I mean, example what I told you 13 before. So I read the term, dynamic advertising for the 14 304. And dynamic advertisement typically, they -- 15 (Reporter clarification.) 16 THE WITNESS: The dynamic advertisement term is 17 some form of advertisement that's changing. That's why 18 it's dynamic and not static. So the moment you have the 19 term dynamic, means you have to have some change in 20 content in -- or within it so inherently means -- so 21 reading Swafford and -- for example, beginning of 22 paragraph 88 saying, "Swafford teaches that the display 23 itself that's labeled devices these display both static 24 images and streaming video of products." So I thought 25 this clearly discusses about a combination of static and	Page 154 1 And in addition to this, as I list in paragraph 2 89, another reason to do that was designing substitute 3 video content in order to display areas is commonly used 4 to provide additional information to a customer or 5 attract the customer's attention. So in a sense, that 6 says that's the advertisement, that's a way to make 7 advertisement more efficient, and that's also dynamic. 8 So that was listed in Swafford paragraph 0404, 9 and that was the whole point of using the term 10 inherently. So I would have used a different, but I 11 explained why I use this here. 12 Q. Okay. That's helpful. I appreciate the 13 clarification. 14 And so, is it fair to say that any time in your 15 declaration you use the word inherently, is that you 16 aren't intending it in a legal sense? 17 MR. FAHY: Objection. Form. 18 THE WITNESS: Well, as I explained, I'm not 19 really familiar with the legal sense. Whenever they add 20 these type of explanations, again, my technical opinions 21 about displays and these terms. So utilize based on my 22 expertise and also get in to the position of a person 23 with ordinary skills at the time of the patent. 24 BY MS. KAISER: 25 Q. So each -- I'm sorry. Page 156

1 A. So I read -- I read some early petitions of the 2 patent. And then based on my person of ordinary skills 3 experience, I utilize terms like it. So that's how each 4 and every -- I would say almost every -- each and every 5 person on this would translate this. 6 Q. Okay. So when you say a reference inherently 7 teaches something, you're saying that could be an example 8 of how a person of ordinary skill in the art would 9 interpret what the reference says? 10 A. What I say is that a person of ordinary skills 11 reading a specific teaching, for example, here, looking 12 at figure 43, or reading the teaching by Swafford 13 displays half inch labeled devices or designed to display 14 both static images and streaming video product, that 15 would mean to some person of ordinary skill that dynamic 16 advertisement may include some content as a streaming 17 video displayed in the background of the displays. I'm 18 providing technical opinions here, so that's how I put 19 together technical part here. 20 Q. I want to go back for a second to Masumoto 21 again. 22 A. Okay. 23 Q. And particularly, again, to the disclosure about 24 the fifth exemplary embodiment. And this starts at 25 paragraph 102 of Exhibit 1005. Let me know when you're	Page 157 1 Now, give notification means a couple different ways. 2 That's what we discuss. So you could have specific 3 transmission to A210 utilizing some address information. 4 You could have -- which would be like unicast from point 5 one to point two, like from D240 to A210, or you can do 6 like multicast with notation that this message is only 7 for A210. So it says notification. Notification means 8 transmit with some way this information, to A210, doesn't 9 mean the notification. 10 Q. So let me give you a hypothetical. This is, 11 again, where you have D240 as the master display, and you 12 have A210 to C230, which receives the request for a frame 13 number. Okay? 14 A. Okay. 15 Q. Do you understand? 16 A. Yeah. So you have -- you receive data from 17 different screens? 18 Q. Correct. And in the example here, in paragraph 19 115, you see that A210 sends its frame number as 7190. 20 Do you see that? 21 A. Let me -- it's frozen again. Give me a second. 22 So it froze. What's -- 23 Q. Paragraph 115. 24 A. 115, just unfroze. So it's a firm number, 25 received on display of Step 23 is a number 70190 display Page 159
1 there. 2 A. Okay. 3 Q. We talked for a while earlier about the example 4 that's disclosed here where display D240 is the master 5 display and it receives a frame number from display A210. 6 Do you remember that? 7 A. Yes. 8 Q. And we talked about how, in that example, 9 display D240 calculates a frame correction quantity from 10 the frame number that it receives from display A210. 11 A. Okay. 12 Q. In this example, display D240 sends that -- the 13 frame correction quantity only to display A210; is that 14 true? 15 A. So you said -- the question was that the display 16 D240 sends the correction frame to only to A210? 17 That's your question? 18 Q. Yes. 19 A. The question is A2 -- let me see. D240 -- one 20 second. Let me go to -- to the figure. 21 So figure 9 on Step, actually, S26 says, "Give 22 notification of the frame correction quantity to display 23 with the difference." So give notification. There's 24 no -- no way to tell about the specific way of 25 transmission of the data. It says, Give notification. Page 158	1 is delayed for the required -- okay. 2 Q. So my question was, so in this hypothetical, the 3 frame number of display A210 is 7190? 4 A. Okay. 5 Q. And the desired frame number is 7200. Do you 6 see that? 7 A. Yeah. 8 Q. And so, D210 calculates a difference -- I'm 9 sorry. 10 D240 calculates a difference of 10 frames? 11 A. Sure. 12 Q. If B220 sends a frame number of 7200, then D240 13 would calculate a difference of zero -- 14 A. Okay. 15 Q. -- correct? 16 A. Sure. 17 Q. In this hypothetical, D240 sends the difference 18 value of A210 of 10 frames, right? 19 A. A210, yeah. It will send to A210 the frames. 20 Yes. 21 Q. And to B220, it would send -- it -- it would not 22 send the difference value because there is no difference? 23 A. Exactly. 24 Q. Okay. And so, in this hypothetical, D240 would 25 not send the same difference number to both A210 and Page 160

1 B220? 2 MR. FAHY: Objection. Form. 3 THE WITNESS: It will transmit the difference of 4 10 to 1, and it will not transmit a difference value to 5 the other one. 6 BY MS. KAISER: 7 Q. Okay. 8 A. Now, still, there is -- this constitutes some 9 form of some flat communication. The reason I'm saying 10 that is each and every display will effectively receive a 11 flag number, even if there is no specific transmission 12 from D240 to A210. The reason I'm saying that is -- 13 (Reporter clarification.) 14 THE WITNESS: The reason I'm saying that is that 15 this process of listening takes place periodically. Now 16 A210 will receive this information at some time, let's 17 say T1, and the B220 will receive no information in this 18 time interval. Now that's equivalent to receiving a flag 19 equal of zero saying you are synchronized. Because 20 unless it receives something, the flag value would not 21 change. 22 So even not transmitting a frame correction 23 allows the receiving display A210 or B220 to determine 24 whether it's asynchronous or synchronous. 25 Q. Okay. If you don't mind, let's take 5 or	Page 161 1 going to read either, you have to read out loud or -- so 2 she can't write it down -- 3 A. Okay. 4 Q. -- or you have to read it to yourself. 5 A. Sorry. I'll read to myself. 6 Okay. So should I focus just on 164 and figure 7 14, or should I continue on? 8 Q. Yeah. I have some questions about the annotated 9 figure 14. 10 A. Okay. Great. 11 Q. Great. Paragraph 164, there's an annotated 12 version of Takashi's figure 14. 13 A. Uh-huh. 14 Q. Did you annotate figure 14? 15 A. Yes. Yes. 16 Q. And did you decide which portion of figure 14 to 17 shade purple? 18 A. This one was the display portion D, which is -- 19 let me see. So portion D was the second display portion 20 that has a display portion larger than the first display 21 portion and mainly displays images about the merchandise. 22 So larger than the first display portion, which is the 23 bottom one, the 70a, and then display portion B is larger 24 than the 70a, and displays images about merchandise. So 25 empirically 70a -- a, which is this little green square
Page 162 1 10 minutes here. 2 A. Yes. Sure. 3 Q. Okay. We'll take 10 minutes. 4 (A recess was held from 1:58 p.m. to 2:11 p.m.) 5 MS. KAISER: Back on the record. Welcome back. 6 BY MS. KAISER: 7 Q. Dr. Tentzeris, I wonder if you can get in front 8 of you Exhibit 1008, which is the certified translation 9 of the Takashi reference. I'll put it in the chat, as 10 well. 11 A. Which one? 12 Q. Exhibit 1008. 13 A. 1008. 14 Q. Let me know when you have that open. 15 A. Okay. Good. 16 Q. All right. And then at the same time, could you 17 go to your declaration, which is Exhibit 1004, starting 18 at paragraph 163. 19 A. 163. Okay. 20 Q. And just to orient you, Takashi is one of the 21 references that you referenced. 22 Do you see in paragraph 164 you talk about 23 figure 14 of Takashi? 24 A. Let me -- 25 Q. And just to help the court reporter, if you're	Page 164 1 annotated as -- I think that's green because that's the 2 first portion saying mostly displaying text information 3 as listed in paragraph 0051 and display portion D, which 4 is larger and displays about the merchandise. So that's 5 how I identify this purple side. 6 Now, you would have lots of information in 80a, 7 like cross section videos, usage in commercial video, and 8 that's how I chose this area to denote as this portion. 9 And also 80a is pretty much pointing even by the original 10 figure 14. You see there is this term 80a. I don't know 11 what was the 800, but I just did 80a have some arrow 12 pointing to this side. I know there's some special 13 characters, but that's how I read this figure. 14 Q. So is it your opinion that the purple you're 15 indicating here is display portion D? 16 A. In a sense, D could be everything but the green. 17 So D could be the broad side, could be a combination of 18 other sides, it could be, like, 2D or 3D representation. 19 We're talking about videos. We're talking about 20 non-textual information about the product. And I chose 21 the, I would say, the smallest amount. Like, the 22 narrowest area, easily, I could have painted purple, 23 equally well, all four walls or all three walls around 24 here for customers to see these videos, advertisement 25 videos.

1 Q. Why didn't you choose the front portion to be D 2 instead of the left side where D is actually pointing? 3 A. If you go -- 4 MR. FAHY: Objection to form. 5 THE WITNESS: If you go to -- let me go to a 6 classic figure 14. Now, the -- let me see is anything 14 7 they were -- 8 (Reporter clarification.) 9 THE WITNESS: Figure 14. And I am making a 10 statement reading the original figure now, not the 11 annotated figure. You see that they are -- a visual is 12 placed above a merchandise display itself 70a. I think 13 that's there. So the shelf is in front. And also the 14 information about the product is in front. So the 15 easiest way to satisfy the purpose of providing enhanced 16 information where merchandising informational display 17 system would be to have the extent information on the 18 front of the shelf and near the area of where the textual 19 information is provided. It would be counterintuitive to 20 have on one side the model of the shoe and the price of 21 the shoe. And then have videos on the other side. It 22 would not serve the purpose of enhancing the experience 23 of the customer and the advertisement. The whole point 24 is, the Takashi says in 00 -- 0052 display text 25 information about the merchandise along with images. And	Page 165 1 enhance intelligence. First, the video catches the 2 attention and then the merchandise information display 3 terminal will text, complete the customer experience. So 4 purple could be either the front or could be also the 5 front and the side. But definitely, the merchandise 6 information display terminal, as it is shown here, would 7 be placed just in the front of the display shelf. I 8 mean, you can see -- I mean, super markets, you can see 9 department stores price, the name of the product is in 10 the front. And the company media are in the front. As 11 well, you can make it 3D. But that's the typical 12 configuration in the environments Takashi is talking 13 about merchandise areas. 14 BY MS. KAISER: 15 Q. Okay. So I understand you are just giving an 16 explanation about why display area D would be on the 17 front. Do you see the dotted lines that are around? 18 Because it's sort of -- well, strike that. 19 Do you see figure 14 in Exhibit 1008 has both 20 dotted lines and solid lines? 21 A. Sure. 22 Q. Isn't it possible that even if display area D is 23 on the front, that it would only be comprised of the area 24 of the dotted lines and not also the solid lines? 25 A. Can you -- can you be more specific? Page 167
1 also, it says the shelf tag terminal is not limited to 2 what is illustrated in the above embodiment. 3 So there are different ways of doing that; among 4 them, it would be straightforward for somebody to think 5 that, due to the fact Takashi relates to merchandizing 6 display system, and that's in the abstract for this to be 7 more effective for the customers, to have display portion 8 D or part of the display portion D to be integrated or to 9 be on the same side where the merchandise textual 10 information 80a. Front of merchandise display shelf or 11 first display portion 70a being immediately observable by 12 walker-by, possibly as I told you since Takashi says that 13 this is not limited to what's straight in the embodiments 14 and could be even more generalized. You could have 15 videos pointing on all three or four sides, but the most 16 natural selection could be to integrate both of them on 17 the same side, allow a potential customer, not only 18 getting some dry information in terms of the model and 19 the price, but also seeing some video attracting his 20 attention. Typically, what is happening is -- oops. I 21 guess I might have -- okay. 22 So typically, for the environment that Takashi 23 is talking about more merchandise environments, the whole 24 idea was that's something we saw when we initially were 25 testing, was aware -- experimenting with technologies to Page 166	Page 168 1 Q. Sure. If you go back -- 2 A. The way to look at this, and that's the way I 3 translate this figure is that the shelf -- let's say the 4 baseline of the shelf tag terminal is the solid line. 5 And what you can do is you may extend the projection area 6 by just placing some glasses or some other material 7 around the product to give more information. So in the 8 least, the solid line is what's there. And then a 9 display portion D would be the whole system allowing 10 videos, but I would say that would be quite impractical 11 in terms of cost and efficiency to utilize only the extra 12 space of the -- of the dotted lines and leave out the 13 area of the shelf tag terminal itself. I mean, this is 14 part of the infrastructure. This is part of what you 15 place on a merchandise display shelf. So that will be 16 the starting point. 17 Q. Okay. Let me -- let me ask you it differently. 18 If you go to Exhibit 1003 and your annotated 19 version of Exhibit -- or, I'm sorry, of figure 14 that 20 follows the text of paragraph 164. 21 A. Okay. 22 Q. There's nothing in the disclosure of Takashi 23 that says that display portion D extends from the top all 24 the way down to the bottom of the shelf face, instead of 25 just from the top to the top of the shelf face is there?

1 MR. FAHY: Objection. Form. Page 169 2 THE WITNESS: The way -- the way I read Takashi 3 in paragraph 0051, I have included in the declaration, 4 and, again, I'm going to go to paragraph 164. Clearly, 5 Takashi teaches that the merchandising information 6 display system one includes two displays. May include 7 merchandising information on display terminal 80a, have a 8 first display portion 70a, that displays text information 9 about the information. And a display portion D, serving 10 a second display that has a display portion larger than 11 the first display portion and mainly display images about 12 the merchandise. So, clearly, the display portion we -- 13 was the second display portion having the display portion 14 larger than the first display portion. And they're 15 talking about display portions here. So part of the same 16 display. That's portion A. Portion D, now that's in 17 paragraph 51. And then 51, again, in paragraph 164 in my 18 declaration, that says, "An integral combination of the 19 shelf tag terminal 70 and the image display terminal 80a 20 and also the image display terminal," which is the 80a, 21 "may display not only the appearance, but cross-sections, 22 images, still images, display videos usage in commercial 23 videos." 24 So display terminal 80 has two portions the 70aA 25 or 70a. I don't know what you read or just 70. And the	1 THE WITNESS: The what? That's what I described Page 171 2 in the expert report. So I don't want to repeat myself, 3 just reiterate that this is aligned with the front of the 4 merchandise display shelf for the shelf rail. This one 5 is integrated with the textual information about the 6 product in the green box. And that's an integral part of 7 the cell. So the starting point is this, could it be 8 also on the sides, left or right? Sure. But one or -- I 9 will say the most critical section of these display 10 should be to be integrated, an integral part of shelf tag 11 terminal, which is in the front. And that also, along 12 the same plain with the merchandising information on the 13 display channel, so on here. 14 And if I could -- other -- and now the closing 15 statement here. There is a discussion about first 16 display portion and another display portion. So first 17 display portion on 70a and the second display portion D. 18 Now, talking about first and second display portion, the 19 most natural choice as a starting point would be the 20 display along the same plain. If you want to extend 21 display to the left and right, that will be fine. But 22 there are -- I would say a person of ordinary skill would 23 think that the two display portion would be on the same 24 plain, which would be the front plain, play along the 25 merchandise to display straight.
1 display portion D display portion D because display Page 170 2 portion is larger than 70a. That's what is disclosed by 3 Takashi. So it has to be larger than this green squares 4 on here that's point number one. 5 Point No. 2 is that this D has to be larger than 6 the 70a. So the dimensions of D have to be larger than 7 this green square. And also, the other idea is that's an 8 integral combination of the shelf tag terminal and the 9 image display terminal. So the structure has to be 10 integrated so it can not be a part one from the other. 11 Now, the -- talking about integral part, as we 12 discussed before, and keeping in mind the purpose of this 13 to display information about the merchandise, was not 14 only text, but also with images or videos that leads to 15 this annotation. The purple one is integral part, so it 16 can be very effectively integrated. It's larger size 17 than the green part. And also, it's able to project a 18 variety of videos, pictures, additional information about 19 this. 20 You could assume, as we said before, that this 21 could not only be the front side, but some other sides, 22 as well. But the most clear combination would be the way 23 that's on the expert report. And then it talks about the 24 reasons for this. 25 (Reporter clarification.)	1 BY MS. KAISER: Page 172 2 Q. So is it your position that, because paragraph 3 51 of Takashi says first and second display portion, that 4 the two portions have to be part of the same overall 5 display? 6 MR. FAHY: Objection. Form. 7 THE WITNESS: What I listed here is I gave you 8 more than one reason. And I just said that, in addition 9 to the teachings of Takashi saying that portion D have to 10 be larger than the first portion and has to be able to 11 display, not only, the appearance, but different images, 12 display videos used in commercial video, then the most 13 efficient way to satisfy the purpose of Takashi, which is 14 merchandising information display system, would be to 15 place everything the way I notated. 16 The reason I stressed the first and second 17 portion, so here is to show that you have two different 18 portions. And in the beginning, when you thought about 19 the topology and the purpose, these two portions could be 20 placed at the same plain. That would be the easiest 21 portion, orientation for this case. Though this is not 22 the main reason. The main reason is the features of D 23 and the features of 80a that made me annotate this. 24 Q. If you go in your declaration, which is 25 Exhibit 1003 to page 89 of the PDF, let me know when

1 you're there. 2 A. 89, okay. 3 Q. And I want to direct you to the section that's 4 about claim limitation 1.4. 5 A. Okay. 6 Q. In this section starting at paragraph 19, you 7 talk about Takashi's teachings. 8 A. Okay. 9 Q. And you discuss both figure 5 of Takashi and 10 figure 14 of Takashi. Is it your opinion that figure 5 11 of Takashi teaches limitation 1.4? 12 A. Figure 5 of Takashi. So figure 5 -- let me -- 13 let me go back to Takashi and see figure 5. 14 Q. And I guess, ultimately, my question is, are you 15 relying on figure 5, figure 14, or some combination of 16 the two? 17 A. Let me check. Let me show more because figure 5 18 is too small. 19 Now, comparing figure 5 and figure 14 of 20 Takashi, I can see that the fundamental features of these 21 two figures are serving the same purpose, which is shown 22 in 182. But also, there is the same entry about the 23 description. You have the first display portion that 24 displays text information about the merchandise. Any 25 display portion D. So a display portion larger than the	Page 173 1 this. 2 Also, talking about figure 5 in the same 3 paragraph referring to Takashi figure 5, it says, "The 4 shelf tag terminal 70 is provided with a display portion 5 70a that displays information including text information 6 relating to merchandise, such as merchandise name and 7 price on the front side of the thin plate label-shaped 8 housing," which justifies what I said before about the 9 placement of this, of the front side of the cell. 10 In addition, "Figure 5 of Takashi teaches that 11 shelf tag terminal 70 included the display portion of 70a 12 displaying product information or product price related 13 information and the image display terminal 80, including 14 display area displaying display videos. 15 So figure 5 has some more explanation about the 16 screens, about the placement, about the displays. And 17 figure 14, in a sense, teaches the same functions of the 18 two display portions 70a and D. And then that's an 19 integral combination of the shelf tag terminal and the 20 image display terminal 80. So by just combining the 21 additional information given in figure 5, figure 5 22 description in this paragraph showing that D could be 23 plainer what could be 3D, and also showing that that's 24 displayed on the front of the south. That means that 25 correspondence virtual electronic shelf label within a
Page 174 1 first display portion displaying images about the 2 merchandise. So the reason I utilize the reference of 3 figure 5 is that there is information about the display 4 type. So qualitative figure 5 and figure 14 are quite 5 similar. But the description of figure 5 shows a case 6 where the display device is configured as a display 7 device displaying a 3D image, so the appearance of the 8 merchandise, and talking about what really means taking 9 advantage of three plains. 10 And then the reason I refer to figure 5, in 11 addition to figure 14, was watching Takashi 0020 that's 12 in paragraph 179 of my expert report. And we give some 13 information about image display. So I note at the end of 14 page 87 of declaration, page 91 of the PDF, it is 15 possible to configure the image display as a known 16 display device, CRT and LCD. That displays two 17 dimensional images of the merchandise. In such cases, 18 the display area is flat. 19 And the -- the reason I stress that at the top 20 of page 88 of declaration page 91 of the PDF is exactly 21 what I said before, that this case display area D is 22 flat. And the best way to do it is having display area 23 and the textual information to be on the same plain. 24 Otherwise, you may need more costly infrastructure. You 25 may need to replicate around different sites and all	Page 176 1 section of the display portion the overlapping the video 2 as shown in the annotated figure 14 above paragraph 1 -- 3 181. 4 And the other thing is that, in paragraph 181, 5 Takashi discloses in paragraph 0052 that the shelf tag 6 terminal is not limited to what it is illustrated in the 7 embodiments. And you could have display of text 8 information about the merchandise along with images 9 relating to the merchandise. So a section displays text 10 information about a merchandise in the image display 11 terminal 80. In a section with the second display unit 12 D, that displays text information about the merchandise, 13 time to consider as the virtual electronic cell labels, 14 so on, here. And then clearly combining the information 15 for the schedule figure 5, figure 14 cannot consider to 16 completely disclose, the term virtual electronic shelf 17 labels. 18 Q. Okay. So I think I understand from your answer 19 that for claim limitation 1.4, you're relying on both 20 figure 5 and figure 14 of Takashi; is that right? 21 A. I list that on paragraph 181 saying that we know 22 in figure 5, figure 14 are embodiments, pretty much 23 disclose, you know, almost identical configurations with 24 two different displays. And figure 5 provides some 25 additional information about the displays, the

1 orientation, and potential 3D or plainer deployment of 2 display portion. 3 Q. In figure 14, the electronic shelf label is not 4 on the shelf rail itself, correct? 5 A. Can you say that again? 6 Q. In figure 14 of Takashi, which is Exhibit 1008, 7 the electronic shelf label is not on the shelf rail 8 itself? 9 A. That's placed -- let me see if I can identify 10 the -- the Takashi. So what's given in Takashi 0019, 11 that's in paragraph 179, page 88 of my declaration. And 12 that shows the self deck terminal 70 is provided with 13 display portion that displays information, including text 14 information related to merchandise. It says merchandise, 15 name and price, on the front side of the theme plate 16 label shaped housing. 17 And this side in figure 5 shows that this smart 18 label is on top of self. So this is an alternative 19 implementation of this system. So you can mount either 20 on top of merchandise display shelf or the self branch on 21 here, as in figure 5, or you can place it above the front 22 of the merchandise display shelf. So these are two 23 potential manifestations of Takashi system. 24 Q. Okay. And if you could listen to my question 25 because I am hopeful that we're almost done. So if you	Page 177 1 merchandise displays. 2 Q. Okay. And maybe I wasn't asking my question 3 precisely enough. So let me try one more time. 4 In figure 14, the electronic shelf label is not 5 mounted directly to the front of the shelf rail, correct? 6 A. This is mounted at the topside of the front. So 7 one is mounted in the -- around the middle of the front. 8 The other is mounted around the top of the front shelf. 9 So on figure 5, you can see the direct covers the whole 10 area of the shelf. So this is mounted around the center 11 of the front shelf. And then the figure 14 is mounted on 12 the top of this front shelf. So it's like placing the 13 label not in the -- not around the center, but mount of 14 the top of the front of the shelf. The front of the 15 shelf defines the plain. This is different. So talking 16 about the front of the shelf is a plain. 17 Now, whenever we're talking about mounting 18 some -- the structure or a metal plate or an enclosure 19 plate on a plain, there are different orientation, 20 different ways you can do it. You can mount the BSL at 21 the bottom of this plain, hugging, pretty much, what's 22 happening in the supermarket. So many times what you are 23 doing is you see this hanging at the bottom of the front 24 of the -- of the shelf. Then in figure 5, you see that's 25 in the middle of the front of the shelf. And then figure
1 could listen to my question and try to answer my 2 question. 3 My question was, in figure 14 of Takashi, which 4 is Exhibit 1008, the electronic shelf label is not on the 5 shelf rail. That's correct, isn't it? 6 A. It is on the shelf rail. That's exactly on the 7 operative side of the shelf rail. If you look at figure 8 14, this one is on top of the merchandise display shelf 9 rail 78. 10 So your question has to do -- just clarify. 11 Your question has to do with placing the electronic shelf 12 rail on top of the front or just on the merchandise 13 display shelf. Because the way I look at this, is the 14 question is placed on the merchandise display shelf, both 15 figures 14 and figure 5 do that. Now, figure 14, they 16 place it on -- on top of the edge of the rail. And then 17 figure 5 does it in -- on top of the front, but both of 18 them are on top of merchandise display shelf. 19 Now, is it on top of the front, or is it on the 20 topside of the front? This is a difference that will not 21 effect the functionality. So these are two different 22 manifestations that would be complimented past. There's 23 no difference in terms of functionality on here. They're 24 either on top of the front mounted, or they're on top of 25 the shelf as in figure 14. But both of them are on the	Page 180 1 14, it's on the top of the front of the shelf. So it has 2 just the amount of structure, if you want to have two 3 clips, then you can place it covering the whole area 4 between the front of the shelf. If you have to stable 5 clips mounted to the top of the shelf, you have figure 6 14. And if you have two hanging clips, you would have a 7 third equivalent implementation where this one would hang 8 below the bottom of the front shelf. All of them is same 9 thing as mounting, just different mounting structures. 10 Q. Okay. So as I understand the answer that you 11 just gave, it's your opinion that the electronic shelf 12 label in figure 14 of Takashi is mounted on top of the 13 display that is on -- that is on shelf rail 78; is that 14 accurate? 15 A. This is the mounted on top of the display? I 16 don't see anywhere in the patent referring to mounting 17 one display within another display. Could be embedded. 18 We could use the term embed because what you can see is 19 in figure 14, when I had annotated the front. In this 20 case, you would have the BSL to be embedded on the 21 projections section of B. So embedding, I would say so. 22 Now, mounting within the display, I cannot 23 recall this term in Takashi. I don't think anywhere 24 Takashi says mounting BSL within the display. Let me -- 25 let me look. But I cannot recall any time when you use

1 the term mounting. Let me see. Let me see if there is a 2 term mounting here. No. There's no exact matching. So 3 I would say embed. Embed would be the right -- the right 4 term. 5 MS. KAISER: Okay. That's all the questions I 6 have as to the '188 IPR. So I turn the witness over to 7 Mr. Fahy. 8 MR. FAHY: And I have no questions on the '188 9 IPR. 10 MS. KAISER: Okay. Then I believe that's it for 11 this transcript, Nicole. 12 THE REPORTER: Okay. Who all would like a copy 13 of this one? 14 MS. KAISER: I definitely do. I would like to 15 get a rough, please. 16 MR. FAHY: Same here, please. 17 THE REPORTER: You would like a rough and copy, 18 Mr. Fahy? 19 MR. FAHY: Yes. 20 (Whereupon proceedings concluded at 2:55 p.m.) 21 22 23 24 25	Page 181
1 REPORTER'S CERTIFICATE 2 3 4 I, NICOLE HATLER, a Shorthand Reporter, State of 5 California, do hereby certify: 6 That MANOS TENTZERIS, Ph.D., in the foregoing 7 deposition named, was present and by me sworn as a 8 witness in the above-entitled action at the time and 9 place therein specified; 10 That said deposition was taken before me at said 11 time and place, and was taken down in shorthand by me, a 12 Certified Shorthand Reporter of the State of California, 13 and was thereafter transcribed into typewriting, and that 14 the foregoing transcript constitutes a full, true and 15 correct report of said deposition and of the proceedings 16 that took place; 17 That before completion of the proceedings, 18 review of the transcript [^] was [X] was not requested. 19 IN WITNESS WHEREOF, I have hereunder subscribed 20 my hand this 28th day of AUGUST 2024. 21 22 23 24 25	Page 182 NICOLE HATLER, CSR NO. 13730 State of California

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generics (1)	helpful (5)	illustrating (8)	installed (1)
genetic (1)	helps (1)	image (9)	installing (2)
Georgia (14)	hereunder (1)	images (14)	instance (8)
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gigahertz (1)	high (6)	impact (1)	instructs (1)
give (36)	higher (3)	implanted (1)	instrument (1)
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giving (8)	highlighting (3)	implementing (1)	integrated (26)
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Good (8)	holding (1)	inch (1)	intending (1)
Googles (1)	home (1)	include (8)	intent (1)
governor (2)	Honestly (2)	included (8)	intention (5)
granted (1)	Honeywell (1)	includes (12)	interacted (1)
graphing (1)	hop (1)	including (4)	interaction (1)
gravity (1)	hopeful (1)	incoming (1)	interactive (1)
Great (7)	hour (4)	incorporate (2)	interconnect (1)
green (8)	hours (1)	incorporates (1)	interconnection (1)
ground (1)	housing (2)	incorporation (1)	interconnects (1)
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	humans (1)	industrial (1)	interlaced (1)
< H >	humidity (1)	industry (5)	internal (1)
hac (1)	hundreds (1)	infer (2)	International (1)
half (1)	hungry (1)	inferring (1)	internet (6)
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hardware (5)	identified (4)	inherently (9)	intervals (1)

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invented (1)	keeps (1)	life (1)	lunch (7)
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invention (3)	kilohertz (4)	likewise (1)	magnetic (1)
inventor (4)	kind (9)	limitation (18)	magnitude (1)
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invited (2)	< L >	line (4)	major (11)
involved (7)	lab (3)	linear (1)	majority (1)
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IP (3)	labeled (3)	lines (8)	malls (1)
IPP (2)	labels (2)	linked (1)	manifestations (2)
IPR (22)	label-shaped (1)	linking (2)	MANOS (8)
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IPTO (8)	lacks (1)	listen (4)	manufacturing (3)
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ISDN (2)	landscape (3)	Listing (7)	mapping (2)
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ISS (1)	language (6)	literally (1)	marked (1)
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< J >	lawyer (3)	localized (1)	material (1)
JESSICA (4)	lawyers (2)	locate (1)	materials (9)
Jkaiser@perkinscoie.c	layer (46)	located (1)	math (1)
om (1)	layers (16)	location (26)	mathematical (2)
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(1)	legal (13)	lots (11)	media (3)
Katehi (1)	level (8)	loud (1)	meet (1)
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	LG (1)	low-cost (4)	megahertz (5)
	LGHTC (2)	lower (1)	member (1)
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merchandizing (1)	motivation (1)	newly-formed (1)	Okay (241)
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message (14)	mounted (10)	NFC-based (1)	once (3)
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messaging (4)	move (2)	NFCs (1)	ones (1)
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minute (2)		notified (4)	optimizing (1)
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particularly (1)	pitches (1)	present (2)	pronounce (1)
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pay (1)	planner (1)	price-related (1)	provide (12)
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< Q >	real-world (1)	released (2)	rest (4)
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radiofrequencies (1)	recorded (2)	represent (7)	robotics (1)
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raised (1)	recovering (1)	represented (8)	room (6)
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random (1)	reduce (1)	represents (5)	rough (2)
range (2)	reevaluated (1)	reproduced (1)	RPT (2)
ranging (1)	reexamination (1)	request (5)	rude (1)
rare (1)	reexamine (1)	requested (1)	rule (9)
rate (1)	refer (8)	requesting (4)	rules (1)
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reached (4)	referred (1)	requirement (2)	< S >
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real (6)	rejection (4)	respect (3)	satisfy (2)
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scenario (1)	settled (1)	slave (1)	standard (5)
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schedule (1)	Seven (5)	sleeping (1)	standards (3)
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School (2)	shade (1)	slow (1)	stands (1)
Science (3)	shake (1)	slowly (1)	starred (1)
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see (141)	side (22)	sounds (2)	stay (2)
seeing (1)	sides (4)	source (7)	steal (1)
seen (3)	S-I-G-E (1)	sources (1)	steals (1)
selected (3)	signal (24)	south (2)	Stenographically (2)
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sending (10)	similar (10)	special (1)	stored (2)
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sent (4)	single (7)	specifying (1)	streaming (19)
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sequence (1)	six (1)	spend (2)	stressed (1)
serve (5)	Sixteenth (1)	spoke (6)	stressing (1)
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subject (3)	Takashi (35)	theory (1)	transistors (2)
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sub-THz (2)	TCPIP (16)	thought (4)	transmitted (5)
successful (4)	teach (1)	thousands (1)	transmitter (2)
sufficient (3)	teaches (17)	three (21)	transmitting (7)
suggest (1)	teaching (8)	threshold (1)	transport (6)
Suite (3)	teachings (4)	throwing (1)	transporting (1)
summarize (2)	team (3)	TikTok (1)	trapezoidal (1)
summarized (1)	Tech (4)	time (80)	tremendous (1)
super (4)	technical (15)	times (7)	TRIAL (2)
supermarket (1)	technically (1)	time-wise (1)	tricks (3)
supervising (2)	technique (5)	timing (3)	tried (4)
supplementary (1)	techniques (1)	tiny (1)	trucking (6)
supports (1)	technologies (23)	tires (3)	T-R-U-C-K-I-N-G (1)
supposedly (1)	TECHNOLOGY (16)	title (1)	trucks (1)
sure (41)	telephones (1)	titled (4)	true (2)
surroundings (1)	telephony (1)	titles (1)	truly (2)
sustainability (1)	tell (11)	today (6)	trusted (1)
sustainable (1)	telling (1)	told (22)	truth (5)
Swafford (18)	temperature (1)	tolls (1)	try (7)
Swafford.....4 (1)	tenants (1)	Tomonobu (1)	trying (11)
Swafford's (2)	tens (1)	tone (2)	turn (1)
switch (1)	TENTZERIS (30)	tool (1)	turned (1)
sworn (3)	T-E-N-T-Z-E-R-I-S (1)	tools (1)	TV (3)
symposium (2)	Tentzeris.....4 (1)	top (30)	twice (1)
sync (2)	Tenure (2)	topic (3)	twin (7)
synchronization (12)	terahertz (1)	topologies (9)	twinning (3)
synchronized (4)	term (74)	topology (25)	twins (28)
synchronizing (1)	terminal (21)	topside (2)	T-W-I-N-S (2)
synchronous (6)	terms (45)	totally (1)	two (44)
syncing (4)	tested (1)	toy (1)	type (6)
sincronize (1)	testified (3)	track (3)	typed (1)
system (24)	testifying (1)	tracking (7)	types (1)
systems (33)	testimony (3)	T-R-A-C-K-I-N-G (1)	typewriting (1)
< T >	testing (1)	traction (1)	typical (10)
T1 (1)	text (13)	TRADEMARK (2)	typically (26)
		transaction (1)	

< U >	verbally (1)	well-working (1)
U.S (5)	Verizon (1)	went (6)
UDP (30)	versa (4)	We're (23)
Uh-huh (1)	version (3)	we've (8)
UHS (1)	versus (10)	WHEREOF (1)
ultimately (1)	vice (5)	white (1)
undergraduate (2)	video (142)	widening (1)
underlying (5)	video/audio (1)	wild (2)
underneath (1)	videos (23)	wireless (18)
understand (35)	view (2)	witness (94)
understandable (1)	virtual (5)	Witness/Litigation (1)
understanding (24)	virtually (1)	won (3)
understood (6)	virtue (1)	wonder (2)
unfortunately (1)	visit (1)	wondering (3)
unfroze (1)	visiting (1)	word (4)
unicast (15)	visitor (1)	words (9)
unicasting (1)	visual (1)	work (20)
unidirectional (4)	vitae (1)	worked (4)
unique (4)	voice (1)	working (11)
unit (2)		works (2)
UNITED (1)	< W >	world (5)
University (6)	wait (3)	write (2)
un-patentability (2)	waiting (1)	write-up (1)
unstable (1)	waiver (1)	written (3)
updating (1)	walk (3)	wrong (1)
upper (1)	walker-by (1)	wrote (1)
UR (1)	walking (1)	
usage (2)	walk-inside (1)	< Y >
use (27)	walls (2)	Yeah (27)
useless (1)	want (42)	year (2)
user (1)	wanted (13)	years (7)
usually (1)	warehouses (1)	Yep (1)
utilize (14)	watch (1)	yes/no (1)
utilized (24)	watching (1)	YouTube (3)
utilizing (15)	water (3)	
UTP (2)	wave (3)	< Z >
	wavefront (1)	zero (5)
< V >	wavelengths (1)	zones (1)
valid (1)	wavenet (1)	Zoom (4)
validate (1)	waves (1)	
validated (1)	way (63)	
value (4)	ways (19)	
variance (1)	wearable (1)	
varies (1)	weather (1)	
variety (22)	week (1)	
various (1)	weeks (2)	
varying (1)	Welcome (4)	
vast (1)	well (31)	
verb (1)	well-known (3)	