

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

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ACTIVISION BLIZZARD, INC.;  
ELECTRONIC ARTS INC.; TAKE-TWO  
INTERACTIVE SOFTWARE, INC.;  
2K SPORTS, INC.; AND ROCKSTAR  
GAMES, INC.,  
  
Petitioners,  
  
vs. No. IPR2016-00747  
  
ACCELERATION BAY LLC,  
  
Patent Owner.

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PROTECTIVE ORDER MATERIAL  
VIDEOTAPED DEPOSITION OF HARRY BIMS, Ph.D  
Menlo Park, California  
Tuesday, February 7, 2017  
Volume I

Reported by:  
CATHERINE A. RYAN  
CSR No. 8239  
Job No. 2531666  
  
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<p style="text-align: right;">Page 2</p> <p>1 UNITED STATES PATENT AND TRADEMARK OFFICE 2 BEFORE THE PATENT TRIAL AND APPEAL BOARD 3 4 _____ 5 ) 6 ACTIVISION BLIZZARD, INC.; ) 7 ELECTRONIC ARTS INC.; TAKE-TWO ) 8 INTERACTIVE SOFTWARE, INC.; ) 9 2K SPORTS, INC.; AND ROCKSTAR ) 10 GAMES, INC., ) 11 ) 12 Petitioners, ) 13 ) 14 vs. ) No. IPR2016-00747 15 ) 16 ) 17 ACCELERATION BAY LLC, ) 18 ) 19 Patent Owner. ) 20 ) 21 _____ ) 22 ) 23 ) 24 ) 25 )</p> <p>Videotaped deposition of HARRY BIMS, Ph.D, Volume I, taken on behalf of Petitioner, at 990 Marsh Road, Menlo Park, California, beginning at 9:34 a.m. and ending at 5:40 p.m., on Tuesday, February 7, 2017, before CATHERINE A. RYAN, Certified Shorthand Reporter No. 8239.</p>	<p style="text-align: right;">Page 4</p> <p>1 INDEX 2 WITNESS EXAMINATION 3 HARRY BIMS, Ph.D Volume I 4 BY MR. TOMASULO 7 5 6 EXHIBITS 7 NUMBER DESCRIPTION PAGES 8 Exhibit 1 "Declaration of Dr. Harry Bims in 10 9 Support of Patent Owner's Response"; 10 41 pages 11 12 Exhibit 2 Graph; 1 page 86 13 14 Exhibit 3 "Appendix A"; 25 pages 88 15 16 Exhibit 4 "United States Patent, Holt et al., 102 17 Patent No.: US 6,732,147 B1, Date of 18 Patent: May 4, 2004"; 58 pages 19 20 Exhibit 5 "Declaration of Michael Goodrich, 119 21 Ph.D. in Support of Patent Owner's 22 Response to Petition"; 114 pages 23 24 Exhibit 6 "All Blu-ray players bow to the 160 25 PlayStation3?"; 7 pages</p>
<p style="text-align: right;">Page 3</p> <p>1 APPEARANCES: 2 For Petitioner: 3 WINSTON &amp; STRAWN LLP 4 BY: MICHAEL TOMASULO 5 DAVID K. LIN 6 Attorneys at Law 7 333 South Grand Avenue, 38th Floor 8 Los Angeles, California 90071 9 (213) 615-1973 10 (213) 615-1750 Fax 11 dlin@winston.com 12 13 For Respondent: 14 15 KRAMER LEVIN NAFTALIS &amp; FRANKEL LLP 16 BY: JAMES HANNAH 17 STEPHANIE NGUYEN 18 Attorneys at Law 19 990 Marsh Road 20 Menlo Park, California 94025-1949 21 (650) 752-1712 (Mr. Hannah) 22 (650) 752-1812 Fax 23 (650) 752-1733 (Ms. Nguyen) 24 (650) 752-1800 Fax 25 jhannah@kramerlevin.com snguyen@kramerlevin.com</p> <p>Also Present: PAUL MAIN, Electronic Arts, Inc. DUSTIN BROWN, Videographer, Veritext</p>	<p style="text-align: right;">Page 5</p> <p>1 INDEX (Continued) 2 EXHIBITS 3 NUMBER DESCRIPTION PAGES 4 Exhibit 7 "6,732,147, Sony PlayStation Product"; 161 5 34 pages 6 7 Exhibit 8 "XBox 360 Destiny"; 1 page 207 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25</p>

<p style="text-align: right;">Page 6</p> <p>1 Menlo Park, California; Tuesday, February 7, 2017</p> <p>2 9:34 a.m.</p> <p>3</p> <p>4 THE VIDEOGRAPHER: Good morning. We are</p> <p>5 on the record at 9:34 a.m. on February 7th, 2017.</p> <p>6 This is the video-recorded deposition of Dr. Harry</p> <p>7 Bims. My name is Dustin Brown. I'm here with our</p> <p>8 court reporter, Catherine Ryan. We are here from</p> <p>9 Veritext Legal Solutions at the request of counsel</p> <p>10 for Petitioners. This deposition is being held at</p> <p>11 990 Marsh Road in Menlo Park, California. The</p> <p>12 caption of this case is Activision Blizzard,</p> <p>13 Incorporated, et al. versus Acceleration Bay LLC.</p> <p>14 Case number is IPR2016-00747.</p> <p>15 Please note that audio and video recording</p> <p>16 will take place unless all parties agree to go off</p> <p>17 the record. Microphones are sensitive and may pick</p> <p>18 up whispers, private conversations, and cellular</p> <p>19 interference.</p> <p>20 I am not authorized to administer an oath.</p> <p>21 I am not related to any party in this action, nor am</p> <p>22 I financially interested in the outcome in any way.</p> <p>23 If there are any objections to proceeding,</p> <p>24 please state them at the time of your appearance,</p> <p>25 beginning with the noticing attorney.</p>	<p style="text-align: right;">Page 8</p> <p>1 A Yes.</p> <p>2 Q Any reason that you can't give true and</p> <p>3 correct testimony today?</p> <p>4 A No.</p> <p>5 Q Okay. You understand you have the</p> <p>6 obligation to tell the truth, the whole truth, and</p> <p>7 nothing but the truth, right?</p> <p>8 A Yes.</p> <p>9 Q And -- and that means if you can't</p> <p>10 understand something, will you let me know?</p> <p>11 A Yes.</p> <p>12 Q And if you answer a question without</p> <p>13 saying "I don't understand you," the record will</p> <p>14 reflect that you understood and answered the</p> <p>15 question, right?</p> <p>16 A Yes.</p> <p>17 Q Now, do you consider yourself qualified to</p> <p>18 offer expert testimony on the matters on which you</p> <p>19 have opined in your declaration?</p> <p>20 A Yes.</p> <p>21 Q Anything in that declaration -- now, you</p> <p>22 signed that declaration, and you understood it when</p> <p>23 you signed it, right?</p> <p>24 A Yes.</p> <p>25 Q And is there anything that has caused you</p>
<p style="text-align: right;">Page 7</p> <p>1 MR. TOMASULO: Michael A. Tomasulo from</p> <p>2 the law firm of Winston &amp; Strawn. With me is my</p> <p>3 associate David Lin and in-house counsel for</p> <p>4 Electronic Arts, Inc., one of the petitioners, Paul</p> <p>5 Main, also a California barred attorney.</p> <p>6 We are here on behalf of the three</p> <p>7 petitioners -- or all of the petitioners identified</p> <p>8 in the proceeding.</p> <p>9 MR. HANNAH: James Hannah from Kramer</p> <p>10 Levin, representing Acceleration Bay and the</p> <p>11 witness, and with me is Stephanie Nguyen.</p> <p>12 THE VIDEOGRAPHER: Thank you. The witness</p> <p>13 will be sworn in, and counsel may begin the</p> <p>14 examination.</p> <p>15 HARRY BIMS, Ph.D.,</p> <p>16 having been administered an oath, was examined and</p> <p>17 testified as follows:</p> <p>18 EXAMINATION</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q Good morning, Dr. Bims.</p> <p>21 A Good morning.</p> <p>22 Q You realize you're under oath?</p> <p>23 A Yes.</p> <p>24 Q You've had your deposition taken before,</p> <p>25 yes?</p>	<p style="text-align: right;">Page 9</p> <p>1 to change your testimony?</p> <p>2 A There was one paragraph in which there was</p> <p>3 a mistaken name given in that paragraph that I had</p> <p>4 noticed --</p> <p>5 Q Okay.</p> <p>6 A -- when I reviewed my deposition -- my</p> <p>7 declaration the other day.</p> <p>8 Q Okay. We'll get to that.</p> <p>9 Anything else besides that one --</p> <p>10 A No.</p> <p>11 Q -- mistake? Okay.</p> <p>12 And you attached your CV to that</p> <p>13 declaration, right?</p> <p>14 A Yes.</p> <p>15 Q And was -- when you attached that, it was</p> <p>16 complete and accurate?</p> <p>17 A Yes.</p> <p>18 Q And do you maintain a LinkedIn biography</p> <p>19 or some kind of a LinkedIn account as well?</p> <p>20 A Yes.</p> <p>21 Q And is that accurate?</p> <p>22 A Yes. For the most part, yes.</p> <p>23 MR. TOMASULO: I'd like to mark as --</p> <p>24 let's call it -- do you -- are you starting just at</p> <p>25 1? Is that how you did it with Carter, or did you</p>

<p style="text-align: right;">Page 10</p> <p>1 start with, like, 3000 or anything like that?</p> <p>2 MR. HANNAH: I believe we just started at</p> <p>3 1.</p> <p>4 MR. TOMASULO: Okay. So we'll just mark</p> <p>5 this as Bims Exhibit 1, and that will be your CV.</p> <p>6 (Exhibit 1 was marked for identification</p> <p>7 by the court reporter.)</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q And did you prepare this, Exhibit 1, your</p> <p>10 CV?</p> <p>11 A Yes.</p> <p>12 Q Okay. And it has something called Bims</p> <p>13 Laboratories, LLC. What is Bims Laboratory?</p> <p>14 A It's a company that I started a few years</p> <p>15 ago within which I do a number of research projects</p> <p>16 in the area of networking.</p> <p>17 Q Okay. Is that company still ongoing?</p> <p>18 A Yes.</p> <p>19 Q When was the last -- it looked to me like</p> <p>20 the last project that's listed under Bims</p> <p>21 Laboratories ended in -- ended in 10/2009. Is --</p> <p>22 are there other projects or am I misreading this?</p> <p>23 A Well, what it says here on page A-3 is</p> <p>24 that there's an ongoing effort in the 802.16 working</p> <p>25 group in which I have a number of leadership</p>	<p style="text-align: right;">Page 12</p> <p>1 third party or any revenue, for that matter?</p> <p>2 A I'm trying to think because I have had</p> <p>3 some engagements that were to be considered</p> <p>4 confidential consulting arrangements, and I'm trying</p> <p>5 to remember the last time that occurred. That was a</p> <p>6 few years ago, probably at least -- at least five</p> <p>7 years ago.</p> <p>8 Q Okay. So then, say, in the last five</p> <p>9 years has your work primarily been as a technical</p> <p>10 expert witness?</p> <p>11 MR. HANNAH: Objection. Form.</p> <p>12 THE WITNESS: Well, I would say in the</p> <p>13 last five years that most of my income has come from</p> <p>14 engagements as an expert witness.</p> <p>15 BY MR. TOMASULO:</p> <p>16 Q Okay. Any other income that you can think</p> <p>17 of in the last five years besides engagements as an</p> <p>18 expert witness, whether it be testifying or</p> <p>19 consulting?</p> <p>20 A I would say all of -- all of the matters</p> <p>21 that have generated income have related to -- in one</p> <p>22 way or another to litigation activities.</p> <p>23 Q Okay. You have something here that says:</p> <p>24 "Access network protocol development, technical lead</p> <p>25 developer." That's on page A-3.</p>
<p style="text-align: right;">Page 11</p> <p>1 positions starting in October of 2009 and to the</p> <p>2 present.</p> <p>3 Q Okay. Any other projects that are ongoing</p> <p>4 under the Bims LLC -- Bims Laboratories, LLC?</p> <p>5 A Well, as part of that effort with that</p> <p>6 802.16 working group, we -- we meet every two months</p> <p>7 alongside other working groups within the IEEE, such</p> <p>8 as the 802.11 working group. So in my capacity</p> <p>9 working for that working group, I'm also involved in</p> <p>10 the standardization efforts throughout the IEEE 802</p> <p>11 committee's efforts, which includes standardization</p> <p>12 of WiFi technology, standardization of Ethernet</p> <p>13 technology in 802.3 personal area networking and</p> <p>14 802.15, et cetera.</p> <p>15 MR. HANNAH: Counsel, do you have an extra</p> <p>16 copy of the exhibit?</p> <p>17 MR. TOMASULO: Oh. I'm sorry. Yeah, I</p> <p>18 do.</p> <p>19 MR. HANNAH: Thank you.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q Is that a paid position that would -- that</p> <p>22 you've just described?</p> <p>23 A My activities there are all volunteer.</p> <p>24 Q Okay. When was the last time Bims</p> <p>25 Laboratories, LLC generated direct revenue from a</p>	<p style="text-align: right;">Page 13</p> <p>1 A Yes.</p> <p>2 Q What is that?</p> <p>3 A So that's an ongoing project which still</p> <p>4 is not complete to create a -- within one project an</p> <p>5 implementation of a wide variety of networking</p> <p>6 protocols, not only the networking protocols that I</p> <p>7 mentioned within the IEEE 802 committee, but also</p> <p>8 other protocols, such as what you would find in the</p> <p>9 3GPP standard -- standardization organization as</p> <p>10 well in -- as in the areas of digital cable and --</p> <p>11 and et cetera.</p> <p>12 Q What is -- on the second line under</p> <p>13 "Technical Lead Developer" it says "Channel Model."</p> <p>14 What does that mean?</p> <p>15 A Okay. So that line talks about the IMT</p> <p>16 2020 channel models. There's an umbrella</p> <p>17 organization that looks to harmonize the various</p> <p>18 worldwide networking protocol standards in a common</p> <p>19 framework, and to that end there are a series of</p> <p>20 requirements that new standards efforts need to --</p> <p>21 need to adhere to. And so in order to prove</p> <p>22 conformance to the harmonized requirements globally,</p> <p>23 the IMT 2020 channel models were developed as a</p> <p>24 common reference benchmark for testing various</p> <p>25 wireless protocols, such as LTE or 802.11 or 802.16,</p>

<p style="text-align: right;">Page 14</p> <p>1 to make sure that their physical and RF layer  2 performance is up to standard.  3 Q And what does the word "channel" mean in  4 this context?  5 A So an IMT 2020 channel is a wireless  6 channel.  7 Q And what does that mean? Does that mean  8 that it's a type of point-to-point communication or  9 it's a channel that multiple people can listen to  10 like a broadcast? What does the word "channel" mean  11 in this context? Can you elaborate a little?  12 MR. HANNAH: Objection. Form.  13 THE WITNESS: So the IMT 2020 channels are  14 focusing on the modulation and demodulation of  15 electromagnetic signals for communication between  16 two nodes in a -- over a wireless medium. The  17 wireless medium itself can be used for a variety of  18 network topologies, including both point-to-point as  19 well as point-to-multi-point technologies.  20 BY MR. TOMASULO:  21 Q So it can establish from one to one or one  22 to many?  23 A Yes, both are possible in a wireless  24 medium.  25 Q Okay. And how does that -- how does that</p>	<p style="text-align: right;">Page 16</p> <p>1 communicate between two nodes, right?  2 MR. HANNAH: Objection. Form.  3 THE WITNESS: Yes, typically a standard  4 that is being tested according to an IMT 2020  5 channel model is a wireless standard, which means  6 that, as part of that standards document, there will  7 be a section that describes the RF modulation and  8 demodulation of electromagnetic signals.  9 BY MR. TOMASULO:  10 Q You mention Bluetooth here. What's  11 Bluetooth?  12 A So Bluetooth is a wireless standard that  13 was developed in Europe and has since been  14 incorporated into a U.S. standard within the IEEE  15 802.15 working group and is typically used for  16 short-range wireless communications up to a range of  17 about 30 to 50 feet.  18 Q And that can be used for point-to-point  19 communication, right, when I use my Bluetooth on my  20 phone to communicate with another Bluetooth device,  21 right?  22 A Yes, that's possible.  23 Q And to do that there's a connection that's  24 established between my phone and, let's say, my  25 wireless speaker, right?</p>
<p style="text-align: right;">Page 15</p> <p>1 form a connection between, let's say, just one to  2 one? In a point-to-point connection for a channel  3 model under the IMT 2020 standard, how is a  4 connection established? Or is a connection  5 established?  6 A So --  7 MR. HANNAH: Objection. Form.  8 THE WITNESS: So as I was alluding to  9 earlier, the IMT 2020 channel models focus on the RF  10 and physical layer performance of wireless  11 networking protocols. Typically connections that  12 are formed over the wireless medium occur at a  13 higher layer in the protocol stack than what the IMT  14 2020 channel models are addressing.  15 BY MR. TOMASULO:  16 Q So the IMT 2020 doesn't actually  17 facilitate a connection?  18 A No. The IMT 2020 channel models are  19 modeling the RF and physical layer communication  20 between two wireless nodes by setting the parameters  21 for testing the -- the performance of a networking  22 protocol in terms of its ability to communicate  23 electromagnetic signals that are modulated with the  24 RF and physical layer standards.  25 Q It can be -- the standard is used to</p>	<p style="text-align: right;">Page 17</p> <p>1 MR. HANNAH: Objection to form.  2 THE WITNESS: Well, there are a lot of  3 things going on in the Bluetooth standard. When the  4 Bluetooth standard establishes a connection, it  5 actually -- there are different types of connections  6 that can be established. So based upon the context  7 in -- in which the device is operating, a particular  8 type of connection would be established with its own  9 set of access procedures to establish that  10 connection. But that's all well laid out in the --  11 in the document, which is thousands of pages long  12 describing this procedure.  13 BY MR. TOMASULO:  14 Q So there's a protocol by which two devices  15 establish a point-to-point connection; is that right  16 -- or multiple protocols, perhaps?  17 A Well, the Bluetooth standard describes the  18 protocol which performs a number of operations, and  19 -- and one of those operations is to establish one  20 of a variety of types of connections that are  21 possible within the Bluetooth standard itself --  22 Q And that --  23 A -- or for communication of -- of video,  24 audio, digital data, et cetera.  25 Q And that would be a point-to-point</p>

5 (Pages 14 - 17)

<p style="text-align: right;">Page 18</p> <p>1 connection, right?</p> <p>2 A It can be a point-to-point connection.</p> <p>3 Q Are those connections that you mentioned</p> <p>4 -- are some of those not point-to-point connections</p> <p>5 when you talk about video or data or -- you listed</p> <p>6 several things. Are those not all types of</p> <p>7 point-to-point connections that are being used to</p> <p>8 exchange that type of data?</p> <p>9 A So what I was describing were types of</p> <p>10 data that are communicated over a Bluetooth</p> <p>11 protocol, such as video data, audio data, digital</p> <p>12 data, each one of which has its own characteristics</p> <p>13 for communication and would require a different type</p> <p>14 of connection to be formed, and the Bluetooth</p> <p>15 standard, in an attempt to optimize the use of the</p> <p>16 wireless medium, has different procedures for</p> <p>17 establishing connections depending on the type of</p> <p>18 data to be communicated.</p> <p>19 Q My question was would it be a</p> <p>20 point-to-point connection? That's my question.</p> <p>21 A Well, it depends on the use case scenario.</p> <p>22 Within Bluetooth standard there's a section which</p> <p>23 describes a wide variety of use case scenarios all</p> <p>24 the way from the communication of a photo from one</p> <p>25 node to another to printers that are connected via</p>	<p style="text-align: right;">Page 20</p> <p>1 A It's possible, yes.</p> <p>2 Q Okay. And so going to page A4, you have</p> <p>3 listed some of your work as an expert witness, along</p> <p>4 with your -- along with your clients.</p> <p>5 Do you see that?</p> <p>6 A Yes.</p> <p>7 Q And so it says here that you were retained</p> <p>8 by your client, Kramer Levin, on 12/15. Is that</p> <p>9 correct?</p> <p>10 A Yes.</p> <p>11 Q And before 12/15 had you ever seen the --</p> <p>12 any of the Boeing patents that you have offered</p> <p>13 testimony on?</p> <p>14 A No.</p> <p>15 Q And before 12/15 had you ever offered any</p> <p>16 testimony or given any expert opinions on matters</p> <p>17 involving video games?</p> <p>18 A Not directly.</p> <p>19 Q What does that mean, "Not directly"?</p> <p>20 A Well, video game technology is really an</p> <p>21 application layer technology which uses underlying</p> <p>22 networking protocols to communicate between</p> <p>23 participants. So that extent the work that I have</p> <p>24 done throughout my career focuses on the -- the</p> <p>25 underlying networking technology which can be</p>
<p style="text-align: right;">Page 19</p> <p>1 Bluetooth. There are a wide variety of use case</p> <p>2 scenarios within which Bluetooth is envisioned to be</p> <p>3 used --</p> <p>4 Q So --</p> <p>5 A -- and not all of them are necessarily</p> <p>6 point-to-point communication scenarios.</p> <p>7 Q Okay. So you identified two right here.</p> <p>8 One was where a -- was a communication to a printer</p> <p>9 from a phone; is that right? Just one?</p> <p>10 A It could be a phone, yes.</p> <p>11 Q Okay. So a phone to a printer establishes</p> <p>12 the Bluetooth connection. Would that be a</p> <p>13 point-to-point connection?</p> <p>14 A I'd have to go back and look at that use</p> <p>15 case again, but within the universe of what's</p> <p>16 possible in Bluetooth, it's possible to establish</p> <p>17 point-to-point communication.</p> <p>18 Q So if I use -- pull out my phone and you</p> <p>19 enable your Bluetooth, can we establish a</p> <p>20 point-to-point communication?</p> <p>21 A That's possible depending on --</p> <p>22 Q So --</p> <p>23 A -- which application modes you invoked for</p> <p>24 using Bluetooth.</p> <p>25 Q So, yes, we could?</p>	<p style="text-align: right;">Page 21</p> <p>1 leveraged by a wide variety of applications,</p> <p>2 including online gaming technology.</p> <p>3 Q Okay. Have you ever worked in a case</p> <p>4 where the accused device was a video game?</p> <p>5 A Yes.</p> <p>6 Q What -- which one?</p> <p>7 A There was a litigation involving the CSIRO</p> <p>8 organization, C-S-I-R-O, versus about 30</p> <p>9 co-defendants in which the CSIRO organization</p> <p>10 accused the co-defendants of infringing an 802.11</p> <p>11 technology that was embedded in the products of the</p> <p>12 co-defendants. Some of those co-defendants</p> <p>13 included, for example, Microsoft, and the list of</p> <p>14 accused products included, for example, the</p> <p>15 Microsoft Xbox because that gaming console includes</p> <p>16 802.11 technology.</p> <p>17 Q Okay. So that was a case that was based</p> <p>18 on 802.11 technology, and some of the accused</p> <p>19 products -- one of the accused products was the</p> <p>20 Microsoft Xbox; is that right?</p> <p>21 A That's the one that comes to mind, but,</p> <p>22 again, with 30 co-defendants, the list of accused</p> <p>23 products was quite extensive and covered a wide</p> <p>24 variety of 802.11 devices, including, as I</p> <p>25 mentioned, gaming devices.</p>

<p style="text-align: right;">Page 22</p> <p>1 Q And in the context of that case did you</p> <p>2 study the Microsoft Xbox?</p> <p>3 A So in the context of that case what I was</p> <p>4 asked to do was to focus on the 802.11 technology</p> <p>5 embedded within all of these products, and that's</p> <p>6 really where I focused.</p> <p>7 Q Okay. But my question was different.</p> <p>8 Did you study the Microsoft Xbox or not?</p> <p>9 A Only to the extent that I studied the</p> <p>10 802.11 technology embedded within the Xbox.</p> <p>11 Q Did you ever physically touch a Microsoft</p> <p>12 Xbox in that case?</p> <p>13 A I don't think that I did, no.</p> <p>14 Q Okay. Other -- so other than that, has</p> <p>15 any of your testimony involved video games directly?</p> <p>16 A Not that I recall.</p> <p>17 Q Okay. And in the Finjan case you have</p> <p>18 testified for Kramer Levin as your client there. In</p> <p>19 September 2015 to the present you were engaged in</p> <p>20 that matter; is that right? This is on page A-5.</p> <p>21 A Yes.</p> <p>22 Q And did you offer any opinion on</p> <p>23 infringement or non-infringement or validity there?</p> <p>24 It looks like it was only a tutorial.</p> <p>25 A Correct. I only offered a tutorial to the</p>	<p style="text-align: right;">Page 24</p> <p>1 by Amazon that describe in detail the operation of</p> <p>2 the networking system that they have created. In</p> <p>3 addition, I reviewed a number of depositions of</p> <p>4 various Amazon employees, and as well I reviewed the</p> <p>5 expert report from the -- Amazon's technical expert</p> <p>6 as well as the claim construction order that was</p> <p>7 issued by the judge in that case, and putting</p> <p>8 together all of the information that I -- that I</p> <p>9 reviewed, I created my own expert reports, which I</p> <p>10 submitted in the case regarding the question of</p> <p>11 infringement.</p> <p>12 Q Did you review source code in that case?</p> <p>13 A Yes, there was some source code that I</p> <p>14 reviewed.</p> <p>15 Q Okay. Did you rely on the source code to</p> <p>16 form your opinion of infringement?</p> <p>17 A I relied on everything that I reviewed in</p> <p>18 order to reach the opinions that I had in the case,</p> <p>19 including source code.</p> <p>20 Q So to form your infringement of -- to --</p> <p>21 I'm sorry.</p> <p>22 To form your opinion of infringement, you</p> <p>23 relied on the materials you described, which</p> <p>24 included confidential design documents and source</p> <p>25 code and depositions, correct?</p>
<p style="text-align: right;">Page 23</p> <p>1 court to explain network security -- security</p> <p>2 technology, without rendering any opinions on the</p> <p>3 question of infringement or validity.</p> <p>4 Q Okay. And then your next case here you</p> <p>5 worked for Microsoft in an inter partes review</p> <p>6 proceeding. And I imagine you were testifying that</p> <p>7 the patent was invalid; is that right?</p> <p>8 A Yeah, I did submit declarations in that</p> <p>9 case in support of the petitioner.</p> <p>10 Q Okay. And then the next case here is for</p> <p>11 your client Reed &amp; Scardino, LLP, and it says you</p> <p>12 were a testifying expert and you offered testimony</p> <p>13 on infringement; is that right?</p> <p>14 A Yes.</p> <p>15 Q And how did you reach the conclusion --</p> <p>16 what did you do before you reached your conclusion</p> <p>17 of infringement in that case in terms of what did</p> <p>18 you look at? Did you look at source code? Did you</p> <p>19 look -- did you test the device? Did you listen to</p> <p>20 deposition testimony? Did you see design documents?</p> <p>21 A So in that -- excuse me. In that case</p> <p>22 there were a number of patents asserted in that</p> <p>23 case, and so my -- my role in the case was to review</p> <p>24 the patents and file history and then to review the</p> <p>25 technical documents that were disclosed in that case</p>	<p style="text-align: right;">Page 25</p> <p>1 A Correct, I looked at those things and more</p> <p>2 in reaching my opinions.</p> <p>3 Q Okay. Did you do any testing?</p> <p>4 A In what sense?</p> <p>5 Q Testing the network, testing the device.</p> <p>6 A Well, certainly the asserted patents in</p> <p>7 that case had a number of claims which were asserted</p> <p>8 in the case, and as I reviewed the materials that</p> <p>9 were before me, in light of the asserted claims, I</p> <p>10 had to mentally step through each and every claim</p> <p>11 element and each word in the claim and at least</p> <p>12 mentally test whether or not the evidence that I'm</p> <p>13 reviewing proves or disproves infringement.</p> <p>14 Q Other than mentally testing it, did you</p> <p>15 test the operation of the device or the accused</p> <p>16 system or the accused network?</p> <p>17 A I did not have physical access to the</p> <p>18 Amazon network other than interacting with it the</p> <p>19 way any end user would interact with the network.</p> <p>20 Q Okay. And then your next listing -- I'm</p> <p>21 sorry.</p> <p>22 Going back to your testimony here, did you</p> <p>23 attempt to interact with the network in the way any</p> <p>24 other end user would interact with a network to form</p> <p>25 your opinion of infringement? In other words, did</p>

7 (Pages 22 - 25)

<p style="text-align: right;">Page 26</p> <p>1 you operate the network to try to form your opinion 2 of infringement in the case against Amazon? 3 A For at least one of the claim elements I 4 did have to operate the user interface to the 5 package delivery notification system in order to 6 test whether or not the system was performing the -- 7 the steps called for in that part of the claim. 8 Q Okay. And that was a test, then, right? 9 A Yes. 10 Q Okay. Your next listing is, again, for 11 your client Kramer Levin, and this is another -- is 12 this just another tutorial that you gave? If you 13 answer "yes" or "no," it will keep things moving 14 along. 15 A Yes, this is another case in which I 16 offered a tutorial to the court on security 17 technology without reaching any opinions on the 18 question of infringement or validity. 19 Q Okay. And then in the next case it's 20 again for your client Reed &amp; Scardino, and that's as 21 -- that's the same -- is that the same set of 22 patents that were -- more or less the same set of 23 patents that were asserted against Amazon? This is 24 a case against BlackBerry. 25 Do you see that? It's on page A-7.</p>	<p style="text-align: right;">Page 28</p> <p>1 for your client Reed &amp; Scardino, again involving 2 Mobile Technologies, this one versus UPS, and here 3 you offered expert reports regarding infringement. 4 Do you see that? 5 A Yes. 6 Q And in that case did you rely on those 7 same four things: confidential design documents, 8 source code, deposition testimony, and physical 9 testing? 10 A For this case I did not perform physical 11 testing of the UPS system. 12 Q Okay. So -- but you did rely on the other 13 three items -- the source code, the deposition 14 testimony, and the confidential design documents -- 15 right? 16 A As well as, you know, the Markman order of 17 the court and the expert reports from the experts 18 for UPS. 19 Q Okay. And that was a case involv- -- what 20 was the general technology of all three of those 21 cases? It says packet delivery and notification. 22 Is it a business method patent, or is it a wireless 23 technology patent, or -- in a couple of sentences 24 can you explain what that technology was that was 25 accused?</p>
<p style="text-align: right;">Page 27</p> <p>1 A Yes -- 2 Q Okay. 3 A -- I see that. 4 Q And in this case did you rely on the -- as 5 in the Amazon case, did you rely on confidential 6 design documents, source code, and deposition 7 testimony and testing in forming your opinion on 8 infringement? 9 A Yes, I did look at a wide variety of 10 things. 11 Q Including those things that I just 12 identified, right -- those four things? 13 A For the Research in Motion system I 14 believe the -- as I recall, the user interface to 15 the system was not a claim element, and as such I 16 did not perform physical testing of the system. 17 Q Okay. So you just -- in that case there 18 was no need to do physical testing so -- but you 19 relied on confidential design documents, source code 20 and deposition testimony, right -- in forming your 21 opinion of infringement? 22 A As well as the Markman order of the court 23 and expert reports from their witnesses at Research 24 in Motion. 25 Q Okay. And then the next case is, again,</p>	<p style="text-align: right;">Page 29</p> <p>1 A So the general technology space was 2 networking technology, which included wired and/or 3 wireless components of the network itself, and it 4 involved the use of those underlying networks to -- 5 to perform the application of package delivery and 6 notification. 7 Q Okay. This is a case involving 8 networking? 9 A Not just networking per se, but the use of 10 that -- those networking protocols for the 11 deployment of an application such as package 12 delivery notification. 13 Q Okay. Next case is for Fish &amp; Richardson, 14 representing Samsung. 15 Do you see that? 16 A Yes. 17 Q I'm not clear what you did here. Did you 18 -- you did not offer an expert report? 19 A That's -- that's correct. 20 Q And the case settled before that? 21 A Yes. 22 Q Had you reached an opinion on infringement 23 or non-infringement at the time the case settled? 24 A No. 25 Q Okay. The next one is in a case where you</p>



<p style="text-align: right;">Page 30</p> <p>1 were representing the plaintiff ZTE -- I'm sorry.  2 You were representing -- your client was Brinks,  3 Gilson on behalf of ZTE Corporation; is that right?  4 A Yes.  5 Q And you were testifying in an IPR  6 proceeding there regarding validity, and so you were  7 testifying on behalf of the patent owner, I suppose;  8 is that right? Or were you testifying on behalf of  9 the petitioner? It's not really clear to me.  10 A I was testifying in support of ZTE's  11 positions in that case.  12 Q And was ZTE the patent owner or were they  13 an accused infringer?  14 A The -- ZTE was the one issuing the IPR; so  15 they were the petitioner, not the patent owner.  16 Q So the -- you were opining that the patent  17 was invalid?  18 A Correct.  19 Q Okay. And your next case is for your  20 client Kramer Levin. Who is your principal point of  21 contact at Kramer Levin? Was that Paul Andre in  22 this case -- this Sirius case?  23 A Yes, Paul Andre and James Hannah were two  24 people that I worked closely with in that case.  25 Q Okay. And in this case you were</p>	<p style="text-align: right;">Page 32</p> <p>1 BY MR. TOMASULO:  2 Q Your next case is not a patent case. It's  3 for Seyfarth Shaw. It's an employment case. Does  4 that have anything to do with source code, patents,  5 anything like that?  6 A So in that case there was a patent  7 involved. The patent was co-assigned to the  8 plaintiff in that case, the University of Florida  9 Research Foundation and Rapid Mobile Technologies  10 and the individual inventor who -- in this case the  11 individual inventor filed an employment law case  12 that related to the patented inventions, and I was  13 asked to opine in that case on the question of  14 infringement.  15 Q Okay. And so the next case is another  16 case for Reed &amp; Scardino again involving the Mobile  17 Telecommunications Technologies, LLC. This one is  18 against Clearwire Corporation.  19 Do you see that?  20 A Yes.  21 Q Okay. And this appears that you provided  22 a report regarding validity.  23 Did you also provide any opinions on  24 infringement?  25 A No.</p>
<p style="text-align: right;">Page 31</p> <p>1 representing the defendant?  2 A Yes.  3 Q And you provided an expert report on  4 non-infringement?  5 A Yes.  6 Q And in that case what -- did you -- did  7 you look at source code before perform- -- before --  8 let me try again.  9 Did you look at source code before forming  10 your opinion of non-infringement?  11 A No.  12 Q Did you look at deposition testimony  13 before performing -- before forming your opinion of  14 non-infringement?  15 A I may have. I know I spent a fair amount  16 of time reviewing the documentation -- the technical  17 documentation of the system operation as well as a  18 fair amount of time interviewing the engineers at  19 SiriusXM to understand directly from the people who  20 design and built the network how it actually works.  21 Q Got it. And you did that before you  22 formed your opinion of non-infringement?  23 A Yes.  24 MR. HANNAH: Bless you.  25 //</p>	<p style="text-align: right;">Page 33</p> <p>1 Q So you were retained solely for validity?  2 A Yes.  3 Q The next case is for Foley &amp; Lardner, was  4 your client, and testifying expert in a case  5 involving mobile device testing systems.  6 Do you see that?  7 A Yes.  8 Q And had you reached any opinions in that  9 case regarding infringement or non-infringement?  10 A I did have a declaration concerning the  11 claim constructions in that case, but before the  12 case proceeded to the point where I offered any  13 opinions on the question of infringement, the case  14 settled.  15 Q Okay. And then the next one is a Wilmer  16 Hale case for Broadcom, and that was an IPR; is that  17 right?  18 A Yes.  19 Q Okay. And then the next case here is for  20 Kilpatrick &amp; Townsend, and you're representing  21 Google or they're representing Google and Motorola  22 Mobility there; do you see that?  23 A Yes.  24 Q And then this is involving smartphone  25 technology --</p>

<p style="text-align: right;">Page 34</p> <p>1 A Yes.</p> <p>2 Q -- is that right?</p> <p>3 A Yes.</p> <p>4 Q And then you gave a declaration in support</p> <p>5 of a motion for a protective order?</p> <p>6 A Yes.</p> <p>7 Q And what was -- what did you opine there</p> <p>8 or what was your declaration? What was the</p> <p>9 substance of that?</p> <p>10 A I'm trying to remember, but at the time</p> <p>11 the accused products were products that were</p> <p>12 manufactured by Motorola Mobility, and I think there</p> <p>13 was some issue as to whether or not certain</p> <p>14 documents should be covered under a protective</p> <p>15 order, and I had to give an opinion on that. That</p> <p>16 was a very short declaration.</p> <p>17 Q And I think -- and it's your opinion,</p> <p>18 right, that -- you know, that evidence of how a</p> <p>19 particular function is performed in a product is</p> <p>20 typically contained within most, you know, seven or</p> <p>21 eight files of source code, right? That's your</p> <p>22 general experience?</p> <p>23 MR. HANNAH: Objection to form.</p> <p>24 THE WITNESS: It depends on a number of</p> <p>25 factors. Generally speaking, when I do source code</p>	<p style="text-align: right;">Page 36</p> <p>1 is typically contained within, at most, seven or</p> <p>2 eight files? Is that or is that not your general</p> <p>3 experience?</p> <p>4 MR. HANNAH: Objection to form.</p> <p>5 THE WITNESS: Well, as I said earlier, it</p> <p>6 depends on a number of factors. Context does matter</p> <p>7 because, like I say, the complexity of the function,</p> <p>8 who's writing the code -- a number of things come to</p> <p>9 play in determining, you know, how many files --</p> <p>10 BY MR. TOMASULO:</p> <p>11 Q I'm sorry, but my question was is it or is</p> <p>12 it not your general experience that evidence of how</p> <p>13 a particular function is performed in a product is</p> <p>14 typically contained within, at most, seven or eight</p> <p>15 files? Is it or is that not your general</p> <p>16 experience?</p> <p>17 MR. HANNAH: Objection. Form. Asked and</p> <p>18 answered. Counsel, you're starting to harass the</p> <p>19 witness. He's giving you an answer. You're cutting</p> <p>20 him off, and this is completely irrelevant to the</p> <p>21 declaration that he submitted in this case. You're</p> <p>22 -- you've been wasting an hour now on these -- these</p> <p>23 matters that have nothing to bear with the 15-page</p> <p>24 declaration he submitted.</p> <p>25 MR. TOMASULO: It's his CV I'm going</p>
<p style="text-align: right;">Page 35</p> <p>1 review, I'll look at quite a bit of source code.</p> <p>2 You know, typically it's at least a hundred thousand</p> <p>3 lines of code that I'll have access to in my</p> <p>4 reviews, typically, before reaching an opinion.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q So is it or is it not your general</p> <p>7 experience that evidence of how a particular</p> <p>8 function is performed in a product is typically</p> <p>9 contained within, at most, seven or eight files of</p> <p>10 source code?</p> <p>11 A It's hard to give a signal number on that</p> <p>12 because the circumstances are very different from</p> <p>13 one case to another in terms of the complexity of</p> <p>14 the function as well as the way in which the accused</p> <p>15 functionality was actually implemented in the source</p> <p>16 code. From one developer to another, one developer</p> <p>17 may implement a function in one file, and then</p> <p>18 another developer may use several files to implement</p> <p>19 the same function. So there are a lot of variables</p> <p>20 at play, and it's -- it's hard to give a single</p> <p>21 number that's universally true across all -- all</p> <p>22 code and all functions in -- in --</p> <p>23 Q I'm sorry. But my question was is it or</p> <p>24 is it not your general experience that evidence of</p> <p>25 how a particular function is performed in a product</p>	<p style="text-align: right;">Page 37</p> <p>1 through. So let me -- if you want to call the</p> <p>2 board, call the board.</p> <p>3 Q Have you ever testified that it is, quote,</p> <p>4 your general experience that evidence of how a</p> <p>5 particular function is performed in a product is</p> <p>6 typically contained within, at most, seven or eight</p> <p>7 files of source code?</p> <p>8 MR. HANNAH: Objection. Form. Asked and</p> <p>9 answered.</p> <p>10 THE WITNESS: I don't remember whether I</p> <p>11 have or haven't.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. So in reaching your opinion of</p> <p>14 non-infringement on behalf of Google and Motorola,</p> <p>15 did you rely on source code?</p> <p>16 A I was asked to review source code as part</p> <p>17 of my expert witness work in that case, yes.</p> <p>18 Q And did you rely on the source code to</p> <p>19 form your opinion of non-infringement?</p> <p>20 A The source code that I reviewed was in</p> <p>21 support of an expert report that was written by</p> <p>22 Dr. Bovik regarding the way in which the camera</p> <p>23 inside the Motorola smartphone was able to identify</p> <p>24 faces in a scene. So as such, my analysis of the</p> <p>25 source code was not used by myself to form an</p>

<p style="text-align: right;">Page 38</p> <p>1 opinion on the question of infringement but was,  2 rather, used by Dr. Bovik in his formulation of  3 opinions.  4 Q Did you offer an opinion of  5 non-infringement?  6 A Yes.  7 Q Okay. And did you rely on confidential  8 design documents in -- to form your opinion of  9 non-infringement?  10 A Yes.  11 Q And did you rely on witness interviews or  12 witness testimony to form your opinion of  13 non-infringement?  14 A Yes.  15 Q But you did not -- and did you rely on any  16 testing to form your opinion of non-infringement?  17 A Yes, we did have a number of products that  18 we were given -- that I was given as part of the  19 work that I did.  20 Q And you did physical tests on those  21 products to form your opinion --  22 A Yes.  23 Q -- of non-infringement?  24 A Yes.  25 Q What type of test did you do?</p>	<p style="text-align: right;">Page 40</p> <p>1 report.  2 Did you offer an opinion of  3 non-infringement in this case?  4 A Yes.  5 Q And in that case, the case for Paul  6 Hastings where you testified on behalf of Apple, did  7 you review source code in forming your opinion of  8 non-infringement?  9 A No.  10 Q Did you review confidential design  11 documents or interview witnesses?  12 A No.  13 Q You reached the opinion of  14 non-infringement. What was the basis for your  15 opinion of non-infringement?  16 A So what I was asked to do in that case was  17 to review the 3GPP standards to determine whether or  18 not a device that was compliant with the 3GPP  19 standard would infringement the claims that were  20 asserted in that case, and so my opinion was -- was  21 limited to that question and was added as an  22 appendix to the expert report of Dr. Wilson.  23 Q I see. Okay.  24 And then your next case here is again for  25 Reed &amp; Scardino, representing a different company</p>
<p style="text-align: right;">Page 39</p> <p>1 A So one of the accused functionalities was  2 the ability of the smartphone to relay photos  3 between the Internet and a third-party device over  4 Bluetooth, and so, as part of the analysis work that  5 I performed, I was given a couple representative  6 devices that are Motorola Mobility devices to test  7 the ability of the phone to relay photos between the  8 Internet and a third-party device using Bluetooth.  9 Q And how did you perform the test? Did you  10 use a packet detector or some software like that?  11 A So on the accused product there is a  12 application programming interface or user interface,  13 rather, and through the user interface I was able to  14 configure the product to perform the use case  15 scenario that I was analyzing.  16 Q Did you -- did you use any testing  17 software to do your test?  18 A No.  19 Q Any testing hardware to do your test other  20 than the physical device itself?  21 A No.  22 Q Okay. The next case is your -- it doesn't  23 say what your testimony is in this case. It looks  24 like you were representing Apple, which was probably  25 an accused infringer, and you gave a rebuttal expert</p>	<p style="text-align: right;">Page 41</p> <p>1 this time called EON IP Holdings, LLC.  2 And in that case you offered an expert  3 opinion regarding infringement, right?  4 A Yes.  5 Q And you were deposed, right?  6 A Yes.  7 Q And in that case did you rely on source  8 code to form your opinion of non-infringement -- I'm  9 sorry. Your -- did you rely on source code to form  10 your opinion of infringement?  11 A No.  12 Q Did you do any testing of the device?  13 A No.  14 Q Did you rely on any confidential design  15 documents or witness depositions?  16 A Yes.  17 Q Okay. And then again for EON IP Holdings  18 you offered an opinion of infringement on behalf of  19 EON, again. And in that case did you review any  20 source code to form your opinion of infringement?  21 A No.  22 Q Did you do any testing of the device or  23 the accused system?  24 A No.  25 Q Did you review any confidential design</p>

<p style="text-align: right;">Page 42</p> <p>1 documents -- did you rely on any confidential design</p> <p>2 documents or witness deposition testimony in forming</p> <p>3 your opinion of infringement?</p> <p>4 A Yes, I did.</p> <p>5 Q Okay. And here for Perkins Coie you had a</p> <p>6 case for Intel.</p> <p>7 You testified regarding non-infringement;</p> <p>8 do you see that?</p> <p>9 A Yes.</p> <p>10 Q And in that case did you review source</p> <p>11 code to form your opinion of non-infringement?</p> <p>12 A Yes.</p> <p>13 Q And did you do any testing of the system</p> <p>14 to form your opinion of non-infringement?</p> <p>15 A Only my mental analysis of the source code</p> <p>16 I was looking at.</p> <p>17 Q Okay. And did you rely on confidential</p> <p>18 design documents and witness interviews or testimony</p> <p>19 to form your opinion of non-infringement?</p> <p>20 A Yes, all of the above.</p> <p>21 Q Okay. And then the next case for Harris</p> <p>22 Corporation you offered an opinion on infringement</p> <p>23 as well, right?</p> <p>24 A Yes.</p> <p>25 Q Did you offer an opinion that the accused</p>	<p style="text-align: right;">Page 44</p> <p>1 network traffic?</p> <p>2 A It allows me to monitor the network</p> <p>3 traffic that is being communicated across the</p> <p>4 medium.</p> <p>5 Q Okay. And how long did it take you to do</p> <p>6 those tests?</p> <p>7 A Let's see. Those tests were performed</p> <p>8 over the course of about two to three weeks.</p> <p>9 Q Okay. And do you know what software you</p> <p>10 used?</p> <p>11 A I know I at least used Wireshark but may</p> <p>12 have used another tool as well.</p> <p>13 Q And what is Wireshark?</p> <p>14 A Wireshark is a type of network protocol</p> <p>15 analyzer tool that is used for the purpose of</p> <p>16 monitoring networking traffic that is communicated</p> <p>17 over a medium, whether it's wired or wireless.</p> <p>18 Q Okay. And had you ever used Wireshark</p> <p>19 before?</p> <p>20 A Yes.</p> <p>21 Q In -- in what context?</p> <p>22 A So throughout my career as a networking</p> <p>23 engineer building networking products for a number</p> <p>24 of companies, I've had to rely on a number of tools,</p> <p>25 including Wireshark, to test the implementation of</p>
<p style="text-align: right;">Page 43</p> <p>1 products infringe the patents?</p> <p>2 A Yes.</p> <p>3 Q And did you rely on source code in forming</p> <p>4 that opinion?</p> <p>5 A No.</p> <p>6 Q Did you rely on any testing of the device</p> <p>7 to form your opinion of infringement?</p> <p>8 A Yes.</p> <p>9 Q What type of testing did you do?</p> <p>10 A Well, because this case involves the use</p> <p>11 of RF technology and smart antennas to communicate</p> <p>12 packets of information, I had to set up a lab</p> <p>13 experiment using a protocol sniffer that would</p> <p>14 capture packets that were transmitted over the air</p> <p>15 between two of the accused products in order to</p> <p>16 determine whether or not those products were</p> <p>17 performing the steps outlined in the claim elements.</p> <p>18 Q Okay. And what is a protocol sniffer?</p> <p>19 A A protocol sniffer is a type of testing</p> <p>20 tool that will capture in what's called promiscuous</p> <p>21 mode all of the packets that are being communicated</p> <p>22 across the medium that's under test, whether that's</p> <p>23 a wired medium, such as an Ethernet cable, or if</p> <p>24 that's a wireless medium.</p> <p>25 Q And so that will help you determine</p>	<p style="text-align: right;">Page 45</p> <p>1 the protocol features in the product that was being</p> <p>2 developed, including going as far back as my days</p> <p>3 working at Wireless Access, which was back in the</p> <p>4 '95 time frame. I was using Wireshark to monitor</p> <p>5 the network traffic communicated over the wireless</p> <p>6 medium for the two-way paging network to determine</p> <p>7 whether or not our products as well as the products</p> <p>8 of -- of our competitor were compliant with the</p> <p>9 proprietary ReFLEX protocol.</p> <p>10 Q What type of things can you detect with</p> <p>11 Wireshark? Let me say it differently.</p> <p>12 What type of things have you used</p> <p>13 Wireshark to detect?</p> <p>14 A So Wireshark is a very versatile tool as a</p> <p>15 protocol analyzer. It can analyze literally</p> <p>16 hundreds of different types of protocols, and --</p> <p>17 Q What do you mean by a "protocol"?</p> <p>18 A So a protocol is a collection of</p> <p>19 functions, procedures, and message formats that are</p> <p>20 defined by engineers as a language, if you will,</p> <p>21 that is used for two computers to communicate with</p> <p>22 each other.</p> <p>23 Q So Wireshark can detect protocols.</p> <p>24 What else can it detect?</p> <p>25 A Well, it's primarily designed for the</p>

<p style="text-align: right;">Page 46</p> <p>1 monitoring and analysis of protocol functions over  2 the medium, whether it's wired or wireless. That's  3 its primary usage.  4 Q And can it -- can it help map network  5 traffic?  6 A What do you mean by "map network traffic"?  7 Q To show what -- who was communicating with  8 whom.  9 A Well, you can configure Wireshark to  10 display all of the contents of each and every packet  11 that it has captured, and as part of a typical  12 packet -- for example, if it were to capture an IP  13 packet, then it would display all of the fields  14 associated with that IP packet including the source  15 address, which would be the IP address where the  16 packet originated, and the destination address,  17 which is the -- the end destination where the packet  18 is headed, but then there are a number of additional  19 fields also that you can display and monitor as part  20 of Wireshark.  21 Q Okay. Is it considered a reliable tool  22 for the functions you've just described?  23 A It's widely used for that purpose, for  24 testing functionality, not just the IP protocol or  25 -- or even other standard protocols, but it also can</p>	<p style="text-align: right;">Page 48</p> <p>1 mode of the driver.  2 Q What does that mean, "promiscuous mode"?  3 A So typically in the low-level drivers that  4 are used for communication over either a wired or a  5 wireless medium, the low-level software, which we  6 call a driver, which is interfacing directly with  7 that communication hardware, is programmed or  8 configured to listen to packets that are -- that  9 have a specific destination address or a specific  10 set of destination addresses and to reject any  11 packets that do not have that particular destination  12 address.  13 But the drivers have a mode called  14 promiscuous mode within which the driver does not  15 filter the packets according to whether or not their  16 destination address is on the list of configured  17 destination addresses, but, rather, will pass to the  18 upper layers of the software all packets received  19 regardless of their destination address.  20 Q Okay. And so how many products -- you  21 said you used Wireshark for two to three weeks to  22 support your opinion of infringement in the case  23 against Ruckus Wireless, right?  24 A Yes.  25 Q And do you -- how many products were you</p>
<p style="text-align: right;">Page 47</p> <p>1 be configured to examine proprietary protocols as  2 well.  3 Q And how many times have you used  4 Wireshark?  5 A I don't know that I can give you an  6 accurate number of times. I know that I've used  7 Wireshark quite a bit over the years.  8 Q Okay. And how many times have you used it  9 in the context of litigation, either to form an  10 opinion of infringement or non-infringement?  11 A I know I used it in that case -- the  12 Ruckus Wireless case. I don't recall using it in  13 other cases.  14 Q Okay. Are there other types of -- you  15 called it a protocol sniffer. That's -- is that the  16 general category of software which Wireshark falls  17 into?  18 A It's a type of protocol sniffer, but  19 it's -- it's really a complete testing tool that  20 allows you to capture and store packet communication  21 over a period of time and even allows you to create  22 packets that are injected into the communication  23 stream. So a packet sniffer is really a very  24 limited functionality device which will simply  25 listen to communication in what we call promiscuous</p>	<p style="text-align: right;">Page 49</p> <p>1 testing?  2 A I believe there were three to four  3 products.  4 Q Okay. And did the opposing side offer a  5 rebuttal test?  6 A Not that I'm aware of.  7 Q And was your test ultimately -- was it  8 challenged in any way by the court? Did someone say  9 your test is no good; it's not admissible?  10 A No.  11 Q The next case for -- it looks like you  12 were representing some defendants in a case brought  13 by InterDigital. You offered some opinions on  14 infringement and non-infringement; is that right?  15 A So I offered expert reports in which I --  16 in those reports I had opinions that the accused  17 products were not infringing the asserted patents as  18 well as expert report on the patents themselves  19 being invalid, and, in addition to that, I published  20 witness statements in which I testified in written  21 form -- in a Q-and-A fashion in written form on  22 these issues of infringement and validity.  23 Q So did -- in forming your opinions of  24 non-infringement or infringement, did you rely on  25 source code in this case?</p>

<p style="text-align: right;">Page 50</p> <p>1 A No. No.</p> <p>2 Q Witness testimony or witness interviews?</p> <p>3 A Yes.</p> <p>4 Q Confidential design documents?</p> <p>5 A As I recall, I looked at a number of</p> <p>6 technical documents. I'm not sure whether I would</p> <p>7 characterize them as design documents. My main</p> <p>8 focus was on the 3GPP standard and the requirements</p> <p>9 of that standard as it relates to the asserted</p> <p>10 claims.</p> <p>11 Q So the question, briefly, was really more</p> <p>12 whether the standard, which could be reduced to a</p> <p>13 public or semi-public writing -- whether that</p> <p>14 standard caused infringement or not.</p> <p>15 A Whether or not the accused products,</p> <p>16 number one, were implementing the standard and in</p> <p>17 particular the required elements of the standard</p> <p>18 that related to the question of infringement.</p> <p>19 Q Okay. In the next case here -- and did</p> <p>20 you do any testing in that case? Sorry. And that</p> <p>21 case referring to the Nokia, Huawei, and ZTE case.</p> <p>22 A No.</p> <p>23 Q And the next case here, it says you</p> <p>24 offered an opinion regarding infringement for EON IP</p> <p>25 again.</p>	<p style="text-align: right;">Page 52</p> <p>1 opinion of non-infringement in that case?</p> <p>2 A No.</p> <p>3 Q Okay. Did you rely on any witness</p> <p>4 interviews in reaching the short opinion on</p> <p>5 non-infringement in that case?</p> <p>6 A No.</p> <p>7 Q And what did you rely on in reaching your</p> <p>8 opinion of non-infringement in that case?</p> <p>9 A I looked at the --the wireless standard</p> <p>10 and the requirements of the wireless standard for</p> <p>11 any compliant device such as the accused products.</p> <p>12 Q And is that -- is that a confidential</p> <p>13 document, the -- the wireless standard documents?</p> <p>14 A No.</p> <p>15 Q And it's not a short document either,</p> <p>16 right? It's a very detailed document?</p> <p>17 A Well --</p> <p>18 Q I thought you said they could be thousands</p> <p>19 of pages?</p> <p>20 A Yeah. I'm just trying to, you know, be</p> <p>21 clear that the -- the wireless standards are -- are</p> <p>22 living documents. So we're constantly meeting every</p> <p>23 couple of months to revise them and publish what are</p> <p>24 called amendments to the document.</p> <p>25 So there is what's called a base standard,</p>
<p style="text-align: right;">Page 51</p> <p>1 Do you see that?</p> <p>2 A Yes.</p> <p>3 Q Did you rely on any source code in forming</p> <p>4 your opinions of infringement there?</p> <p>5 A I believe so, yes.</p> <p>6 Q Okay. And did you rely on confidential</p> <p>7 design documents and witness depositions from the</p> <p>8 engineers?</p> <p>9 A Yes.</p> <p>10 Q Okay. And then the next case was -- and</p> <p>11 did you do any testing in that case for EON against</p> <p>12 Sensus, et al.?</p> <p>13 A In that case I did not perform physical</p> <p>14 testing.</p> <p>15 Q Okay. Next one, Sidley &amp; Austin was your</p> <p>16 client. You were representing Research in Motion</p> <p>17 again. And you are testifying -- it doesn't say.</p> <p>18 I'm assuming you were offering an opinion of</p> <p>19 invalidity or non-infringement or both. Do you</p> <p>20 recall?</p> <p>21 A So in this case this was a -- this was a</p> <p>22 very -- it was a short involvement. I wrote a</p> <p>23 declaration on the issue of non-infringement.</p> <p>24 Q Okay. And did you rely on any source code</p> <p>25 or confidential design documents in reaching that</p>	<p style="text-align: right;">Page 53</p> <p>1 and then there are a series of amendments to the</p> <p>2 base standard, and then every few years the</p> <p>3 amendments are rolled up into a new base standard.</p> <p>4 So the standard is really -- at any time that</p> <p>5 standard is a base standard plus any amendments that</p> <p>6 have been made to the base standard at that time so</p> <p>7 that it may comprise more than one document and</p> <p>8 often cases -- for example, in the 3GPP world, the</p> <p>9 LTE standard is a collection of hundreds of</p> <p>10 documents.</p> <p>11 Q Okay. And then the next time you -- it</p> <p>12 looks like you offered a Texas -- for White Case you</p> <p>13 offered a rebuttal expert report involving wireless</p> <p>14 LAN protocols.</p> <p>15 Was that an infringement or</p> <p>16 non-infringement report?</p> <p>17 A That was on the question of</p> <p>18 non-infringement.</p> <p>19 Q And what -- did you rely on source code or</p> <p>20 confidential design documents to reach your opinion</p> <p>21 of non-infringement there?</p> <p>22 A Yes.</p> <p>23 Q Okay. And did you rely on witness</p> <p>24 interviews or witness depositions?</p> <p>25 A Yes.</p>

<p style="text-align: right;">Page 54</p> <p>1 Q And did you do any testing?</p> <p>2 A No. I simply reviewed the source code and</p> <p>3 the VHDL code.</p> <p>4 Q Okay. And then your next case here is for</p> <p>5 Perkins Coie.</p> <p>6 Is that -- who was your point of contact</p> <p>7 there? Was that Mr. Andre again, who I believe used</p> <p>8 to be at Perkins Coie?</p> <p>9 A No, that was not Mr. Andre.</p> <p>10 Q Different team?</p> <p>11 A Yes.</p> <p>12 Q Okay. And it looks like -- did you not</p> <p>13 offer an opinion on infringement? It looks like</p> <p>14 it's just claim construction.</p> <p>15 A Correct.</p> <p>16 Q Okay. And then the next one here you</p> <p>17 offered a expert report for EON again. And that was</p> <p>18 a -- did you offer an opinion on infringement there?</p> <p>19 A Yes.</p> <p>20 Q And did you rely on source code to form</p> <p>21 that opinion?</p> <p>22 A No.</p> <p>23 Q Did you rely on confidential design</p> <p>24 documents or a standard --</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 56</p> <p>1 that was used to test these ReFLEX products. So I</p> <p>2 knew the products pretty well and how they worked</p> <p>3 and how the protocol worked.</p> <p>4 Q It had already been tested?</p> <p>5 A So I already knew how it -- how everything</p> <p>6 worked.</p> <p>7 Q As a result of the testing you had already</p> <p>8 done at Motorola?</p> <p>9 A And in general my experience working with</p> <p>10 the network and the products, et cetera.</p> <p>11 Q Okay. McDermott, Will &amp; Emery</p> <p>12 representing GE Licensing in this case here. It</p> <p>13 does not say -- is it involving modem technology?</p> <p>14 Is there -- did you offer an opinion on infringement</p> <p>15 or non-infringement in this case?</p> <p>16 A Yes, I offered an opinion on -- on</p> <p>17 non-infringement of -- or infringement, rather, of</p> <p>18 the accused products by Agere.</p> <p>19 Q So you -- your client was the patent</p> <p>20 owner; is that right -- or patent holder?</p> <p>21 A Yes. I was retained by McDermott, Will &amp;</p> <p>22 Emery, who was representing the plaintiff in that</p> <p>23 case.</p> <p>24 Q And you testified that the accused</p> <p>25 products were infringed?</p>
<p style="text-align: right;">Page 55</p> <p>1 Q -- setting document?</p> <p>2 Which one?</p> <p>3 A That was the ReFLEX standard, which is a</p> <p>4 proprietary two-way paging protocol published by</p> <p>5 Motorola.</p> <p>6 Q Okay. So you had a detailed standard to</p> <p>7 rely on to form your opinion; is that right?</p> <p>8 A Well, the combination of that and the fact</p> <p>9 that I worked closely with Motorola as they were</p> <p>10 developing the ReFLEX standard back at Wireless</p> <p>11 Access and -- and built the testing platform that</p> <p>12 tested two-way paging devices that implemented the</p> <p>13 ReFLEX protocol to make sure they were compliant</p> <p>14 with all elements of the protocol before they were</p> <p>15 certified to operate on the SkyTel network, for</p> <p>16 example. So I had a lot of personal experience with</p> <p>17 the ReFLEX protocol in addition to the document in</p> <p>18 front of me.</p> <p>19 Q Did you do any testing in that case?</p> <p>20 A No.</p> <p>21 Q Okay. Why not? It sounded like you knew</p> <p>22 how to do a test in that case.</p> <p>23 A Well, you know, like I say, you know, I</p> <p>24 worked closely with Motorola as they were developing</p> <p>25 the protocol and implemented the testing platform</p>	<p style="text-align: right;">Page 57</p> <p>1 A Yeah, were infringing the patents, yes.</p> <p>2 Q Right. And then two were found infringed</p> <p>3 and two weren't. Were your -- was there a -- did</p> <p>4 you testify regarding all four?</p> <p>5 A Yes.</p> <p>6 Q Okay. And did you rely on source code or</p> <p>7 confidential design documents to form your opinions</p> <p>8 of infringement in that case?</p> <p>9 A Yes.</p> <p>10 Q And did you rely on any testing to form</p> <p>11 your opinion of infringement in that case?</p> <p>12 A No.</p> <p>13 Q And did you have -- did you review any</p> <p>14 deposition testimony to form your opinion of</p> <p>15 infringement in that case?</p> <p>16 A Yes.</p> <p>17 Q Okay. In your next case here you're</p> <p>18 representing Cisco, again, regarding communication</p> <p>19 protocols, and you gave an opinion -- it looks like</p> <p>20 the patents were found valid and infringed; is that</p> <p>21 right?</p> <p>22 A Yes.</p> <p>23 Q And you gave an opinion -- I assume that</p> <p>24 you gave an opinion that they were not infringed; is</p> <p>25 that right?</p>

<p style="text-align: right;">Page 58</p> <p>1 A Yes.</p> <p>2 Q And in forming your opinion of</p> <p>3 non-infringement, did you rely on source code or</p> <p>4 confidential design documents?</p> <p>5 A Confidential design documents.</p> <p>6 Q And did you have -- did you -- in forming</p> <p>7 your opinion of non-infringement, did you interview</p> <p>8 Cisco witnesses or other engineers?</p> <p>9 A No.</p> <p>10 Q Just the confidential design documents was</p> <p>11 the basis of your opinion of non-infringement?</p> <p>12 A And also reviewing deposition</p> <p>13 transcripts --</p> <p>14 Q I see.</p> <p>15 A -- and the expert reports from --</p> <p>16 Q Okay.</p> <p>17 A -- for Commil.</p> <p>18 Q Almost done here.</p> <p>19 You have a case for co-defendants. It</p> <p>20 looked like you gave a -- did you give an opinion or</p> <p>21 any opinions in these cases brought by Commonwealth</p> <p>22 Scientific regarding non-infringement or</p> <p>23 infringement?</p> <p>24 A Yes, I offered an opinion of</p> <p>25 non-infringement on behalf of the joint defense</p>	<p style="text-align: right;">Page 60</p> <p>1 Q And here for -- you were work with Niro</p> <p>2 Scavone, and you testified -- you authored an expert</p> <p>3 report regarding infringement.</p> <p>4 Do you see that?</p> <p>5 A Yes.</p> <p>6 Q And that technology is, again, cell phone</p> <p>7 technology; is that right?</p> <p>8 A Yes.</p> <p>9 Q And did you rely on any source code or</p> <p>10 confidential design documents in forming that</p> <p>11 opinion?</p> <p>12 A Confidential design documents.</p> <p>13 Q Okay. And did you rely on any deposition</p> <p>14 transcripts in forming that opinion?</p> <p>15 A Yes.</p> <p>16 Q Okay. And any testing in that case?</p> <p>17 A No.</p> <p>18 Q So as -- as far as you can recall, the</p> <p>19 testing using a protocol sniffer is restricted to</p> <p>20 the Harris v. Ruckus Wireless case; is that right?</p> <p>21 A As I recall, that's the -- the one case</p> <p>22 where I did use the Wireshark.</p> <p>23 Q Okay. So you were -- you were retained in</p> <p>24 this case in 12/15; is that right? It says on your</p> <p>25 CV.</p>
<p style="text-align: right;">Page 59</p> <p>1 group.</p> <p>2 Q Okay. And did you rely on any</p> <p>3 confidential design documents or source code to</p> <p>4 develop that opinion?</p> <p>5 A Yes.</p> <p>6 Q And did you rely on any witness interviews</p> <p>7 or deposition transcripts to form that opinion?</p> <p>8 A Yes.</p> <p>9 Q And did you perform any testing of the</p> <p>10 accused devices or systems to form that opinion?</p> <p>11 A No.</p> <p>12 Q Okay. And ultimately the patents were</p> <p>13 actually found valid and infringed; is that right?</p> <p>14 A Yes, we did stipulate to infringement;</p> <p>15 that's correct.</p> <p>16 Q Okay. But you had testified that the</p> <p>17 patents weren't infringed?</p> <p>18 A Correct, under the prevailing claim</p> <p>19 construction order at that time, which was changed</p> <p>20 on the eve of trial.</p> <p>21 Q I see. Now, in this Kecker &amp; Van Nest case</p> <p>22 you just offered testimony on claim construction</p> <p>23 opinions and did not form an opinion of infringement</p> <p>24 or non-infringement; is that right?</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 61</p> <p>1 A December 2015, yes.</p> <p>2 Q Okay. And --</p> <p>3 MR. HANNAH: If we're moving on to a new</p> <p>4 topic, can we take a break?</p> <p>5 MR. TOMASULO: Yeah. Absolutely.</p> <p>6 THE VIDEOGRAPHER: Going off record at</p> <p>7 10:57 a.m.</p> <p>8 (Recess.)</p> <p>9 THE VIDEOGRAPHER: Back on record at</p> <p>10 a.m.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q So to sum up to say, in the course of your</p> <p>13 testimonies as an expert, you have provided</p> <p>14 testimonies on infringement and non-infringement</p> <p>15 multiple times, right?</p> <p>16 A Yes.</p> <p>17 Q And in each of -- in many of those cases</p> <p>18 you relied on source code, correct --</p> <p>19 MR. HANNAH: Objection.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q -- in forming those -- in many of those</p> <p>22 cases you relied on source code or confidential</p> <p>23 design documents to form your opinion, correct?</p> <p>24 MR. HANNAH: Objection to form.</p> <p>25 THE WITNESS: I think in most all of them</p>



<p style="text-align: right;">Page 62</p> <p>1 I relied on confidential technical documents, and in  2 some of them I looked at source code as well.  3 BY MR. TOMASULO:  4 Q And in most of them you relied either on  5 deposition transcripts from engineers or interviews  6 with engineers, right?  7 MR. HANNAH: Objection. Form.  8 THE WITNESS: In some cases there were --  9 there was testimony from employees of the company  10 accused of infringement. For the most part there  11 were depositions of experts who were in the case and  12 employees who may have been managers overseeing  13 various groups.  14 BY MR. TOMASULO:  15 Q And in certain instances you relied on  16 extensive technical documentation from a  17 standard-setting agency, right?  18 A Yes, in many cases I had to review  19 standards documents.  20 Q Is there any case that you can recall  21 where you reached an opinion of infringement or  22 non-infringement without reviewing either source  23 code or some other confidential technical design  24 document or witness testimony?  25 MR. HANNAH: Objection to form.</p>	<p style="text-align: right;">Page 64</p> <p>1 A Okay. So the scope of my assignment was  2 to look at the secondary considerations of  3 nonobviousness with respect to the -- the asserted  4 patents.  5 Q When did you first read any of the  6 asserted Boeing patents?  7 A I think shortly after the engagement  8 started.  9 Q Okay. And the patent that we're here to  10 talk about today is U.S. Patent 6,732,147, right?  11 A Sounds right.  12 Q Okay. And if I call that the '147 patent,  13 is that okay?  14 A Yeah.  15 Q When was the first time you read the '147  16 patent?  17 A The first time I read it?  18 Q Yeah.  19 A When I was engaged to work on this case.  20 Q How many hours have you spent, all told,  21 on your assignments for Acceleration Bay in these  22 matters?  23 A About 75 hours.  24 Q And is that including your witness  25 preparation time for today or is that in addition --</p>
<p style="text-align: right;">Page 63</p> <p>1 THE WITNESS: There was the one  2 declaration that I mentioned earlier, which was  3 added as an appendix to another expert's report, in  4 which I reviewed the 3GPP standards to determine  5 whether or not the requirements of the standard  6 proved or disproved infringement.  7 BY MR. TOMASULO:  8 Q And in that case you had an actual  9 standard-setting document to rely on, right?  10 A Yeah, set of documents. Yes.  11 Q So other than that case, is there any  12 other case you can recall where you reached an  13 opinion of infringement or non-infringement without  14 reviewing either source code or some other  15 confidential technical design document or performing  16 testing?  17 MR. HANNAH: Objection to form.  18 THE WITNESS: I don't recall any.  19 BY MR. TOMASULO:  20 Q Okay. When -- you were retained in 12/15.  21 What was the scope of your assignment when  22 you were retained?  23 A In this case?  24 Q Yes. I'm sorry. Yeah, in the present  25 case.</p>	<p style="text-align: right;">Page 65</p> <p>1 or is that separate?  2 A Including witness prep time.  3 Q And what is your hourly rate?  4 A Six hundred.  5 Q And you were retained directly by Kramer  6 Levin, or were you retained through a search firm?  7 A No. I was retained directly by Kramer  8 Levin.  9 Q So all 600 of the dollars is --  10 A Yeah.  11 Q -- yours?  12 What did you do to prepare for this  13 deposition?  14 A I went back over the -- the declaration --  15 the two declarations that I submitted with respect  16 to the '147 patent, the dec- -- the original  17 declaration and then the supplemental, and then I  18 also went through the exhibits for those  19 declarations, which included looking at the '147  20 patent itself, looking at the claim chart that I  21 created, looking at Mr. Bourassa's invention  22 disclosure form, and a number of other documents.  23 Q How many -- and did you have -- did you  24 have meetings to prepare for this deposition?  25 Meetings with counsel? meetings with anyone?</p>

<p style="text-align: right;">Page 66</p> <p>1 A I did have a meeting with counsel 2 yesterday. 3 Q Okay. How long was that meeting? 4 A The meeting itself lasted maybe an hour, 5 hour and a half. 6 Q Okay. And that's the only meeting you've 7 had to prepare for this deposition -- or phone call? 8 A Yes, that's the meeting that I had to 9 prepare for this deposition, yes. 10 Q And in that context, who was present at 11 that -- either in person or telephonically at your 12 preparation meeting? 13 A Mr. Hannah. 14 Q Have you ever met Mr. Eric Cole? 15 A Yes. 16 Q When was the last time you spoke with him? 17 A It had to be at least a few months ago. 18 Q Okay. Now, you -- your testimony 19 indicates you relied on the declarations of Drs. 20 Bourassa and Goodrich; is that right? 21 A Yes. 22 Q And you relied on those to form your 23 opinions? 24 A In part, yes. 25 Q Okay. And did you talk to Professor</p>	<p style="text-align: right;">Page 68</p> <p>1 declaration and the invention disclosure 2 statement -- to form your opinions? 3 A Yes, in part. 4 Q Okay. And did you -- did you understand 5 both of those documents? 6 A Yes. 7 Q And did you disagree with any part of the 8 Bourassa declaration? 9 A No. 10 Q And did you disagree with any part of his 11 invention disclosure statement? 12 A No. 13 Q Now, between the Goodrich declaration and 14 the Bourassa declaration, that's a fair amount of 15 material. 16 How much time did you spend studying that 17 material? 18 A I don't know that I can parse it out. I 19 basically had a volume of material to go through, 20 and so typically what I'll do is I'll review, say, a 21 declaration, and in the course of reviewing that 22 declaration, to refresh my memory, I'll turn to the 23 patent. So I'll bounce back and forth between 24 documents while I'm reviewing the collection. 25 So it's hard to say, you know, how many</p>
<p style="text-align: right;">Page 67</p> <p>1 Goodrich? 2 A No. 3 Q And did you read and understand his whole 4 declaration? 5 A Yes. 6 Q Okay. And were there any parts of his 7 declaration you disagreed with? 8 A Not that I recall. 9 Q Okay. And for Dr. Bourassa -- I believe 10 it's a doctor -- did you talk to him ever? 11 A No. 12 Q Have you ever spoken with either 13 Dr. Goodrich or Bourassa? 14 A No. 15 Q Okay. How -- did you read the entire 16 declaration from Dr. Bourassa? 17 A Yes. 18 Q And then it attached an invention 19 disclosure statement. 20 Do you recall that? 21 A Yes. 22 Q Did you read that entire invention 23 disclosure statement? 24 A Yes. 25 Q And did you rely on both of those -- the</p>	<p style="text-align: right;">Page 69</p> <p>1 minutes was spent focusing on just one document 2 because I'll look at a number, go back and forth 3 between them. 4 Q When did you first see either declaration? 5 A After they were submitted in this case, I 6 saw them. I don't remember the exact date. 7 Q So you don't think you saw the 8 declarations until they were submitted? 9 A I didn't see any drafts or anything like 10 that. 11 Q Okay. Did you perform any tests in 12 reaching your opinions? 13 A No. 14 Q Are you a video game guy? You know, do 15 you play video games, that kind of stuff? 16 MR. HANNAH: Objection. Form. 17 THE WITNESS: I have played them in the 18 past, yes. 19 BY MR. TOMASULO: 20 Q Okay. When was the last time -- have you 21 played any games on the Microsoft Xbox One counsel 22 -- console? I'm sorry. 23 Have you played any games on the Microsoft 24 One Xbox console? 25 A I don't think so, no.</p>

<p style="text-align: right;">Page 70</p> <p>1 Q Okay. So you reviewed the asserted 2 patents, correct? 3 A Mm-hmm. 4 Q You reviewed the prosecution history? 5 A Yes. 6 Q Okay. You didn't do any testing, right? 7 A No physical testing. 8 Q Okay. And you didn't review any source 9 code, right? 10 A Correct. 11 Q And did you -- can you talk with -- or is 12 there -- is there any other materials beyond what's 13 identified in your report that you relied on in 14 forming your opinions? 15 A With respect to the '147 patent, all the 16 material I relied on is disclosed in the 17 declarations. 18 Q Okay. During the course of this 19 engagement, you have never spoken with Dr. Goodrich; 20 is that right? 21 A Correct. 22 Q And you have not spoken with Dr. Bourassa 23 either, right? 24 A Correct. 25 Q And how about Dr. Holt?</p>	<p style="text-align: right;">Page 72</p> <p>1 Q But in the context of that case you never 2 even physically inspected an Xbox One, right? 3 A Correct. 4 Q And that's really your lone experience 5 with the video game industry, right? 6 MR. HANNAH: Objection to form. 7 THE WITNESS: What do you mean by 8 "experience"? 9 BY MR. TOMASULO: 10 Q Well, you haven't testified for a video 11 game company other than this one experience 12 involving the 802.11 standard on the -- as it was 13 being implemented by the Xbox console, right? 14 A Right. Outside of that case, I've never 15 testified for a video gaming company. 16 Q Okay. Do you know much about the video 17 game market? 18 A I -- I know what I've learned from 19 reviewing documents given to me in this case, some 20 aspects of the video gaming market. 21 Q Do you have any idea what successful video 22 game -- like, what would be an average annual sales 23 of a successful video game in, say, 2000 or 2006 or 24 today? 25 MR. HANNAH: Objection to form.</p>
<p style="text-align: right;">Page 71</p> <p>1 A Same thing. 2 Q Okay. And in the course of this 3 engagement, have you spoken with Dr. Cole -- 4 A No. 5 Q -- Eric Cole? 6 I don't know if he is a doctor or not. 7 A No. 8 Q Okay. How about -- do you know someone 9 named Dr. Medvidovic? 10 A I've heard the name. 11 Q Have you ever spoken with him? 12 A No. 13 Q And then what attorneys have you worked 14 with in the context of this -- this IPR matters? 15 A Mr. James Hannah and Ms. Nguyen. 16 Q And that's it? 17 A Yes. 18 Q Okay. So you've never worked for a video 19 game company, right? 20 A Correct. 21 Q Okay. And you've never been retained by a 22 video game company as an expert witness, right? 23 Well, you've been retained by Microsoft in a case; 24 is that right? 25 A Yes, yes.</p>	<p style="text-align: right;">Page 73</p> <p>1 THE WITNESS: So in my review for this 2 case there were some financial documents disclosed 3 which talked about video gaming sales. I don't 4 remember the exact numbers off the top of my head, 5 but those numbers were included in the documents 6 that I have reviewed in this case. 7 BY MR. TOMASULO: 8 Q What -- do you know how Activision or EA 9 or Take-Two generates revenue from online 10 multiplayer games? 11 A I have not investigated that. 12 Q What is a gaming console? 13 A Well, generally speaking, a gaming console 14 is a product that's produced by a gaming 15 manufacturer for the purpose of running an 16 application or a set of applications that would be 17 considered computer games. 18 Q And what are the -- what are the different 19 consoles that you're aware of? 20 A Well, there are a wide number of them that 21 have been accused of infringement, and I don't know 22 that I can rattle off all the names, but certainly 23 manufacturers such as Sony and EA Sports and Rocket 24 Star [sic], and Activision, et al. produce gaming 25 applications.</p>

<p style="text-align: right;">Page 74</p> <p>1 Q Okay. And do they all produce game 2 consoles? 3 A They all produce gaming applications, 4 which is what I really focused on and not hardware, 5 necessarily. 6 Q So you didn't focus on hardware? 7 A For the purpose of my assignment, which 8 was the secondary considerations of nonobviousness, 9 I focused on the documentation in this case that was 10 describing the functionality of the gaming 11 applications. 12 Q Okay. So hardware was not something you 13 studied? 14 MR. HANNAH: Objection to form. 15 THE WITNESS: I think what I've studied 16 I've disclosed, and, like I said earlier, I looked 17 at the functionality of the -- the gaming 18 applications that -- that are accused. 19 BY MR. TOMASULO: 20 Q Do -- do you know how long the typical 21 development cycle is for a major video game? 22 A I -- I don't know the -- the typical 23 development cycle time for a gaming application. 24 Q Do -- do you know how the games are 25 developed?</p>	<p style="text-align: right;">Page 76</p> <p>1 duplicated across devices. You know, I have not 2 considered all of the network nodes that are 3 required to implement a gaming application to 4 consider, you know, how much code in toto resides in 5 all of those networking nodes to implement an online 6 gaming application. 7 Q Okay. What are the most important 8 features that are valued by consumers in video 9 games? Let's start with in the year 2000. 10 MR. HANNAH: Objection. Form. 11 THE WITNESS: What are the ...? 12 BY MR. TOMASULO: 13 Q Most important features that are valued by 14 consumers, end users for -- for video games? 15 A I haven't performed that marketing 16 analysis. 17 Q And so you don't know that for today or 18 for 2006, for any time period, really, right? 19 MR. HANNAH: Objection. Form. 20 THE WITNESS: I did not perform a market 21 analysis in the work that I have performed in this 22 case; so I don't know. 23 BY MR. TOMASULO: 24 Q Do you know what Durango is? 25 A Yes.</p>
<p style="text-align: right;">Page 75</p> <p>1 A They're developed by software developers 2 who write code that implements the application. 3 Q Okay. And do you know how they're sold? 4 A They're sold to end consumers through a 5 variety of marketing channels. 6 Q Any idea how many lines of code is in a -- 7 in any of the accused video games or in any major 8 video game? 9 MR. HANNAH: Objection to form. 10 THE WITNESS: I have not counted the lines 11 of code in any particular gaming application. 12 BY MR. TOMASULO: 13 Q But, I mean, can you hazard a guess as to 14 how many -- I mean, you've identified a series of 15 games that are in your charts. 16 Do you have any idea how many lines of 17 code those games have? Thousands? Hundreds of 18 thousands? 19 MR. HANNAH: Objection to form. 20 BY MR. TOMASULO: 21 Q Millions? Billions? 22 A Well, you know, certainly these games, 23 when they're online games, have software running in 24 a variety of -- of devices, and some of that code is 25 unique on different devices, and some of it's</p>	<p style="text-align: right;">Page 77</p> <p>1 Q What is that? 2 A Well, the -- the word "Durango" is a 3 marketing term that's used in a variety of contexts 4 to refer to a variety of products from an online 5 game to an automotive vehicle. 6 Q But do you know what it means in the 7 context of -- of these petitioners or these cases? 8 A It's -- 9 MR. HANNAH: Objection. Form. 10 THE WITNESS: -- a marketing term. 11 BY MR. TOMASULO: 12 Q Can you be more specific? I mean, do you 13 know what it -- for instance, if Activision uses the 14 term "Durango," do you know what it would be 15 referring to? 16 A It's referring to a product -- 17 Q A product? 18 A -- that -- that they make, yes. 19 Q Okay. And then how about Demonware? 20 What's Demonware? 21 A Well, that would refer to an application 22 that's running as a process on a particular node 23 that would listen for incoming packets and then 24 reacting to that to perform various operations. 25 Q What is Teredo? Have you ever heard of</p>

<p style="text-align: right;">Page 78</p> <p>1 the term "Teredo"?</p> <p>2 A Teredo.</p> <p>3 Q T-e-r-e-d-e -- T-e-r-e-d-o, Teredo.</p> <p>4 T-e-r-e-d-o.</p> <p>5 A I'm not recalling that --</p> <p>6 Q Okay.</p> <p>7 A -- term.</p> <p>8 Q What's a game engine in the context of a</p> <p>9 video game?</p> <p>10 A So a game engine would be a set of</p> <p>11 software within the gaming application which is</p> <p>12 performing a number of core functions that are</p> <p>13 required by the application.</p> <p>14 Q Okay. And so -- I'm sorry. What -- what</p> <p>15 were you -- what were -- did you finish your answer</p> <p>16 when you were asked to identify all of the different</p> <p>17 game consoles that you were aware of?</p> <p>18 A So I'm trying to remember off the top of</p> <p>19 my head all gaming consoles. I know there were a</p> <p>20 number asserted in this case which I've documented</p> <p>21 in my declarations from the -- the parties in this</p> <p>22 case, and that's an extensive list. I don't know</p> <p>23 that I'm remembering each and every one of them as</p> <p>24 of this moment, but, as I mentioned before, there</p> <p>25 are gaming consoles and applications from each of</p>	<p style="text-align: right;">Page 80</p> <p>1 your declaration. So your answers are your answers</p> <p>2 right now.</p> <p>3 The -- how does Sony make money from</p> <p>4 online multiplayer gaming?</p> <p>5 A By charging consumers.</p> <p>6 Q Okay. So who do they charge? Like, what</p> <p>7 are the different revenues streams that they get?</p> <p>8 MR. HANNAH: Objection. Form.</p> <p>9 THE WITNESS: I've -- I have not looked</p> <p>10 into all the revenue streams that they've used for</p> <p>11 -- as sources of income.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Just name the ones that you're aware of.</p> <p>14 Any in particular that you can associate -- well,</p> <p>15 let's take a step back.</p> <p>16 What's online multiplayer gaming?</p> <p>17 A So that's a term which refers to a gaming</p> <p>18 application that involves multiple participants who</p> <p>19 are playing the game in an online context, which</p> <p>20 means over the Internet.</p> <p>21 Q Okay. And so in that context how does</p> <p>22 Sony make money?</p> <p>23 A By selling and/or renting the gaming</p> <p>24 application to end users.</p> <p>25 Q Okay. Any other ways?</p>
<p style="text-align: right;">Page 79</p> <p>1 the parties that they manufacture and sell.</p> <p>2 Q Okay. So your testimony is that each of</p> <p>3 the parties manufacture gaming consoles and</p> <p>4 applications; is that right?</p> <p>5 A And --</p> <p>6 MR. HANNAH: Objection. Form.</p> <p>7 THE WITNESS: -- and/or applications, yes.</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q And/or applications. Okay.</p> <p>10 And then -- but can you name any of those</p> <p>11 game consoles?</p> <p>12 MR. HANNAH: Objection. Form.</p> <p>13 And feel free to refer to your</p> <p>14 declaration, if you need to.</p> <p>15 THE WITNESS: Yeah, I would have to just</p> <p>16 to be -- just to be accurate, just refer to it to</p> <p>17 make sure that I'm referring to specifically what I</p> <p>18 have mentioned is the basis for my opinions.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q Well, I'm just asking you as you sit here</p> <p>21 today. I mean, you've offered testimony about the</p> <p>22 secondary considerations of nonobviousness and the</p> <p>23 impact of a license in a market for video games, and</p> <p>24 I'm just asking to see what you know about the</p> <p>25 industry. I'm not asking you to recite what's in</p>	<p style="text-align: right;">Page 81</p> <p>1 A There could be other ways, such as</p> <p>2 advertising revenue, et cetera, which are also</p> <p>3 sources of income.</p> <p>4 Q Did you physically operate a PlayStation 3</p> <p>5 or 4 in the context of -- of your retention in these</p> <p>6 cases?</p> <p>7 A No.</p> <p>8 Q Did you see one? Did you touch one?</p> <p>9 A I did not physically handle one in the</p> <p>10 course of this litigation.</p> <p>11 Q Okay. So just to be clear, you did not --</p> <p>12 in the course of your retention, you did not</p> <p>13 physically see or touch a Sony PlayStation 3 or 4,</p> <p>14 correct?</p> <p>15 A Correct.</p> <p>16 Q Okay. And have you -- and in the course</p> <p>17 of this retention you did not physically see or</p> <p>18 touch a Microsoft Xbox One or Xbox 360, right?</p> <p>19 A Correct.</p> <p>20 Q Okay. And in the course of this retention</p> <p>21 did you physically see or touch any of the accused</p> <p>22 games, for instance, Destiny?</p> <p>23 A No.</p> <p>24 Q Okay. And then there's a number of videos</p> <p>25 that are cited to in your report, right? Do you</p>

<p style="text-align: right;">Page 82</p> <p>1 recall that?</p> <p>2 A Yes.</p> <p>3 Q Did you --</p> <p>4 MR. HANNAH: Which report, Counsel? I</p> <p>5 think you might be referring to the one tomorrow.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q You have identified in at least some of</p> <p>8 your reports videos -- YouTube videos, things like</p> <p>9 that, right?</p> <p>10 A I looked at a wide variety of evidence</p> <p>11 online, such as YouTube videos and other things as</p> <p>12 well, yes.</p> <p>13 Q And did you make -- did you watch those</p> <p>14 YouTube videos?</p> <p>15 A In the preparation of my report, yes.</p> <p>16 Q Okay. So you did that before you reached</p> <p>17 your opinions?</p> <p>18 A Yes.</p> <p>19 Q Do you know what the major technology</p> <p>20 problems in the video game industry were in, let's</p> <p>21 say, 2006?</p> <p>22 A Let's see. In the course of my efforts</p> <p>23 here in this litigation I did not examine the full</p> <p>24 range of technical problems experienced by the</p> <p>25 gaming industry in 2006.</p>	<p style="text-align: right;">Page 84</p> <p>1 experiencing in context of the gaming industry in</p> <p>2 2006?</p> <p>3 A Other than probably competitive challenges</p> <p>4 from competitor companies.</p> <p>5 Q Okay. Do you have any experience with</p> <p>6 patent licensing?</p> <p>7 A I am not a patent lawyer. So I haven't</p> <p>8 licensed any patents myself.</p> <p>9 Q And have you licensed any software?</p> <p>10 A Again, I'm not an attorney. So I have not</p> <p>11 personally licensed any software.</p> <p>12 Q It's not an attack on you. I'm just</p> <p>13 trying to get a feel for your experience.</p> <p>14 So you're not a licensing professional in</p> <p>15 the context of either licensing patents or software,</p> <p>16 right?</p> <p>17 MR. HANNAH: Objection. Form.</p> <p>18 THE WITNESS: Correct. I'm not a</p> <p>19 licensing professional.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q Okay. And no experience with licensing</p> <p>22 for video games or game consoles, right?</p> <p>23 A Correct.</p> <p>24 Q What's a graph? Are you able to offer a</p> <p>25 definition?</p>
<p style="text-align: right;">Page 83</p> <p>1 Q Can you identify any that you're -- that</p> <p>2 you're aware of for a certainty they were</p> <p>3 experiencing in 2006?</p> <p>4 MR. HANNAH: Objection. Form.</p> <p>5 THE WITNESS: I was not working for a</p> <p>6 gaming company at that time.</p> <p>7 BY MR. TOMASULO:</p> <p>8 Q So you can't, right?</p> <p>9 A So --</p> <p>10 Q If I asked you --</p> <p>11 A I'd have to have access to that</p> <p>12 information to know specifically what a particular</p> <p>13 gaming company was experiencing at that particular</p> <p>14 time in 2006.</p> <p>15 Q I understand. I'm not -- I just want to</p> <p>16 know.</p> <p>17 A Mm-hmm.</p> <p>18 Q So you -- so you don't know what the</p> <p>19 challenges were at that time, right?</p> <p>20 MR. HANNAH: Objection. Form.</p> <p>21 THE WITNESS: Not for a specific company</p> <p>22 that's listed as one of the accused companies in</p> <p>23 this litigation in 2006, no.</p> <p>24 BY MR. TOMASULO:</p> <p>25 Q Do you know what challenges Sony was</p>	<p style="text-align: right;">Page 85</p> <p>1 MR. HANNAH: Objection. Form.</p> <p>2 THE WITNESS: What do you mean by that?</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q Well, I mean, it has a definition. Most</p> <p>5 things do. I mean, maybe there's multiple</p> <p>6 definitions. But are you able to offer a definition</p> <p>7 of what a graph is?</p> <p>8 MR. HANNAH: Objection to form.</p> <p>9 THE WITNESS: Well, the word "graph" is a</p> <p>10 pretty generic term. So without any context, I</p> <p>11 don't know quite how to answer the question.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. What's an m-regular graph?</p> <p>14 MR. HANNAH: Objection. Form.</p> <p>15 BY MR. TOMASULO:</p> <p>16 Q Let's start with a different question.</p> <p>17 What's a regular graph?</p> <p>18 A In what context?</p> <p>19 Q Graph theory.</p> <p>20 A So in the context of graph theory, a</p> <p>21 regular graph would be a collection of nodes and</p> <p>22 links between the nodes where each node has the same</p> <p>23 number of links to other nodes.</p> <p>24 Q Okay. And then what would be an m-regular</p> <p>25 or a k-regular graph?</p>

<p style="text-align: right;">Page 86</p> <p>1 MR. HANNAH: Objection. Form.</p> <p>2 THE WITNESS: So an m-regular graph within</p> <p>3 the context of graph theory would be a -- a</p> <p>4 collection of nodes and links between those nodes</p> <p>5 where each node has m links to other nodes.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q Okay. And then what's a complete graph?</p> <p>8 MR. HANNAH: Objection to form.</p> <p>9 THE WITNESS: So within the context of</p> <p>10 graph theory, a complete graph would be a graph in</p> <p>11 which a collection of nodes and links between the</p> <p>12 nodes exists such that every node can reach every</p> <p>13 other node in one link hop.</p> <p>14 BY MR. TOMASULO:</p> <p>15 Q Each node has a direct edge or link, as</p> <p>16 you're using the term, to every other node in the</p> <p>17 graph, right?</p> <p>18 A Correct.</p> <p>19 MR. TOMASULO: How about graphs? Pull the</p> <p>20 graphs. So this will be Exhibit Bims 2, I guess.</p> <p>21 (Exhibit 2 was marked for identification</p> <p>22 by the court reporter.)</p> <p>23 MR. HANNAH: Counsel, I'm going to object</p> <p>24 to this exhibit and any questions, and I'm going to</p> <p>25 instruct the witness not to answer any questions</p>	<p style="text-align: right;">Page 88</p> <p>1 MR. TOMASULO: Okay.</p> <p>2 Q Okay. So do -- did you --</p> <p>3 Let's go ahead and mark your declaration.</p> <p>4 She can put that over that. This will be Bims No.</p> <p>5 3. You can put the sticker right on top of my</p> <p>6 writing.</p> <p>7 (Exhibit 3 was marked for identification</p> <p>8 by the court reporter.)</p> <p>9 MR. TOMASULO: Here's a copy of his</p> <p>10 declaration. I gave him one that has the actual CV</p> <p>11 because I had separated that out. So you have the</p> <p>12 declaration and the CV now.</p> <p>13 MR. HANNAH: Sure.</p> <p>14 MR. TOMASULO: Just to be clear, his has</p> <p>15 got the whole thing.</p> <p>16 Q Okay. So this is your declaration, right?</p> <p>17 A Yes.</p> <p>18 Q Okay. And you -- you signed it on</p> <p>19 December 15th, 2016; is that right?</p> <p>20 A Yes.</p> <p>21 Q Okay. And then -- and so you -- if we go</p> <p>22 to page -- page 10, paragraph 28 --</p> <p>23 A You said page 10, paragraph 28?</p> <p>24 Q Yes. Is that -- do you not see that? Is</p> <p>25 that paragraph 28, "In my opinion"; is that -- do --</p>
<p style="text-align: right;">Page 87</p> <p>1 regarding this exhibit unless you can demonstrate</p> <p>2 the relevance of it and how it pertains to his</p> <p>3 declaration in this case.</p> <p>4 MR. TOMASULO: Okay. The case is about</p> <p>5 graph theory. So, you know, I'm going to ask my</p> <p>6 questions, but I'll try to demonstrate some</p> <p>7 relevance beforehand, but I think it's pretty plain</p> <p>8 what's relevant and what's not. I mean --</p> <p>9 MR. HANNAH: He offered an opinion on</p> <p>10 secondary considerations. This is way outside the</p> <p>11 scope of his -- of his opinions in this case. I</p> <p>12 gave you some -- I've been giving you some leniency</p> <p>13 here, but this is clearly outside the scope.</p> <p>14 BY MR. TOMASULO:</p> <p>15 Q Have -- have -- in -- in your testimony</p> <p>16 did you -- did you offer an opinion that the Sony</p> <p>17 PlayStation playing the game Destiny meets the</p> <p>18 limitations of the '147 patent claim six?</p> <p>19 A No, my task was to -- was to consider</p> <p>20 secondary considerations of nonobviousness but not</p> <p>21 to reach the question of infringement of any</p> <p>22 particular claim.</p> <p>23 Q Okay. That's -- okay.</p> <p>24 MR. HANNAH: And, Counsel just so you have</p> <p>25 a heads-up, I will need to take a break at 11:55.</p>	<p style="text-align: right;">Page 89</p> <p>1 A That's page 9.</p> <p>2 Q Oh, okay. I'm just looking. I see it's</p> <p>3 page 9, but it's stamped page 10 at the bottom.</p> <p>4 A Oh. Got it. Yeah. I see that.</p> <p>5 Q Okay. So paragraph 28. Can you just read</p> <p>6 the whole paragraph for me into the record.</p> <p>7 A So paragraph 28 says, quote, In my</p> <p>8 opinion, based on the public information contained</p> <p>9 within the license, Sony utilizes the inventions</p> <p>10 disclosed in the '147 patent. Based on my review,</p> <p>11 Sony markets and sells those products covered under</p> <p>12 at least one claim of the '147 patent in the same</p> <p>13 market as petitioner. To show the nexus between the</p> <p>14 technology of the '147 patent licensed under the</p> <p>15 Sony and Acceleration Bay license agreement and the</p> <p>16 Sony products, I have created, using publicly</p> <p>17 available information, a chart that maps the claims</p> <p>18 of the '147 patent with the technology in the Sony</p> <p>19 patents. This chart is attached as Exhibit 2016.</p> <p>20 As indicated in the chart, PlayStation 3 and</p> <p>21 PlayStation 4 are covered by the '147 patent.</p> <p>22 Q Okay. So is that your opinion?</p> <p>23 A Yes.</p> <p>24 Q Okay. And what you're saying here -- what</p> <p>25 are you saying when you say the chart that maps the</p>

<p style="text-align: right;">Page 90</p> <p>1 claims of the '147 patent with the technology in the 2 Sony products? 3 A So what I'm showing here is that it's in 4 my opinion that it's highly likely that the Sony 5 products are practicing the invention by creating a 6 chart that -- that shows the evidence that I've 7 looked at in the case going through the asserted 8 claims one by one, showing that high likelihood that 9 Sony is practicing the inventions. 10 Q It's an infringement chart that you 11 created, right? 12 MR. HANNAH: Objection. Form. 13 THE WITNESS: No. 14 BY MR. TOMASULO: 15 Q It's not an infringement chart. 16 What do you mean by the term "covered" 17 when you say "Sony markets and sells those products 18 covered by at least one claim of the '147 patent"? 19 What does that means, "covers"? 20 A So that's a general term, and, again, if I 21 were creating a -- an infringement analysis report, 22 I would be specific in terms of which particular 23 claim I'm talking about and which claim element 24 within the claim I'm talking about, but in this 25 sentence it's very general and broad because this</p>	<p style="text-align: right;">Page 92</p> <p>1 different locations around the world to communicate 2 and interact with each other by sending data 3 received from neighboring players to other 4 neighboring players." 5 Q Okay. So is it your opinion that Sony is 6 using -- what -- what does your opinion have to do 7 with the validity of this patent? 8 A So my opinion is with respect to secondary 9 considerations of nonobviousness. 10 Q Okay. So if we go to paragraph 27, is it 11 your opinion that commercial -- a prima facie case 12 of nexus is made when the commercially successful 13 product is the invention disclosed and claimed in 14 the patent? 15 A Yes. 16 Q Okay. And so what you're saying here is 17 that -- have you applied this test? You say that 18 the nexus is shown, right? 19 A Yes. 20 Q Okay. And so when you say the nexus is 21 shown, is -- you're saying that the commercially 22 successful product is the invention claimed in the 23 patent? That's your testimony, right? 24 A The commercially successful product 25 incorporates the inventions described in the '147</p>
<p style="text-align: right;">Page 91</p> <p>1 analysis was performed by looking at the '147 patent 2 and the inventions disclosed in the '147 patent and 3 then looking at the Sony products and making the 4 determination that it's highly likely that the Sony 5 products are practicing the invention. 6 Q Show me where you say "highly likely." 7 A The term "highly likely" does not appear 8 in paragraph 28. 9 Q Have you ever used the word "covered" to 10 mean infringe in any of the multiple cases where you 11 have testified about infringement? 12 A No. 13 Q Okay. And then what about when you say 14 "utilize the invention described in at least one 15 claim"? What do you mean by that term? That's in 16 paragraph 29. 17 A So -- you say in paragraph 29? Okay. Let 18 me see here. 19 Q Just read the whole paragraph into the 20 record. 21 A So paragraph 29 says: "For example, it is 22 my opinion that Sony's PlayStation 3 and PlayStation 23 4, which run the online game Destiny, utilize the 24 invention described in at least one claim of the 25 '147 patent because they enabled players from</p>	<p style="text-align: right;">Page 93</p> <p>1 patent, yes. 2 Q Okay. In other words, it -- in your 3 opinion, it infringes? 4 A Infringement is a specific word that 5 relates to the question of a particular asserted 6 claim having been practiced element by element in 7 the accused product, and I have not performed that 8 level of detailed analysis of the accused products. 9 Q Okay. And what -- and what did you not 10 do? What makes your opinion not an infringement 11 analysis? 12 A So -- excuse me -- my opinion is based 13 upon my reading of the patent itself and what it 14 discloses in the specification about the invention 15 and my understanding, from the documents discovered 16 in this case, the way in which the -- the products 17 -- the Sony products are performing and looking at 18 that general operation to -- to reach the opinion 19 that there is a nexus between how the Sony products 20 are performing and the inventions disclosed in the 21 '147 patent. 22 Q Okay. But you say that -- 23 MR. HANNAH: Counsel, just to give you a 24 heads-up: I do need to take a break. 25 //</p>



<p style="text-align: right;">Page 94</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q You understand that you can't talk to your</p> <p>3 lawyers or anybody about this deposition during</p> <p>4 breaks, right?</p> <p>5 A Of course.</p> <p>6 MR. TOMASULO: Okay. I just want to make</p> <p>7 sure that we don't have an inadvertent issue with</p> <p>8 that rule. Yeah. So -- let's go off the record.</p> <p>9 MR. HANNAH: Okay.</p> <p>10 THE VIDEOGRAPHER: Going off record at</p> <p>11 11:56 a.m.</p> <p>12 (Lunch Recess.)</p> <p>13 THE VIDEOGRAPHER: We're back on record at</p> <p>14 12:54 p.m.</p> <p>15 BY MR. TOMASULO:</p> <p>16 Q Good afternoon.</p> <p>17 A Good afternoon.</p> <p>18 Q You have prepared infringement reports in</p> <p>19 the past, right?</p> <p>20 A Yes.</p> <p>21 Q And you have offered testimony where you</p> <p>22 specifically said, "I have reviewed this product,</p> <p>23 and it infringes," or "I've reviewed this product,</p> <p>24 and it doesn't infringe," right?</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 96</p> <p>1 try to determine whether or not the accused product</p> <p>2 is meeting each and every limitation of a specific</p> <p>3 asserted claim.</p> <p>4 Q Okay. And then -- and then -- then does</p> <p>5 that get you to -- all the way to an opinion that</p> <p>6 either it infringes or it doesn't? I mean, how do</p> <p>7 you make that next step? You've described a process</p> <p>8 that -- the last thing you said was comparing each</p> <p>9 claim elements to the accused product, right?</p> <p>10 A Yes.</p> <p>11 Q And then what? So then --</p> <p>12 A Well --</p> <p>13 Q -- to reach a conclusion of infringement,</p> <p>14 what would you have to determine?</p> <p>15 A Well, to reach an opinion on infringement,</p> <p>16 I would go back and look at the analysis that I</p> <p>17 performed on each claim element, and if the analysis</p> <p>18 that I performed on each claim element shows that</p> <p>19 for each one of those claim elements the product was</p> <p>20 found to infringe that claim element for all of the</p> <p>21 claim elements in a particular claim, then I reach</p> <p>22 the opinion that the product is infringing the claim</p> <p>23 as a whole.</p> <p>24 But if in my analysis there's even one of</p> <p>25 the claim elements in which the product does not</p>
<p style="text-align: right;">Page 95</p> <p>1 Q And you've reached that conclusion by</p> <p>2 doing what? What steps do you perform to reach a</p> <p>3 conclusion of infringement?</p> <p>4 A So I start by reading the patent spec</p> <p>5 itself, and then, you know, I read the -- the</p> <p>6 asserted claims in light of what's written in the</p> <p>7 patent specification, and then I also examine the</p> <p>8 file history to see if there -- if there was</p> <p>9 anything discussed with the examiner in the</p> <p>10 prosecution of the patent that could better inform</p> <p>11 what the claim terms mean or the scope of the</p> <p>12 invention means, et cetera, as I'm reviewing the</p> <p>13 asserted claims.</p> <p>14 And then oftentimes the court will issue a</p> <p>15 claim construction order, which will provide</p> <p>16 definitions of some of the claim terms. So I'll</p> <p>17 look at that court order and substitute the court's</p> <p>18 definition for the claim terms as I'm attempting to</p> <p>19 understand what does each and every asserted claim</p> <p>20 actually mean and what does it actually cover.</p> <p>21 And then -- then after, you know, going</p> <p>22 through all of that, then I look at the accused</p> <p>23 products, and -- and I examine the accused products</p> <p>24 from -- from either a structural sense or from a</p> <p>25 methodology sense depending on the type of claim to</p>	<p style="text-align: right;">Page 97</p> <p>1 meet the limitations of that particular claim</p> <p>2 element, then I say the product does not infringe</p> <p>3 the claim as a whole because there was at least one</p> <p>4 claim element in which the product did not satisfy</p> <p>5 or meet the limitations.</p> <p>6 Q Okay. And then you prepared charts in the</p> <p>7 past before, have you not?</p> <p>8 A Yes.</p> <p>9 Q And those would be called infringement</p> <p>10 charts, I suppose?</p> <p>11 A Yes.</p> <p>12 Q Okay. And what is the purpose of an</p> <p>13 infringement chart that you have prepared?</p> <p>14 A So in the past when I have put together</p> <p>15 infringement charts, the -- the charts really</p> <p>16 summarize the evidence that I've been looking at</p> <p>17 that form the bases of the opinion that I reach in</p> <p>18 that case.</p> <p>19 Q Okay. And then that -- that chart itself</p> <p>20 would summarize your opinion of infringement or --</p> <p>21 or not?</p> <p>22 A It summarizes in one place the evidence</p> <p>23 that I'm using to support my opinion. So the</p> <p>24 infringement claim chart will have in it supporting</p> <p>25 evidence for each one of the claim elements. And</p>

25 (Pages 94 - 97)

<p style="text-align: right;">Page 98</p> <p>1 then when I write my expert report, I'll rely on the</p> <p>2 claim chart -- the evidence that's in the claim</p> <p>3 chart to reach the opinions that are written in my</p> <p>4 report.</p> <p>5 Q Okay. Have you ever had your testimony on</p> <p>6 infringement excluded by a judge?</p> <p>7 A I think I had a supplemental report that</p> <p>8 was filed late, and so it was excluded because it</p> <p>9 was late.</p> <p>10 Q Other than that?</p> <p>11 A No.</p> <p>12 Q So in this case you read the patent?</p> <p>13 A Yes.</p> <p>14 Q You read the specification?</p> <p>15 A Yes.</p> <p>16 Q You studied the claims that were at issue?</p> <p>17 A Yes.</p> <p>18 Q And you read the file wrapper?</p> <p>19 A Yes.</p> <p>20 Q And you compared the -- and you -- and you</p> <p>21 read Dr. Goodrich's testimony?</p> <p>22 A Yes. His declaration, yes.</p> <p>23 Q And in that he created some claim</p> <p>24 constructions, right?</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 100</p> <p>1 Q Okay. So you did apply the claim</p> <p>2 construction the same way you would have applied a</p> <p>3 Markman order?</p> <p>4 A I -- I would say not the same way.</p> <p>5 Q In what way does it differ?</p> <p>6 A So my claim constructions that are in my</p> <p>7 report are really documenting my understanding of</p> <p>8 what those claim terms mean when I read the claim.</p> <p>9 So armed with that understanding, I did a review of</p> <p>10 the evidence of the Sony product, and, based upon</p> <p>11 what I saw in that evidence, it appears to me that</p> <p>12 the Sony products are practicing the invention</p> <p>13 without doing the kind of detailed analysis that I</p> <p>14 would normally do with respect to an infringement</p> <p>15 opinion.</p> <p>16 Q Okay. So at this point are you offering</p> <p>17 an opinion that the -- the material that's charted</p> <p>18 in your chart, which is -- I guess it's the Sony</p> <p>19 PlayStation, right?</p> <p>20 A [Witness nods head.]</p> <p>21 Q Are you offering an opinion that that</p> <p>22 infringes the claims of the '147 patent that you've</p> <p>23 charted?</p> <p>24 A No, I'm not offering an opinion on</p> <p>25 infringement.</p>
<p style="text-align: right;">Page 99</p> <p>1 Q And you applied those?</p> <p>2 A I did look at them, and I agree with them,</p> <p>3 yes.</p> <p>4 Q Okay. And so you created a chart that</p> <p>5 compared the Sony product running the game Destiny</p> <p>6 to the claims of the '147 patent -- or the selected</p> <p>7 claims, right?</p> <p>8 A In a general sense, yes.</p> <p>9 Q Okay. And did that chart apply the claim</p> <p>10 constructions that were developed by Dr. Goodrich</p> <p>11 which you said you agree with?</p> <p>12 A Excuse me. I was not doing a detailed</p> <p>13 analysis of -- of his constructions in that claim</p> <p>14 chart. Rather, when -- the chart that I put</p> <p>15 together in this IPR proceedings, I was simply</p> <p>16 looking at the -- the product itself and does the</p> <p>17 functionality of the product itself appear to have a</p> <p>18 high likelihood of satisfying the IPR claims</p> <p>19 components.</p> <p>20 Q But my question is you have a section in</p> <p>21 your declaration about claim construction, right?</p> <p>22 A Yes.</p> <p>23 Q Okay. Did you apply that claim</p> <p>24 construction when you created your charts?</p> <p>25 A The ones that are in my declaration, yes.</p>	<p style="text-align: right;">Page 101</p> <p>1 Q Okay. Have you reached an opinion on</p> <p>2 infringement?</p> <p>3 A No, I have not.</p> <p>4 Q Okay. Have you reached an opinion on</p> <p>5 infringement -- you've offered other charts as well,</p> <p>6 right?</p> <p>7 A You mean in other litigations?</p> <p>8 Q No. In these proceedings in the context</p> <p>9 of the other patents where you have offered a</p> <p>10 similar declaration on secondary considerations of</p> <p>11 nonobviousness, have you reached an opinion on</p> <p>12 infringement in any of those?</p> <p>13 A No.</p> <p>14 MR. HANNAH: Objection. Form. Outside</p> <p>15 the scope.</p> <p>16 BY MR. TOMASULO:</p> <p>17 Q Okay. So it is the same story with all of</p> <p>18 those? It's not an infringement opinion?</p> <p>19 A That's correct.</p> <p>20 Q Okay. So you have not rendered or reached</p> <p>21 a conclusion of infringement on -- of any of these</p> <p>22 patents so far?</p> <p>23 A That's correct.</p> <p>24 MR. TOMASULO: Let's mark the patent. So</p> <p>25 what will this be?</p>

<p style="text-align: right;">Page 102</p> <p>1 THE REPORTER: No. 4.  2 (Exhibit 4 was marked for identification  3 by the court reporter.)  4 BY MR. TOMASULO:  5 Q What I have placed before you and marked  6 as Exhibit 4 is U.S. patent --  7 Oh, do you need a copy?  8 MR. HANNAH: Yes, please.  9 MR. TOMASULO: You'll have to get a little  10 binder.  11 Q What I've placed before you and marked as  12 Exhibit Bims 4 is U.S. Patent 6,732,147.  13 Do you see that?  14 A Yes.  15 Q Okay. And this is the patent you have  16 testified that you read, correct?  17 A Yes.  18 Q And you read the whole thing?  19 A Yes.  20 Q What is your understanding of the  21 invention claimed in the '147 patent?  22 MR. HANNAH: Objection. Form.  23 THE WITNESS: So at a high level, what the  24 invention is all about is the application of a  25 broadcast channel as an overlay on top of an</p>	<p style="text-align: right;">Page 104</p> <p>1 disparate and different applications?  2 A Potentially, yeah.  3 Q And the term "application layer" is not  4 specifically used in the patent, right?  5 A Correct.  6 Q What do you interpret that to mean?  7 A So that's my way of explaining at a high  8 level what the patent is about by making a  9 distinction between the point-to-point  10 communications network, which is implementing  11 network layer routing protocols, from the broadcast  12 channel, which is overlaid on top of those network  13 layer routing protocols, which, if you look at the  14 protocol stack, the broadcast channel would have to  15 operate at a higher layer in the protocol stack than  16 the network routing protocols.  17 And, as described in the '147 patent, one  18 of the embodiments for how you would use the  19 broadcast channel is for participants to communicate  20 with one another to broadcast messages to one  21 another within the context of an application,  22 although the claims as -- as I've gone through them,  23 the claims don't necessarily limit you to a  24 particular application.  25 Q And how do you determine whether something</p>
<p style="text-align: right;">Page 103</p> <p>1 underlying point-to-point communications network for  2 the establishment of an application layer  3 communication channel for participants all running  4 the same application so that they can broadcast  5 messages to one another over an underlying  6 point-to-point communications network.  7 BY MR. TOMASULO:  8 Q So is it a requirement of the claims that  9 the participants be running the same application?  10 MR. HANNAH: Objection to form.  11 BY MR. TOMASULO:  12 Q I think that's what you just said.  13 A It's an application layer broadcast  14 channel; that's correct.  15 Q So what you said was that it's a  16 communications channel for participants all running  17 the same application so they can broadcast messages  18 to one another.  19 So my question is is it a requirement of  20 the claims that the participants all be running the  21 same application?  22 A They're not required to all run the same  23 application, but the participants communicate to one  24 another over the same broadcast channel.  25 Q So the participants could be running</p>	<p style="text-align: right;">Page 105</p> <p>1 is at the application layer or not? Are there rules  2 that you use to determine whether -- if I'm  3 understanding correctly, what you're saying is if  4 it's not at the application layer, it doesn't meet  5 the terms of the claims; is that right?  6 A No, that's not.  7 MR. HANNAH: Objection. Form.  8 THE WITNESS: That's not what I'm saying.  9 Again, I'm just trying to give you a flavor for what  10 the patent is all about, and the broadcast channel  11 is an overlay on top of the networking -- the  12 point-to-point communications network at the  13 networking layer.  14 So above the networking layer you have  15 three layers, right. You have the transport layer,  16 the session layer, the presentation layer, and then  17 above that the application layer. So potentially  18 the broadcast channel could exist in any one of  19 those or combination thereof layers, but the  20 easiest -- easiest example to explain the broadcast  21 channel is to use the application layer as the -- as  22 the example.  23 BY MR. TOMASULO:  24 Q Okay. So it's not limited to just the  25 application layer? That's your testimony?</p>

<p style="text-align: right;">Page 106</p> <p>1 MR. HANNAH: Objection to form.</p> <p>2 THE WITNESS: Correct. It just needs to</p> <p>3 be an overlay on top of the point-to-point</p> <p>4 communications network.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q Okay. That could be at the application</p> <p>7 layer or any of those other three layers you --</p> <p>8 A Yes.</p> <p>9 Q -- described?</p> <p>10 MR. HANNAH: Objection to form.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q If you look at the background, do you see</p> <p>13 in the first couple of sentences it says here at the</p> <p>14 very beginning of the background -- are you there?</p> <p>15 A Yes.</p> <p>16 Q So it says: "There are a variety --" I'm</p> <p>17 sorry. Let me start again.</p> <p>18 It says: "There are a wide variety of</p> <p>19 computer network communications techniques, such as</p> <p>20 point-to-point network protocols, client server</p> <p>21 middleware, multicasting network protocols, and</p> <p>22 peer-to-peer middleware."</p> <p>23 Do you understand what those different</p> <p>24 protocols or middleware are?</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 108</p> <p>1 about UNIX, TCP/IP, and UDP.</p> <p>2 A Yeah.</p> <p>3 Q Are -- and are those, in your view, all</p> <p>4 prior art network point-to-point protocols?</p> <p>5 MR. HANNAH: Objection. Form.</p> <p>6 THE WITNESS: So a UNIX pipe is really a</p> <p>7 socket that is opened up in the UNIX operating</p> <p>8 system for communication typically within the</p> <p>9 context of a UDP or a TCP socket connection. So a</p> <p>10 UNIX pipe is really kind of a specific version of a</p> <p>11 TCP/IP network protocol stack.</p> <p>12 TCP/IP and UDP are both referring to a</p> <p>13 merging of protocol layers at the transport and</p> <p>14 networking layers into a common implementation. TCP</p> <p>15 actually sits above IP, which is at the networking</p> <p>16 layer, and the same thing with UDP, which is sitting</p> <p>17 at the transport layer above IP at the networking</p> <p>18 layer --</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q Okay. So -- sorry. Go ahead.</p> <p>21 A -- to perform the networking functions.</p> <p>22 Q Okay. So let me give you a blank piece of</p> <p>23 paper. Can you just draw those seven layers so we</p> <p>24 can have something to refer to? I don't know if you</p> <p>25 need one.</p>
<p style="text-align: right;">Page 107</p> <p>1 Q Okay. And so -- and those -- those are</p> <p>2 prior art systems that are not claimed by the</p> <p>3 patent, correct?</p> <p>4 MR. HANNAH: Objection. Form.</p> <p>5 THE WITNESS: Those are examples of</p> <p>6 communications techniques that exist in a prior art</p> <p>7 to this patent, yes.</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q Okay. So what is meant by a</p> <p>10 point-to-point network protocol?</p> <p>11 A So within the category of point-to-point</p> <p>12 network protocols that this sentence is describing</p> <p>13 would be protocols that exist at the -- at the</p> <p>14 networking layer, such as the IP layer networking</p> <p>15 protocols used for routing packets over the</p> <p>16 Internet, for example.</p> <p>17 Q Okay. Any other examples you can think</p> <p>18 of?</p> <p>19 A Well, frame relay is used for</p> <p>20 point-to-point communications. ATM is used for</p> <p>21 point-to-point network protocol communications.</p> <p>22 Ethernet is used for point-to-point communications.</p> <p>23 You know, IPX, probably a few more that I'm leaving</p> <p>24 out.</p> <p>25 Q If you go to the next paragraph, it talks</p>	<p style="text-align: right;">Page 109</p> <p>1 MR. HANNAH: Objection. Form.</p> <p>2 MR. TOMASULO: He's referring to multiple</p> <p>3 layers, and I can't keep track of them in my head</p> <p>4 when he -- so I -- why -- why can he not draw it?</p> <p>5 You are you able to draw it, the seven-layer stack</p> <p>6 you're talking about?</p> <p>7 MR. HANNAH: I don't think it's</p> <p>8 appropriate for the witness, especially in an IPR</p> <p>9 proceeding, to be creating exhibits.</p> <p>10 MR. TOMASULO: So you're instructing him</p> <p>11 not to do it?</p> <p>12 MR. HANNAH: You can ask him -- actually,</p> <p>13 I don't even know -- where is this referring to --</p> <p>14 referenced to in his declaration? That's the only</p> <p>15 thing we're supposed to be talking about today.</p> <p>16 MR. TOMASULO: He relied on Professor</p> <p>17 Goodrich's declaration. Here. Just give that back.</p> <p>18 It sounds like you can't do it.</p> <p>19 Q So you are unable to draw the seven-layer</p> <p>20 stack?</p> <p>21 A I am heeding the advice of counsel to not</p> <p>22 create the exhibit.</p> <p>23 Q But could you do it?</p> <p>24 A I understand the layers in a networking</p> <p>25 stack, yes.</p>

<p style="text-align: right;">Page 110</p> <p>1 Q So you could draw it?</p> <p>2 A I could write down what those seven layers</p> <p>3 are in the OSI protocol stack model, yes.</p> <p>4 Q So you said TCP/IP. What -- what layer</p> <p>5 does that sit at?</p> <p>6 A So TCPI --/IP is a combination of the</p> <p>7 Transmission Control Protocol and the Internet</p> <p>8 Protocol, with the Internet Protocol existing at the</p> <p>9 networking layer and the Transmission Control</p> <p>10 Protocol operating at the transport layer.</p> <p>11 Q Okay. And you said that the patent</p> <p>12 includes connections made at the application layer,</p> <p>13 correct?</p> <p>14 A Yeah.</p> <p>15 Q And at the presentation layer?</p> <p>16 MR. HANNAH: Objection. Form.</p> <p>17 THE WITNESS: Basically, at any layer that</p> <p>18 exists above the point-to-point communications</p> <p>19 protocol that's described in the '147 patent.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q Okay. So is -- does -- is it above -- is</p> <p>22 it restricted to things that are above the session</p> <p>23 layer, including the session layer?</p> <p>24 MR. HANNAH: Objection.</p> <p>25 //</p>	<p style="text-align: right;">Page 112</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q I want to know if you're able to say what</p> <p>3 layers are for sure included within your view of</p> <p>4 what could be a participant in the claim.</p> <p>5 MR. HANNAH: Objection to form.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q You said -- you said it has to be above</p> <p>8 the point-to-point network protocol, right?</p> <p>9 A Correct.</p> <p>10 Q But there is no thing that says</p> <p>11 point-to-point network protocol in the seven-layer</p> <p>12 stack, right? That's not a layer?</p> <p>13 A So a point-to- --</p> <p>14 MR. HANNAH: Object to form. Outside the</p> <p>15 scope.</p> <p>16 THE WITNESS: A point-to-point network</p> <p>17 protocol is generally operating at the network</p> <p>18 layer.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q So then the transport layer is a</p> <p>21 candidate -- if the connections are made there, in</p> <p>22 your view, it's a candidate to be involved in the</p> <p>23 scope of the claims?</p> <p>24 MR. HANNAH: Objection to form. Outside</p> <p>25 the scope.</p>
<p style="text-align: right;">Page 111</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q I'm just trying to figure out what you</p> <p>3 believe it includes.</p> <p>4 A Well, I think we've already outlined some</p> <p>5 examples that the '147 patent identifies in the</p> <p>6 specification of point-to-point network protocols,</p> <p>7 and given that the '147 patent says that the</p> <p>8 broadcast channel exists above the point-to-point</p> <p>9 network protocols, then at any layer that sits above</p> <p>10 any of these examples would be a candidate for a</p> <p>11 broadcast channel.</p> <p>12 Q Okay. So any layer above the</p> <p>13 point-to-point layer?</p> <p>14 A The point-to-point network protocol layer,</p> <p>15 yes.</p> <p>16 Q And so for the avoidance of doubt, what</p> <p>17 layers would be at least for sure above that layer?</p> <p>18 The application layer, right?</p> <p>19 A Well, you would look at a case-by-case</p> <p>20 basis --</p> <p>21 MR. HANNAH: Objection. Beyond the scope.</p> <p>22 THE WITNESS: -- at a variety -- at the</p> <p>23 networking protocols, but, you know, as a general</p> <p>24 matter, a networking protocol operates at the</p> <p>25 networking layer.</p>	<p style="text-align: right;">Page 113</p> <p>1 THE WITNESS: Well, it depends on my</p> <p>2 analysis of the system in terms of what I identify</p> <p>3 in the system as the point-to-point network</p> <p>4 protocol, which I haven't done that exercise, but if</p> <p>5 I were to do that exercise, then certainly the</p> <p>6 broadcast channel would exist above it.</p> <p>7 BY MR. TOMASULO:</p> <p>8 Q We see here in the first sentence it talks</p> <p>9 about client server middleware.</p> <p>10 What is your understanding of what that</p> <p>11 means?</p> <p>12 A So client --</p> <p>13 MR. HANNAH: Objection. Form.</p> <p>14 THE WITNESS: -- client server middleware</p> <p>15 refers to a layer of software that resides in a end</p> <p>16 user device and also in a network node, which allows</p> <p>17 for communication between an end user client, a</p> <p>18 plurality of end user clients and a central server.</p> <p>19 So the client server middleware</p> <p>20 description here as one of the communications</p> <p>21 techniques implies that we're referring to a network</p> <p>22 configuration in which communication from client</p> <p>23 devices directly flows to a central server.</p> <p>24 BY MR. TOMASULO:</p> <p>25 Q And that's outside the scope of the</p>

<p style="text-align: right;">Page 114</p> <p>1 patent, correct?</p> <p>2 MR. HANNAH: Objection. Form.</p> <p>3 THE WITNESS: That's simply part of the</p> <p>4 background of possible communications techniques</p> <p>5 that have existed prior to the '147.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q Okay. So are -- is it your testimony that</p> <p>8 a client server could be within the scope of the</p> <p>9 patent?</p> <p>10 MR. HANNAH: Objection. Form of the</p> <p>11 question.</p> <p>12 THE WITNESS: So it's my testimony that --</p> <p>13 that I have not analyzed the '147 patent with</p> <p>14 respect to the -- the full breadth of the coverage</p> <p>15 of the invention as to whether or not client server</p> <p>16 middleware implementations could or could not</p> <p>17 infringe the patent.</p> <p>18 BY MR. TOMASULO:</p> <p>19 Q What's multicasting network protocols?</p> <p>20 A So for a multicasting network protocol,</p> <p>21 that would be a protocol that allows for</p> <p>22 communication between network nodes in which a</p> <p>23 packet that is sent from one node can be received by</p> <p>24 a plurality of destination nodes.</p> <p>25 Q Is there any other definitions for</p>	<p style="text-align: right;">Page 116</p> <p>1 answered.</p> <p>2 THE WITNESS: I haven't looked into it.</p> <p>3 So I really can't answer.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q Well, what's the difference between</p> <p>6 broadcasting and multicasting?</p> <p>7 MR. HANNAH: Objection to form. Outside</p> <p>8 the scope.</p> <p>9 MR. TOMASULO: How -- how could it</p> <p>10 possibly be outside the scope to ask questions about</p> <p>11 terms in the claims, terms in the patent when he's</p> <p>12 testified about the scope of the patents and what's</p> <p>13 within the scope of the patents? You can have a</p> <p>14 standing objection on form and outside the scope.</p> <p>15 MR. HANNAH: I'll tell you exactly what's</p> <p>16 outside the scope. He is -- he is a witness</p> <p>17 offering a 15-page declaration on secondary</p> <p>18 considerations. He is not the main invalidity or</p> <p>19 validity expert in these IPR proceedings. You have</p> <p>20 his deposition coming next week or the week after,</p> <p>21 and that is fair -- that's fair questions about the</p> <p>22 scope of the claims, the scope of the patent, what</p> <p>23 these different terms mean.</p> <p>24 This witness did not offer an opinion on</p> <p>25 any of these terms. He didn't put an opinion about</p>
<p style="text-align: right;">Page 115</p> <p>1 multicasting network protocol that you can think of</p> <p>2 or you think that's a pretty accurate definition?</p> <p>3 A Well, that's -- that's generally --</p> <p>4 generally what multicasting is about, which is the</p> <p>5 ability to -- for a single packet to be transmitted</p> <p>6 to a plurality of destination nodes.</p> <p>7 Q Okay. And is that what would have been</p> <p>8 the definition of multicasting around the time that</p> <p>9 this patent was filed, say, in 2000, 1999, 1998?</p> <p>10 MR. HANNAH: Objection. Form.</p> <p>11 THE WITNESS: I have not thought about</p> <p>12 that question with respect to that particular time</p> <p>13 frame.</p> <p>14 BY MR. TOMASULO:</p> <p>15 Q As you sit here today, can you think of</p> <p>16 any reason why the definition you just gave wouldn't</p> <p>17 be applied or applicable in 1998 to 2000?</p> <p>18 MR. HANNAH: Objection to form.</p> <p>19 THE WITNESS: I haven't looked into it.</p> <p>20 So I can't offer an opinion one way or the other.</p> <p>21 BY MR. TOMASULO:</p> <p>22 Q So you -- there is no reason as you sit</p> <p>23 here today that you could say that you think will</p> <p>24 probably be inapplicable to that time frame?</p> <p>25 MR. HANNAH: Objection. Form. Asked and</p>	<p style="text-align: right;">Page 117</p> <p>1 multicasting or any of these other terms that you're</p> <p>2 talking about in his declaration.</p> <p>3 And in these IPRs you're supposed to limit</p> <p>4 your questions to what's in the declaration. And I</p> <p>5 -- we've given you a lot of leeway here. So this is</p> <p>6 absolutely outside the scope of his very limited</p> <p>7 declaration in these proceedings.</p> <p>8 MR. TOMASULO: He offered an infringement</p> <p>9 chart. He offered definitions of broadcast channel.</p> <p>10 This is crazy. He's talking about the patent.</p> <p>11 Let's call the board. I mean, I've never even heard</p> <p>12 of something like this. I'm asking him questions</p> <p>13 about the patent. This is just silly.</p> <p>14 MR. HANNAH: You're asking about what --</p> <p>15 the scope of the claims and what they -- and what</p> <p>16 they mean and how they apply to prior art or not. I</p> <p>17 mean, that's not what his opinion is. His opinion</p> <p>18 is on secondary consideration.</p> <p>19 MR. TOMASULO: His opinion -- he's offered</p> <p>20 a chart that says that he has applied the claims and</p> <p>21 that the Sony PlayStation product meets the recited</p> <p>22 claim language. I'm entitled to ask anything I want</p> <p>23 about the recited claim language and how he came to</p> <p>24 that opinion. He created a chart. I'm entitled to</p> <p>25 ask him about every single word in that chart. Do</p>

<p style="text-align: right;">Page 118</p> <p>1 you disagree?</p> <p>2 MR. HANNAH: Ask about the chart, then.</p> <p>3 You're not asking about the chart.</p> <p>4 MR. TOMASULO: I'm asking about the</p> <p>5 patent.</p> <p>6 MR. HANNAH: You're asking about UDP,</p> <p>7 TCP/IP. It has nothing to do with that chart.</p> <p>8 MR. TOMASULO: It's in the patent. I can</p> <p>9 ask about anything I want in the patent. Come on.</p> <p>10 Q So what's the difference between</p> <p>11 broadcasting and multicasting?</p> <p>12 MR. HANNAH: Objection. Form. Outside</p> <p>13 the scope.</p> <p>14 THE WITNESS: So as a general matter,</p> <p>15 broadcasting involves the transmission of a packet</p> <p>16 from a sending node to all of the destination nodes</p> <p>17 in the network, whereas multicasting, generally</p> <p>18 speaking, involves the transmission of a packet from</p> <p>19 a sending node to a plurality of destination nodes</p> <p>20 in the network where that plurality might be a</p> <p>21 subset of all the nodes in the network.</p> <p>22 MR. TOMASULO: Okay. We'll mark Professor</p> <p>23 Goodrich's declaration as the next exhibit.</p> <p>24 What is that going to be?</p> <p>25 THE REPORTER: No. 5.</p>	<p style="text-align: right;">Page 120</p> <p>1 A It says in paragraph 40: "More</p> <p>2 particularly, the '147 patent describes methods for</p> <p>3 disconnecting a node (either in a planned or</p> <p>4 unplanned manner) from a broadcast channel that</p> <p>5 overlays a point-to-point network where each node or</p> <p>6 participant is connected to some but not all</p> <p>7 neighboring participants."</p> <p>8 Q Is that a correct description of the '147</p> <p>9 patent, in your opinion?</p> <p>10 A I agree with that high-level description</p> <p>11 of, in general, what the '147 patent is about.</p> <p>12 Q Okay. And then if we go to paragraph 41,</p> <p>13 do you see the statement here: "Such a network</p> <p>14 arrangement where each node in the network is</p> <p>15 connected to the same number of other nodes as --</p> <p>16 known as an m-regular network"?</p> <p>17 A Yes.</p> <p>18 Q Is that, in your view, an accurate</p> <p>19 statement?</p> <p>20 A Yes, I agree with that statement.</p> <p>21 Q And do you agree with the statement that</p> <p>22 "A network is m-regular when each node is connected</p> <p>23 to m other nodes in a steady state and a computer</p> <p>24 will become disconnected from the broadcast channel</p> <p>25 only if all m of the connections to its neighboring</p>
<p style="text-align: right;">Page 119</p> <p>1 (Exhibit 5 was marked for identification</p> <p>2 by the court reporter.)</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q You testified that you read and relied on</p> <p>5 Professor Goodrich's declaration, correct?</p> <p>6 A I did review it in the course of my</p> <p>7 analysis of the evidence, yes.</p> <p>8 Q Okay. And you signed your declaration on</p> <p>9 December 15th, right?</p> <p>10 A Yes.</p> <p>11 Q Okay. And then if you look -- when did he</p> <p>12 sign his declaration?</p> <p>13 A December 12th, 2016.</p> <p>14 Q Okay. So did you review it sometime</p> <p>15 between December 12th and December 15th?</p> <p>16 A Yes.</p> <p>17 Q Is that the first time you saw it?</p> <p>18 A Yes.</p> <p>19 Q If you could turn to page 18. Do you see</p> <p>20 paragraph 40?</p> <p>21 A Yes.</p> <p>22 Q Can you tell me if there's anything -- if</p> <p>23 you view this as a correct statement, the -- the</p> <p>24 second sentence there that begins, "More</p> <p>25 particularly"?</p>	<p style="text-align: right;">Page 121</p> <p>1 nodes fail"? Do you agree with that statement?</p> <p>2 A Yes.</p> <p>3 Q If you go to the next page at the top, do</p> <p>4 you see the first full sentence there states: "The</p> <p>5 '147 patent also describes a computer network in</p> <p>6 which the number of network participants, N, (In</p> <p>7 figure 2 this is 20) is greater than the number of</p> <p>8 connections m to each participant (In this figure 2</p> <p>9 this is 4)"?</p> <p>10 Is that an accurate statement?</p> <p>11 A I agree with that statement.</p> <p>12 Q And the next sentence: "This network</p> <p>13 topology, where no node is connected to every other</p> <p>14 node, is known as an incomplete graph."</p> <p>15 And that's a correct statement, right?</p> <p>16 A Yes.</p> <p>17 Q In the next sentence here it says: "The</p> <p>18 incomplete graph topology relies upon participants</p> <p>19 to disseminate information to other participants."</p> <p>20 Is that a correct statement?</p> <p>21 A Within the context of the '147 patent,</p> <p>22 that's a correct statement, yes.</p> <p>23 Q Okay. And then the next sentence: "As</p> <p>24 described in the '147 patent, to broadcast a</p> <p>25 message, the originating computer sends a message to</p>

<p style="text-align: right;">Page 122</p> <p>1 each of its neighbors using the overlay network."  2 Is that a correct statement?  3 A Yes, that's a correct statement of what's  4 in the specification.  5 Q Okay. And then it says: "Each computer  6 that receives the message then sends the message to  7 its neighbors using the network."  8 Is that a correct statement?  9 A Yes, that's a correct summary of what is  10 described in the patent specification.  11 Q Okay. And then it says: "In this way the  12 message is propagated to the each computer of the  13 overlay network using the underlying network, thus  14 broadcasting the message to each computer over a  15 logical broadcast channel."  16 Is that a correct statement?  17 A Yes.  18 Q And then if we go to the next paragraph,  19 43, it says: "The invention claimed in the '147  20 patent focuses on processes for removing nodes, or  21 participants, from an existing network or healing  22 disconnections when nodes fail or abruptly leave the  23 network."  24 Is that a correct statement?  25 A Yes, those are processes described in the</p>	<p style="text-align: right;">Page 124</p> <p>1 Q Okay. So do you think that's different  2 than what's claimed?  3 A I have not looked at this portion of the  4 patent specification as it relates to the challenged  5 claims in this IPR.  6 Q Isn't this the part of the specification  7 that relates to the claims that are at issue in this  8 IPR?  9 A In the challenged claims it talks about  10 the process of disconnecting from a broadcast  11 channel, but I haven't looked into whether or not  12 the challenged claims are limited to this particular  13 portion of the patent specification.  14 Q Did you read column eight of the patent  15 specification?  16 A Yes.  17 Q Did you read column nine of the patent  18 specification?  19 A Yes.  20 Q So do you agree that the challenged claim  21 is limited to a situation where the network is  22 m-regular and incomplete both before and after the  23 performance of the method?  24 A So which challenged claim are you  25 referring to?</p>
<p style="text-align: right;">Page 123</p> <p>1 patent specification.  2 Q And then it says here: "The challenged  3 claims at issue relate to unplanned disconnections."  4 You agree with that, right?  5 A Yes.  6 Q And then it says: "The -- for example,  7 when a computer leaves the network in an unplanned  8 manner, such as in the event of a power failure, its  9 neighbors discover the computer's absence when each  10 successfully [sic] attempts to send a message to the  11 disconnected computer."  12 And that's a correct statement, right?  13 A "When each unsuccessfully attempts to send  14 a message to the disconnected computer," yes.  15 Q Yes. And then it says: "When a computer  16 detects that one of its neighbors is disconnected,  17 it broadcasts a port connection request over the  18 broadcast channel, indicating that it has an open  19 port that needs a connection and identifying the  20 call-in number for the port."  21 And is that a correct dis- -- is that a  22 correct statement as it pertains to the challenged  23 claims of the '147 patent?  24 A That is a correct statements as it relates  25 to what the patent specification is describing.</p>	<p style="text-align: right;">Page 125</p> <p>1 Q Yeah. That's fine. Let's go to, I  2 believe -- let's start with claim six, I believe is  3 the -- is the independent claim at issue.  4 A So what was your question again?  5 Q Is it, in your opinion, a requirement of  6 claim six that the network be m-regular where m is  7 at least 3 and that it be incomplete both before and  8 after the performance of the claim?  9 MR. HANNAH: Objection. Form.  10 THE WITNESS: Well, as I read claim six,  11 the word "incomplete" doesn't appear. So what  12 claim six says is that the broadcast channel is an  13 m-regular graph where m is at least 3, but it  14 doesn't say whether or not the broadcast channel  15 must be an incomplete graph or not.  16 BY MR. TOMASULO:  17 Q Okay. So can you look at figure 3A.  18 A Yes.  19 Q Okay. So 3A is a 4-regular complete  20 graph; is that correct?  21 A Yes.  22 Q Okay. And if we remove node E --  23 A Okay.  24 Q -- then it would be a 3-regular complete  25 graph, correct?</p>



<p style="text-align: right;">Page 126</p> <p>1 MR. HANNAH: Objection to form.</p> <p>2 THE WITNESS: If you remove node E from</p> <p>3 figure 3A, then it would be a 3-regular complete</p> <p>4 graph.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q Okay. And no new connections would be</p> <p>7 needed to be formed or broken for that to happen,</p> <p>8 right?</p> <p>9 MR. HANNAH: Objection. Form.</p> <p>10 THE WITNESS: I'm not sure.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q Okay. Well, so as a -- as a -- as it is</p> <p>13 now, it's a complete graph because each node has a</p> <p>14 connection to all the other neighbors, right?</p> <p>15 A Correct.</p> <p>16 Q In 3A?</p> <p>17 And then if you remove node E, then A is</p> <p>18 connected to B, C, and D, correct? It already has</p> <p>19 those connections?</p> <p>20 A Okay.</p> <p>21 Q And the same for B? It's connected to A,</p> <p>22 C, and D, right?</p> <p>23 A Hm-hmm.</p> <p>24 Q And the same -- and for C it's connected</p> <p>25 to B, A, and D, right?</p>	<p style="text-align: right;">Page 128</p> <p>1 order to understand the full scope of the claim or</p> <p>2 even the claim term.</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q So you're not able to -- to understand the</p> <p>5 claims right now?</p> <p>6 A I've read and understood the claims.</p> <p>7 Q But right now you're not able to</p> <p>8 understand them?</p> <p>9 MR. HANNAH: Objection. Form.</p> <p>10 THE WITNESS: I am able to understand</p> <p>11 them.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. Are you -- do you under- -- and you</p> <p>14 read Professor Goodrich's declaration, right?</p> <p>15 A Yes.</p> <p>16 Q So let's go to page 21. And do you see he</p> <p>17 has figure 5B there?</p> <p>18 A Yes.</p> <p>19 Q Can you explain in your own words what</p> <p>20 figure 5B is trying to show?</p> <p>21 MR. HANNAH: Objection to form. Outside</p> <p>22 the scope.</p> <p>23 THE WITNESS: Well, I think the patent</p> <p>24 specification makes clear what figure 5B is</p> <p>25 illustrating, which is the unplanned disconnection</p>
<p style="text-align: right;">Page 127</p> <p>1 A Okay.</p> <p>2 Q And D is connected to A, B, and C, right?</p> <p>3 A Okay.</p> <p>4 Q Okay. So does that meet the requirements</p> <p>5 of the graph for it to be m-regular with m is</p> <p>6 greater than 3?</p> <p>7 MR. HANNAH: Objection.</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q Equal to or greater than 3. I'm sorry.</p> <p>10 MR. HANNAH: Objection. Form.</p> <p>11 THE WITNESS: In the steady state you have</p> <p>12 an m-regular complete graph where m is 3.</p> <p>13 BY MR. TOMASULO:</p> <p>14 Q So in your view, would that be -- would</p> <p>15 that meet the limitation of the claim, if you go</p> <p>16 back to the claim language?</p> <p>17 MR. HANNAH: Objection. Form.</p> <p>18 THE WITNESS: I think what you're asking</p> <p>19 for me to do is a -- an analysis of claim six on the</p> <p>20 fly with respect to a particular figure. That's</p> <p>21 typically not how I analyze a claim for the purposes</p> <p>22 of infringement. Usually in analyzing a claim I</p> <p>23 look at the full body of the patent specification,</p> <p>24 not just the particular figure, and in light of</p> <p>25 other inputs, such as claim construction orders, in</p>	<p style="text-align: right;">Page 129</p> <p>1 of computer H from the broadcast channel.</p> <p>2 BY MR. TOMASULO:</p> <p>3 Q Okay. And then walk me through the steps</p> <p>4 that happen.</p> <p>5 MR. HANNAH: Objection to form. Outside</p> <p>6 the scope.</p> <p>7 BY MR. TOMASULO:</p> <p>8 Q Are you able to ask -- are you able to</p> <p>9 apply claim six to 5B?</p> <p>10 A When you say apply claim six to 5B, what</p> <p>11 are you --</p> <p>12 Q Is --</p> <p>13 A -- trying to describe?</p> <p>14 Q Is claim -- does the operation described</p> <p>15 in 5B that you just identified, a unplanned</p> <p>16 disconnection in the E link -- does that meet the</p> <p>17 limitations of claim six in your view?</p> <p>18 MR. HANNAH: Objection to form. Outside</p> <p>19 the scope.</p> <p>20 MR. TOMASULO: How could it possibly be</p> <p>21 outside the scope? It's talked about right here in</p> <p>22 Goodrich's declaration, which he relied on.</p> <p>23 MR. HANNAH: In Good- -- in Goodrich's</p> <p>24 declaration. Counsel, this is a complete waste of</p> <p>25 time and, frankly, money asking him questions about</p>

<p style="text-align: right;">Page 130</p> <p>1 whether drawings infringe the claims when he offers  2 a 15-page dec on secondary considerations. All of  3 these questions are completely outside the scope and  4 unusable in this proceeding.  5 MR. TOMASULO: Okay. It's your opinion.  6 Q Can you answer my question, please?  7 A So the entirety of the '147 patent  8 specification would inform a person of ordinary  9 skill when attempting to understand what claim six  10 means, and figure 5B is one part of the entire  11 specification that would be reviewed when attempting  12 to understand, you know, what claim six is claiming.  13 Q So you can't apply it right now? That's  14 beyond the scope of what you're able to do?  15 A If I were -- if I were to attempt to  16 understand claim six, I would not focus specifically  17 on figure 5B.  18 Q Okay. But when you say attempt to  19 understand claim six, do you understand claim six?  20 A I do understand claim six.  21 Q Okay. And you've charted claim six, in  22 fact, right?  23 A Yes.  24 Q And you have said that all of the  25 limitations of claim six are met by the Sony</p>	<p style="text-align: right;">Page 132</p> <p>1 broadcasting messages between them.  2 Q Okay. And so it says the broadcast  3 channel is m -- is an m-regular graph where m is at  4 least 3.  5 What does that mean to you?  6 A So an m-regular graph is a graph of nodes  7 and links between those nodes in which each node is  8 connected to m other nodes directly using m separate  9 links, and in this particular context of claim six  10 the number for m is 3 -- or at least 3.  11 Q Okay. Meaning 3 or greater?  12 A Three or more, yes.  13 Q And can that include all numbers that are  14 3 or more?  15 MR. HANNAH: Objection. Form.  16 THE WITNESS: M would include all integers  17 that are 3 or greater.  18 BY MR. TOMASULO:  19 Q Okay. What's the minimum number of  20 computers it takes to form a 3-regular graph as  21 claimed -- or 3-regular broadcast channel as claimed  22 in claim six?  23 MR. HANNAH: Objection. Form.  24 THE WITNESS: The minimum number of links  25 or nodes; is that your question?</p>
<p style="text-align: right;">Page 131</p> <p>1 PlayStation, correct?  2 A I've said that each of the limitations in  3 claim six maps to functionality identified in the  4 PlayStation products, and as such it's highly likely  5 that the PlayStation product is practicing the  6 invention.  7 Q Okay. So let's look at claim six. What  8 -- what do you understand the term "a method for  9 healing a disconnection of a first computer from a  10 second computer" -- what do you understand that to  11 mean?  12 MR. HANNAH: Objection. Form.  13 THE WITNESS: So that means that this  14 claim is referring to a disconnection method and a  15 healing that takes place in communication between a  16 first and second -- first and second computer where  17 the disconnection has taken place over the broadcast  18 channel.  19 BY MR. TOMASULO:  20 Q Okay. And the computer is being connected  21 to a broadcast channel.  22 What is a broadcast channel?  23 A So a broadcast channel overlays an  24 underlying point-to-point communications network and  25 is used by two computer nodes in the network for</p>	<p style="text-align: right;">Page 133</p> <p>1 BY MR. TOMASULO:  2 Q Nodes.  3 A Nodes. The minimum number of nodes in a  4 3-regular graph is your question?  5 Q Correct.  6 A That would be four nodes.  7 Q Okay. So is it your opinion -- now, if  8 you have three nodes -- if you have four nodes and  9 it's 3-regular, that's a complete graph, right?  10 MR. HANNAH: Objection to form.  11 THE WITNESS: Generally speaking, yes.  12 BY MR. TOMASULO:  13 Q Okay. So is that an -- is that -- does  14 that meet the term of this claim that the m-regular  15 -- that -- in other words, does that meet this  16 limitation if the broadcast channel has four nodes  17 and this 3-regular? Does that meet the term -- this  18 term here?  19 MR. HANNAH: Objection. Form.  20 THE WITNESS: That would be one  21 possibility.  22 BY MR. TOMASULO:  23 Q So it does -- it can meet it, in other  24 words? I'm not saying it's the only thing that  25 meets it. But in your opinion a -- a broadcast</p>

<p style="text-align: right;">Page 134</p> <p>1 channel that has four nodes that is 3-regular meets 2 that limitation? 3 A If you pull that limitation out and look 4 at it -- looking at it stand-alone without the 5 context of the rest of claim six, then, yes, that's 6 true. 7 Q Okay. What is the minimum number of nodes 8 that is required to perform claim six -- 9 MR. HANNAH: Objection. Form. 10 BY MR. TOMASULO: 11 Q -- nodes or computers? 12 A That's going to take some thought because 13 in claim six you have a broadcast channel that 14 exists in three different states. There's the state 15 before disconnection. There's the state during 16 disconnection, and there's the state after 17 disconnection. And the number of nodes in the -- in 18 the different states can be different. So I'd have 19 to think about that. 20 Q Okay. So if we look at figure 5B, does 21 this -- does this 5B represent the three states that 22 you described: The state before the disconnection 23 would be when H is connected to I, A, F, and E; and 24 the state after disconnection would be there are new 25 connections between I and E -- I'm sorry -- I and F</p>	<p style="text-align: right;">Page 136</p> <p>1 saying that the attempt to send the message, which 2 was described in the first part of the method, is 3 unsuccessful, then the first computer will broadcast 4 a type of message that is called a connection port 5 search message to indicate that this first computer 6 needs a connection. 7 Q What's connection port search message? 8 MR. HANNAH: Objection. Form. 9 THE WITNESS: So a connection port search 10 message is a type of message that the first computer 11 will send to indicate that it needs a connection. 12 BY MR. TOMASULO: 13 Q What is port? Do you know what that term 14 means? 15 A In what context? 16 Q In the context of this claim. 17 A So the word "port" falls within the claim 18 term "connection port search message," which is a 19 claim term that is described in the patent 20 specification. 21 Q What is a port in general computer science 22 terms? 23 MR. HANNAH: Objection. Form. 24 THE WITNESS: So as a general matter, a -- 25 the generic term "port" would refer to a -- an</p>
<p style="text-align: right;">Page 135</p> <p>1 and A and E? 2 A So figure 5B is a snapshot of the network 3 and is not really depicting a sequence of operations 4 that's happening within different states of the 5 network. 6 Q What does the phrase "may attempt to send 7 a message from the first computer to the second 8 computer" -- what does that mean? 9 MR. HANNAH: Objection to form. 10 THE WITNESS: So that's the first part of 11 the method that is described in claim six where an 12 attempt is made to send a message from one computer 13 to another one. 14 BY MR. TOMASULO: 15 Q Okay. And then what is the next -- the 16 next element -- it says: "When the attempt to send 17 the message is unsuccessful, broadcasting from the 18 first computer a connection port search message 19 indicating that the first computer needs a 20 connection." 21 Do you understand that element? 22 A Yes. 23 Q Okay. And what -- what do you understand 24 that element to require? 25 A This claim element is, generally speaking,</p>	<p style="text-align: right;">Page 137</p> <p>1 identifier for use in identifying connections to a 2 network node. 3 BY MR. TOMASULO: 4 Q And one example of a port is a TCP/IP 5 port, right? 6 MR. HANNAH: Objection. Form of the 7 question. 8 THE WITNESS: A TCP/IP port is generally a 9 socket identifier at the TCP level that identifies 10 TCP connections. 11 BY MR. TOMASULO: 12 Q The TCP/IP protocol allocates something 13 like 65,000 ports, right? 14 A The -- 15 MR. HANNAH: Objection. Form. 16 THE WITNESS: The port number is a 16-bit 17 number. And -- which means that the port number can 18 take any of 2 to the 16 possible values, 19 theoretically. 20 BY MR. TOMASULO: 21 Q Let's go to column 6 of the patent, line 22 10. 23 A Which column again? 24 Q Six. 25 A Okay. Column -- line 10?</p>

<p style="text-align: right;">Page 138</p> <p>1 Q Yeah.</p> <p>2 A Got it.</p> <p>3 Q "Each computer connected to the broadcast</p> <p>4 channel allocates five communication ports for</p> <p>5 communicating with other computers. Four of the</p> <p>6 ports are referred to as internal ports because they</p> <p>7 are the ports through which the messages of the</p> <p>8 broadcast channel are sent."</p> <p>9 What's your understanding of what's meant</p> <p>10 here?</p> <p>11 MR. HANNAH: Objection to form.</p> <p>12 THE WITNESS: So what this sentence is</p> <p>13 attempting to -- to convey to a person of ordinary</p> <p>14 skill is that the computers that are part of the</p> <p>15 broadcast channel, through their connections to the</p> <p>16 broadcast channel, will maintain five identifiers of</p> <p>17 communication ports that are used for communicating</p> <p>18 with other computers.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q Okay. And those are going to be the</p> <p>21 messages through which the broadcast channel</p> <p>22 messages are sent, right?</p> <p>23 MR. HANNAH: Objection. Form.</p> <p>24 THE WITNESS: So the computers will use</p> <p>25 those five different identifiers to identify the</p>	<p style="text-align: right;">Page 140</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q And those TCP/IP ports are identified by</p> <p>3 numbers 0 to 65,535, right?</p> <p>4 A Yes.</p> <p>5 Q Okay. Does the patent talk about any</p> <p>6 other types of ports?</p> <p>7 A I haven't looked at the specification with</p> <p>8 that question in mind. I don't know.</p> <p>9 Q What other types of ports can you</p> <p>10 identify?</p> <p>11 A In what context?</p> <p>12 MR. HANNAH: Objection to form.</p> <p>13 BY MR. TOMASULO:</p> <p>14 Q Computers.</p> <p>15 A Not boating or wine?</p> <p>16 Q Or wine. Not that either.</p> <p>17 MR. HANNAH: Objection. Form. Outside</p> <p>18 the scope.</p> <p>19 THE WITNESS: Again, without having read</p> <p>20 through the entire specification with that in mind,</p> <p>21 the things that come to mind are, for example, what</p> <p>22 the patent describes in column 1, the UNIX pipes.</p> <p>23 There are TCP/IP ports, and then there are also UDP</p> <p>24 ports as three possibilities.</p> <p>25 //</p>
<p style="text-align: right;">Page 139</p> <p>1 connections to the other computers in the broadcast</p> <p>2 channel that it's directly connected to.</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q And if we go to the next paragraph, it</p> <p>5 says: "In one embodiment the broadcast technique</p> <p>6 establishes the computer connections using the</p> <p>7 TCP/IP communications protocol, which is a</p> <p>8 point-to-point protocol, as the underlying network."</p> <p>9 Do you see that?</p> <p>10 A Yes.</p> <p>11 Q Then it says: "TCP/IP protocol provides</p> <p>12 for reliable and ordered delivery of messages</p> <p>13 between computers."</p> <p>14 Do you see that?</p> <p>15 A Yes.</p> <p>16 Q And "TCP/IP protocol provides each</p> <p>17 computer with a port space that is shared amongst</p> <p>18 all the processes that may execute on that</p> <p>19 computer," right?</p> <p>20 A Yes.</p> <p>21 Q And so this is a type of port, a TCP/IP</p> <p>22 port or port space?</p> <p>23 A Yes.</p> <p>24 MR. HANNAH: Objection to form.</p> <p>25 //</p>	<p style="text-align: right;">Page 141</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q Okay. So each of those could establish a</p> <p>3 port or has port space; is that right?</p> <p>4 A Each one of those networking protocols --</p> <p>5 MR. HANNAH: Objection. Form.</p> <p>6 THE WITNESS: Each one of those network</p> <p>7 protocols would have within it the concept of a</p> <p>8 port.</p> <p>9 BY MR. TOMASULO:</p> <p>10 Q Okay. Anything else you can think of that</p> <p>11 could be a port, as described in the patent?</p> <p>12 A So there are other network protocols which</p> <p>13 also have this concept of a port that's used for</p> <p>14 point-to-point communications.</p> <p>15 Q Such as ...?</p> <p>16 A Frame relay or ATM or X.25 or IPX or S&amp;A</p> <p>17 and probably a few others.</p> <p>18 Q Okay. If you go to Dr. Goodrich's</p> <p>19 declaration back on page 21 of his declaration,</p> <p>20 paragraph 44, do you see: "When each of H's</p> <p>21 computers --" I'm sorry. "When each of computer H's</p> <p>22 neighbors discovers that H has disconnected, it</p> <p>23 broadcasts a port connection request, indicating it</p> <p>24 needs to fill an empty port," right? Do you see</p> <p>25 that?</p>

<p style="text-align: right;">Page 142</p> <p>1 A Yes.</p> <p>2 Q And if we go back to the patent, we see</p> <p>3 that if we go to par- -- column 9, line 31, 32, 33,</p> <p>4 it says: "When a connected computer detects that</p> <p>5 one of its neighbors is now disconnected, it</p> <p>6 broadcasts a port connection request on the</p> <p>7 broadcast channel, which indicates that it has one</p> <p>8 internal port that needs a connection."</p> <p>9 Is it a requirement of claim six that the</p> <p>10 port connection request be broadcast on the</p> <p>11 broadcast channel and indicate that there -- that</p> <p>12 the broadcaster has one internal port that needs a</p> <p>13 connection?</p> <p>14 MR. HANNAH: Objection to form.</p> <p>15 THE WITNESS: I don't remember those exact</p> <p>16 words being used in claim six.</p> <p>17 BY MR. TOMASULO:</p> <p>18 Q Okay. It says -- next it says: "The</p> <p>19 port --" this document, column 9, says: "The port</p> <p>20 connection request identifies the call-in port of</p> <p>21 the requesting computer."</p> <p>22 Is it a requirement of claim six that port</p> <p>23 connection request -- would it identify the call-in</p> <p>24 port of the requesting computer?</p> <p>25 MR. HANNAH: Objection. Form.</p>	<p style="text-align: right;">Page 144</p> <p>1 referring to as a link that exists between two</p> <p>2 network nodes in a broadcast channel.</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q What is a link?</p> <p>5 MR. HANNAH: Objection. Form.</p> <p>6 THE WITNESS: A link is a communication</p> <p>7 pathway that's established between two nodes in the</p> <p>8 network.</p> <p>9 BY MR. TOMASULO:</p> <p>10 Q Are all communication pathways between two</p> <p>11 nodes a link or an edge?</p> <p>12 A No.</p> <p>13 Q Okay. How do we separate the</p> <p>14 communication pathways between two nodes that are an</p> <p>15 edge, in your view, and those that are not an edge,</p> <p>16 in your view? Is there a rule that you apply?</p> <p>17 MR. HANNAH: Objection. Form.</p> <p>18 THE WITNESS: Yes, so within the context</p> <p>19 of the point-to-point communications network, an</p> <p>20 edge would form a direct link between the two nodes</p> <p>21 that are in the point-to-point communications</p> <p>22 network, irrespective of any underlying -- any --</p> <p>23 irrespective of any -- any underlying equipment in</p> <p>24 the pathway.</p> <p>25 //</p>
<p style="text-align: right;">Page 143</p> <p>1 THE WITNESS: I don't -- I don't remember</p> <p>2 that exact language being used in claim six. I</p> <p>3 don't think it appears there.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q What -- is -- what -- what do you think</p> <p>6 "connection port search message" means?</p> <p>7 A Well, to give an accurate definition of</p> <p>8 "connection port search message," I'd have to go</p> <p>9 back through the specification with that question in</p> <p>10 mind to provide a precise answer. In reading</p> <p>11 claim six, it's clear to me that a connection port</p> <p>12 search message is a message that the first computer</p> <p>13 sends to indicate that it needs a connection.</p> <p>14 Q Okay. And when we go back to paragraph 24</p> <p>15 of your declaration on page 7, do you understand</p> <p>16 what the term "edge" means?</p> <p>17 A You said page 7, right?</p> <p>18 Q Page -- I'm saying on page 7, paragraph 24</p> <p>19 of your declaration where you say that the --</p> <p>20 you've -- you've offered the definition of the term</p> <p>21 "connection" and "connected."</p> <p>22 A Yes, I see that.</p> <p>23 Q Okay. What is an edge?</p> <p>24 MR. HANNAH: Objection. Form.</p> <p>25 THE WITNESS: So an edge is what I've been</p>	<p style="text-align: right;">Page 145</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q Okay. I'm not -- so the edge refers to</p> <p>3 the point-to-point direct link that is made in the</p> <p>4 point-to-point network? Am I following?</p> <p>5 MR. HANNAH: Objection. Form.</p> <p>6 THE WITNESS: So in the point-to-point</p> <p>7 communications network there are a number of nodes,</p> <p>8 and those nodes are linked or connected to one</p> <p>9 another using lines that we call links or edges that</p> <p>10 form direct connections between the nodes in the</p> <p>11 point-to-point communications network.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. And are those different than the</p> <p>14 edges that you talk about in paragraph 24 or are</p> <p>15 those the edges?</p> <p>16 A Those are the edges.</p> <p>17 Q So an example of an edge would be a TCP/IP</p> <p>18 connection?</p> <p>19 MR. HANNAH: Objection to the form of the</p> <p>20 question.</p> <p>21 THE WITNESS: An example of an edge would</p> <p>22 be a link between two network nodes in a</p> <p>23 point-to-point communications network.</p> <p>24 BY MR. TOMASULO:</p> <p>25 Q And could that be a TCP/IP connection or</p>

<p style="text-align: right;">Page 146</p> <p>1 not?</p> <p>2 MR. HANNAH: Objection to the form of the</p> <p>3 question.</p> <p>4 THE WITNESS: Two nodes in a</p> <p>5 point-to-point communications network can establish</p> <p>6 a link or an edge using the TCP/IP protocol to form</p> <p>7 those connections.</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q So the presence of a TCP/IP link or edge</p> <p>10 would be evidence that the nodes were connected?</p> <p>11 MR. HANNAH: Objection. Form.</p> <p>12 THE WITNESS: The establishment of a link</p> <p>13 between two nodes and a point-to-point</p> <p>14 communications network means that those two nodes,</p> <p>15 as far as the underlying network goes, are</p> <p>16 connected, but it does not mean that -- for the</p> <p>17 broadcast channel that overlays the point-to-point</p> <p>18 communications network, it does not mean that they</p> <p>19 are connected at the broadcast channel.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q So it's irrelevant to whether they're</p> <p>22 connected at the broadcast channel?</p> <p>23 MR. HANNAH: Objection. Form.</p> <p>24 THE WITNESS: I would say they're</p> <p>25 different things. The broadcast channel overlays</p>	<p style="text-align: right;">Page 148</p> <p>1 A They may or may not.</p> <p>2 Q Okay. And is it detectable -- what --</p> <p>3 what -- I mean, I'm assuming that it's a requirement</p> <p>4 of the claim that there be an edge, right;</p> <p>5 otherwise, it's not connected?</p> <p>6 MR. HANNAH: Objection. Form.</p> <p>7 THE WITNESS: The claim requires for m to</p> <p>8 be at least 3.</p> <p>9 BY MR. TOMASULO:</p> <p>10 Q The computers need to be connected to a</p> <p>11 broadcast channel, right?</p> <p>12 A Yes.</p> <p>13 Q Okay. So not all computers are connected</p> <p>14 to all broadcast channels, right?</p> <p>15 A It is certainly possible for computers in</p> <p>16 the point-to-point communications network to not be</p> <p>17 part of the broadcast channel.</p> <p>18 Q Okay. So how do you determine whether a</p> <p>19 computer is connected to the broadcast channel?</p> <p>20 What indicia is there? What evidence would there be</p> <p>21 that would allow an expert like you to say this one</p> <p>22 is connected and this one is not?</p> <p>23 A You'd have to look at the broadcast</p> <p>24 channel itself, which is overlaid over the</p> <p>25 point-to-point communications network.</p>
<p style="text-align: right;">Page 147</p> <p>1 the underlying point-to-point communications</p> <p>2 network, and, as such, there could be communications</p> <p>3 formed in the point-to-point communications network</p> <p>4 that are not part of any broadcast channel.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q But is it correct that all of the</p> <p>7 connections that are formed between two application</p> <p>8 programs that form an edge, that those will also be</p> <p>9 reflected by a link at the point-to-point network?</p> <p>10 MR. HANNAH: Objection. Form of the</p> <p>11 question.</p> <p>12 THE WITNESS: So I -- within the context</p> <p>13 of what the '147 patent specification is describing,</p> <p>14 two application programs are connect through the</p> <p>15 logical broadcast channel, which is different than a</p> <p>16 connection at a point-to-point communications</p> <p>17 network level.</p> <p>18 BY MR. TOMASULO:</p> <p>19 Q And so what does it take for them to be --</p> <p>20 not -- not all application programs are -- have an</p> <p>21 edge between them, right?</p> <p>22 A That's not necessarily the case.</p> <p>23 Q Okay. So not -- they don't -- all</p> <p>24 application programs don't have an edge between</p> <p>25 them, right?</p>	<p style="text-align: right;">Page 149</p> <p>1 Q So what -- what would you look -- what</p> <p>2 would be an example of how you would do that? How</p> <p>3 would you look for a broadcast channel? You said</p> <p>4 you would have to look at the broadcast channel.</p> <p>5 How would you find one?</p> <p>6 A So as I had mentioned earlier, a broadcast</p> <p>7 channel is implemented as an overlay at a higher</p> <p>8 layer than the point-to-point network protocol that</p> <p>9 underlies it. So that implementation of the</p> <p>10 broadcast channel would establish connections</p> <p>11 between computers at the level of the broadcast</p> <p>12 channel, and it's those connections that are formed</p> <p>13 by the broadcast channel, which is existing at a</p> <p>14 layer higher than the point-to-point communications</p> <p>15 network. It's those connections that you would have</p> <p>16 to look for.</p> <p>17 Q And how would you do that?</p> <p>18 A By examining the function and operation of</p> <p>19 the network nodes at the -- at the -- at the level</p> <p>20 of the broadcast channel.</p> <p>21 Q And how would you do that?</p> <p>22 MR. HANNAH: Objection. Form.</p> <p>23 THE WITNESS: Through a variety of</p> <p>24 methods. Through the depositions of witnesses.</p> <p>25 Through the examination of technical documentation.</p>

<p style="text-align: right;">Page 150</p> <p>1 Through the examination of publicly available  2 documentation. Through looking at source code.  3 Through a wide variety of statements that are made  4 in licensing agreements. Through all kinds of  5 things.  6 BY MR. TOMASULO:  7 Q What about testing?  8 A Through -- physical testing is also one of  9 the possibilities for evidence to examine, yes.  10 Q Okay. So how would you test for the  11 presence of a broadcast channel that meets the  12 limitations of the claims?  13 MR. HANNAH: Objection. Form. Outside  14 the scope.  15 THE WITNESS: It depends on the product  16 that I'm examining how the test would be set up.  17 BY MR. TOMASULO:  18 Q Okay. But you could use a -- the  19 Wireshark, right?  20 MR. HANNAH: Objection. Form.  21 THE WITNESS: Depending on the particular  22 product I'm looking at, possibly.  23 BY MR. TOMASULO:  24 Q Okay. And so you've talked about the  25 license between Sony and Boeing as being irrelevant</p>	<p style="text-align: right;">Page 152</p> <p>1 A I remember that it was a portfolio, but I  2 don't recall the exact number.  3 Q And your -- your testimony is that the  4 licensing of the portfolio means that the '147  5 patent is valid?  6 A The licensing of the portfolio, which  7 includes the '147 patent, is an indication that it  8 is likely that the licensee believes that their  9 product may infringe the '147 patent.  10 Q There's no services associated with the  11 license, right? It's a bare license? Just you get  12 the patents and that's it, right?  13 A As far as I understand, it's a license  14 that allows the invention to be practiced.  15 Q Okay. And there was two -- the six  16 asserted patents and then some other patents as  17 well, right?  18 A I don't remember the exact number, but I  19 do know that there were several patents involved in  20 that licensing agreement.  21 Q And not all of them are asserted here,  22 right? You know that? Two weren't?  23 A As far as I understand, there are only two  24 patents going through these IPR proceeding.  25 Q Well, you also offer testimony as to three</p>
<p style="text-align: right;">Page 151</p> <p>1 to the validity of the patents; is that right?  2 A I have talked about the license between  3 Sony and Boeing as an indication that the '147  4 patent is nonobvious.  5 Q And what is the thought process there?  6 Why does somebody taking a license have anything to  7 do with the nonobviousness or obviousness of a  8 patent?  9 A Well, because if the patented invention  10 was truly obvious, then there would be no need to  11 take a license.  12 Q Okay. Couldn't someone take a license for  13 a matter of convenience to avoid litigation?  14 MR. HANNAH: Objection to form.  15 THE WITNESS: It's possible for someone to  16 take a license to avoid litigation. There's a  17 feeling that -- if there's a feeling that it's  18 likely that their products infringe.  19 BY MR. TOMASULO:  20 Q Okay. So that's the only circumstance  21 that you think someone could take a license?  22 A That's one possibility.  23 Q Okay. Are all the patents -- so how many  24 patents were licensed in the Sony agreement; do you  25 recall?</p>	<p style="text-align: right;">Page 153</p> <p>1 other patents, right? So there's at least five  2 patents going through the IPR proceedings.  3 A So for what I understand --  4 MR. HANNAH: Objection. Form. Outside  5 the scope.  6 THE WITNESS: From what I understand, I'm  7 only being deposed on two patents going through the  8 IPR proceedings.  9 BY MR. TOMASULO:  10 Q That is correct. But what I'm saying is  11 that there are -- let me ask a different question  12 here.  13 So is it possible that one of the patents  14 was the only patent that Sony wanted? Have you --  15 have you done anything to investigate that?  16 A I have not seen any evidence to suggest  17 that.  18 Q Okay. And you haven't had an opportunity  19 to look at the licensing history or any  20 correspondence between Sony and Boeing, right?  21 A I have not seen anything in the evidence  22 that I've looked at to suggest your hypothetical.  23 Q Well, no. My question was a different  24 question. I said you haven't had an opportunity to  25 look at the licensing history or any correspondence</p>

<p style="text-align: right;">Page 154</p> <p>1 between Boeing and Sony, right? You haven't looked 2 at that? 3 A Not outside of what I've disclosed as 4 evidence that I've relied upon. 5 Q And so the -- the -- do you consider the 6 value paid, the 750,000 or whatever it is that's -- 7 I guess, 900,000, according to you, that -- do you 8 consider that to be significant or insignificant? 9 MR. HANNAH: Objection. Form. 10 THE WITNESS: I have not made any 11 determination of the significance of the dollar 12 amount of the license itself. 13 BY MR. TOMASULO: 14 Q Okay. But if they took a license for a 15 dollar, would that suggest to you that the patents 16 were valid? 17 A Not necessarily. 18 Q Or if it -- you know, some other, I mean, 19 nuisance amount that just says it's less expensive 20 than these proceedings or maybe I might need them in 21 the future, but if it's just nuisance money does it 22 still make the case, in your -- by your way of 23 thinking, that it is relevant to the obviousness 24 analysis or does it have to be a license that is a 25 fair market license, let's say?</p>	<p style="text-align: right;">Page 156</p> <p>1 MR. HANNAH: Objection. Form. 2 THE WITNESS: As far as I understand it, 3 in license agreements there are a number of possible 4 things that are negotiated in the agreement, 5 potentially, in addition to simply cash 6 transactions. But I have not read the license 7 agreement with the -- with the question in mind as 8 to whether or not the cash transaction would be 9 considered a nuisance payment or not. 10 BY MR. TOMASULO: 11 Q Okay. Oh. But if it is a nuisance 12 payment, then it really doesn't support the idea 13 that the license makes the patent somehow 14 nonobvious, right? 15 MR. HANNAH: Objection. Form. 16 BY MR. TOMASULO: 17 Q Let's say this -- 18 A Well, as I said earlier, I'm not qualified 19 to render an opinion on what's considered a nuisance 20 money to begin with let alone base -- use that as a 21 basis for an opinion. 22 Q But -- so if somebody gave Sony a free 23 license, would you think that it made the patents 24 somehow nonobvious? 25 MR. HANNAH: Objection to form.</p>
<p style="text-align: right;">Page 155</p> <p>1 MR. HANNAH: Objection. Form of the 2 question. 3 BY MR. TOMASULO: 4 Q Just any old license does the trick, in 5 your book? 6 A So I have no opinion on what constitutes 7 nuisance money and don't feel qualified to render an 8 opinion on what would constitute nuisance money in a 9 license agreement. 10 Q In your view -- so you can't say if this 11 is nuisance money or not? 12 A So -- 13 MR. HANNAH: Objection. Form. 14 THE WITNESS: It was not my role in this 15 case to determine whether or not the amount of money 16 in the license agreement was considered nuisance 17 money, and I don't feel qualified to offer an 18 opinion as to whether the amount of money in the 19 license agreement is or is not nuisance money. 20 BY MR. TOMASULO: 21 Q Okay. So if it was nuisance money, then 22 it really would be pretty immaterial to the 23 obviousness of the patent; would you agree with that 24 because -- so the dollar wouldn't, you know, mean 25 that the patents were valid, right?</p>	<p style="text-align: right;">Page 157</p> <p>1 THE WITNESS: Not necessarily. 2 BY MR. TOMASULO: 3 Q Okay. So if it's -- if it's free, it 4 doesn't -- it doesn't count towards the obviousness 5 analysis, right? 6 MR. HANNAH: Objection. Form. 7 THE WITNESS: The amount of money was not 8 the issue that I looked at in the license agreement. 9 What I looked at in the license agreement was the 10 fact that a license was taken for these patents for 11 this '147 patent when Sony did not have to take the 12 license in the first place. So the fact that they 13 actually took a license is an indication that an 14 analysis was likely performed by Sony and a 15 determination was made that it is possible that Sony 16 products are infringing the '147 patent. 17 MR. HANNAH: Is it a good time for a 18 break? 19 MR. TOMASULO: Sure. Fifteen minutes? 20 MR. HANNAH: Sure. 21 MR. TOMASULO: How long have we been on 22 the record? 23 THE VIDEOGRAPHER: Three hours, forty-five 24 minutes. 25 Going off record at 2:28 p.m.</p>



<p style="text-align: right;">Page 158</p> <p>1 (Recess.)</p> <p>2 THE VIDEOGRAPHER: Back on the record at</p> <p>3 2:45 p.m.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q One of the things you say in paragraph 31</p> <p>6 is that it's your opinion that the increase in sales</p> <p>7 was due in part because of Sony's license to the</p> <p>8 '147 patent.</p> <p>9 Do you see that?</p> <p>10 A Yes.</p> <p>11 Q Okay. And what's your basis for that</p> <p>12 statement?</p> <p>13 A The basis of the statement is the time</p> <p>14 frame in which the license was taken was right</p> <p>15 before there was a ramp-up in sales of the</p> <p>16 PlayStation 3 product, which is likely to have</p> <p>17 included the '147 patent inventions based on the</p> <p>18 fact that that license was taken at that time, and</p> <p>19 then, given the sales increase which occurred</p> <p>20 afterwards, it's indicative that the incorporation</p> <p>21 of the '147 patent ideas was contributing to the</p> <p>22 commercial success of the PlayStation 3.</p> <p>23 Q Do you have anything else that supports</p> <p>24 your opinion or is this just everything in this</p> <p>25 paragraph here?</p>	<p style="text-align: right;">Page 160</p> <p>1 A I have not looked at a Blu-ray player for</p> <p>2 secondary considerations of nonobviousness.</p> <p>3 MR. TOMASULO: Okay. I'd like to mark as</p> <p>4 Exhibit --</p> <p>5 THE REPORTER: 6.</p> <p>6 MR. TOMASULO: 6.</p> <p>7 (Exhibit 6 was marked for identification</p> <p>8 by the court reporter.)</p> <p>9 MR. HANNAH: And while we're marking that,</p> <p>10 I'd like to designate for the record the transcript</p> <p>11 as Protective Order Material.</p> <p>12 MR. TOMASULO: Okay.</p> <p>13 MR. HANNAH: Can I get a copy?</p> <p>14 MR. TOMASULO: Oh, yeah. I'm sorry.</p> <p>15 Q Have you seen this article before?</p> <p>16 A Yeah, I don't remember this.</p> <p>17 Q Okay. If you look at the second page,</p> <p>18 there -- the first line here --</p> <p>19 MR. HANNAH: I'm going to object to this</p> <p>20 exhibit as lacking foundation.</p> <p>21 BY MR. TOMASULO:</p> <p>22 Q Do you see where it says: "Even if you</p> <p>23 look past the price differences, the argument for</p> <p>24 buying a PS3 instead of current Blu-ray players are</p> <p>25 overwhelming"? Do you see that sentence?</p>
<p style="text-align: right;">Page 159</p> <p>1 A It's just what's in this paragraph.</p> <p>2 Q Okay. And did you make any effort to</p> <p>3 determine what other features were potentially</p> <p>4 driving sales?</p> <p>5 A No.</p> <p>6 Q And -- and so you don't really know if the</p> <p>7 sales were entirely attributable to other features</p> <p>8 that have nothing to do with the patent, right?</p> <p>9 A Right.</p> <p>10 Q And, for instance, do you know when Sony</p> <p>11 began including a Blu-ray player with its</p> <p>12 PlayStation products?</p> <p>13 A What's the question?</p> <p>14 Q Do you know when Sony began including a</p> <p>15 Blu-ray player with its PlayStation products?</p> <p>16 A I don't know the exact time.</p> <p>17 Q And can we agree that a Blu-ray player is</p> <p>18 not accused in this case?</p> <p>19 MR. HANNAH: Objection. Form.</p> <p>20 THE WITNESS: This case is an IPR</p> <p>21 petition. I don't know that --</p> <p>22 BY MR. TOMASULO:</p> <p>23 Q Can I -- can we agree that you have not</p> <p>24 opined that the significance of a Blu-ray player is</p> <p>25 connected to the '147 patent?</p>	<p style="text-align: right;">Page 161</p> <p>1 A Yes.</p> <p>2 Q Okay. And PS3 means PlayStation 3, right?</p> <p>3 A Yes.</p> <p>4 Q Okay. Is this article saying that there's</p> <p>5 a good argument to be made that you should buy a</p> <p>6 PlayStation 3 and use it as a Blu-ray player, right?</p> <p>7 MR. HANNAH: Objection. Form.</p> <p>8 THE WITNESS: Yeah, it appears this -- the</p> <p>9 author of this article is writing about the Blu-ray</p> <p>10 feature in the PlayStation 3.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q Okay. Then that's not something you</p> <p>13 considered, the desirability of this Blu-ray player</p> <p>14 in the PS3? That's not something you considered in</p> <p>15 forming your opinions, right?</p> <p>16 A In forming my opinions I didn't look at</p> <p>17 the functionality of the Blu-ray player in the</p> <p>18 PlayStation 3.</p> <p>19 Q Okay.</p> <p>20 Next.</p> <p>21 (Exhibit 7 was marked for identification</p> <p>22 by the court reporter.)</p> <p>23 BY MR. TOMASULO:</p> <p>24 Q So what's been placed before you is</p> <p>25 something that's been marked by your -- and it's</p>

<p style="text-align: right;">Page 162</p> <p>1 referred to in your declaration as Exhibit 2016,  2 2-0-1-6.  3 Do you see that?  4 A Yes.  5 Q And that's been marked as Exhibit 7.  6 What is Exhibit 7?  7 A So Exhibit 7 is a chart that I created  8 that consolidates the evidence that I relied on to  9 show the -- that the Play- -- that there's a nexus  10 between the functionality in the PlayStation product  11 and the invention described in the '147 patent.  12 Q So you created this?  13 A Yes, in collaboration with counsel.  14 Q Okay. And then did you find the -- the  15 exhibits and things like that that are identified in  16 here? You have Exhibit 2029 and so on and so forth.  17 Is that information that you, yourself, went out and  18 found or was that curated and provided to you by --  19 by counsel?  20 A I don't know about "curated," but counsel  21 did provide the links that are shown here in the  22 claim charts.  23 Q I see. Did you do any independent  24 investigation?  25 A I did not on my own investigate any links</p>	<p style="text-align: right;">Page 164</p> <p>1 A So what I mean by that is that the  2 evidence that I have cited in the chart in this  3 exhibit -- that evidence describes at a high level  4 how the PlayStation product functions, and it's  5 clear from reviewing this high-level description of  6 the PlayStation product functionality that the  7 PlayStation product appears likely to implement what  8 is described in claim six as a method for healing  9 the disconnection of a first computer from a second  10 computer that are connected to the broadcast  11 channel.  12 Q Okay. And so the next sentence down says:  13 "The Sony PlayStation product includes functionality  14 for healing a disconnection of a first computer from  15 a second computer, the computers being connected to  16 a broadcast channel, said broadcast channel being an  17 m-regular graph where m is at least 3."  18 What is the evidence that the Sony  19 PlayStation product has this functionality? Do you  20 cite any evidence for this sentence?  21 A So throughout the evidence in this chart,  22 it appears that the Sony PlayStation product is  23 designed to be used by at least three players. For  24 example, on page 4 on the hypotheticals posed in the  25 evidence suppose we have three players in a</p>
<p style="text-align: right;">Page 163</p> <p>1 outside of what's in the claim chart.  2 Q Got it. Okay. So the information that  3 you used to form your opinions as expressed in this  4 claim chart was all provided to you by counsel,  5 right?  6 A Correct.  7 Q Okay. And then you didn't go outside of  8 that or look for anything else to validate or verify  9 it, correct?  10 A Correct.  11 Q And you did not ever look or touch or  12 physically play a Sony PlayStation product, correct?  13 A Correct.  14 Q And to confirm, you are now -- you have  15 said that this is not actually an allegation of  16 infringement. It's what you are saying is a nexus  17 chart; is that right?  18 A Correct.  19 Q What do you mean here where you say: "The  20 Sony PlayStation product meets the recited claim  21 language because it includes functionality for  22 healing a disconnection of a first computer from a  23 second computer. The computer is being connected to  24 the broadcast channel. Said broadcast channel being  25 an m-regular graph where m is at least 3"?</p>	<p style="text-align: right;">Page 165</p> <p>1 particular public bubble, which suggests, you know,  2 that at least three players were envisioned to be --  3 to use the product, but throughout the evidence it's  4 clear that the PlayStation product is designed to  5 support, as it says on page 9, millions of players  6 online at once, for example, which would be far more  7 than what is required by a 3-regular graph.  8 Q Okay. So is there -- is there anything  9 beyond the fact that it is capable, in your view, of  10 allowing more than three players that supports the  11 sentence here that we just discussed, the first  12 sentence of the second full paragraph where you say  13 that the Sony PlayStation product includes  14 functionality for healing and so on?  15 A So, again, looking through the evidence,  16 the evidence describes the ability of participants  17 to merge with existing public bubbles and to  18 disconnect from existing public bubbles to come and  19 go from those public bubbles, each of which allows  20 the participants within the bubble to broadcast  21 communications to one another.  22 So the ability to disconnect from a public  23 bubble and for that bubble to remain functioning,  24 you know, as described clearly throughout the -- the  25 evidence is an indication that it's highly likely</p>

<p style="text-align: right;">Page 166</p> <p>1 that the Sony PlayStation product is performing the  2 healing method called for in the '147 patent when a  3 computer disconnects from a broadcast channel.  4 Q Any other evidence that supports your view  5 that they're performing this healing connection --  6 healing a disconnection?  7 A There are numerous pictures in the  8 evidence in the claim chart showing multiple  9 participants interacting with each other in a common  10 scene, and as a person of ordinary skill would  11 understand, that for multiple participants residing  12 at different nodes in a network to participate in a  13 common scene, they would have to be part of a  14 communications network between them, such as what  15 the '147 describes as a broadcast channel that's  16 overlaying the point-to-point communications network  17 of the Internet.  18 Q Okay. Anything else?  19 A The -- in the claim chart evidence the  20 Sony PlayStation product is described as having a  21 matchmaker technology, and it's that matchmaker  22 technology that's described as enabling the ability  23 for network participants to connect and disconnect  24 from these various bubbles in a seamless manner,  25 which, again, shows a nexus between the PlayStation</p>	<p style="text-align: right;">Page 168</p> <p>1 the mere capability of doing it? Let me ask you a  2 different question.  3 Is it your opinion that Sony performs the  4 three steps of claim six?  5 A So it's my opinion that it's the Sony  6 products, such as PlayStation 3, that those products  7 perform the method that's described here in  8 claim six because of the appearance of a nexus  9 between what Sony describes their PlayStation  10 product as doing and the method for healing.  11 Q Okay. So let's go to the next sentence.  12 You say: "This functionality controls players  13 disconnecting from a game session and attempts to  14 heal a game session by making new connections."  15 What functionality are you talking about?  16 A Well, for example, I mentioned earlier the  17 matchmaking technology that is described in the  18 evidence as one example of the functionality that  19 I'm talking about.  20 Q Any other examples?  21 [Pause.]  22 Are you going to be required to read the  23 whole thing to answer my question?  24 A No, I'm just trying to make sure that I  25 don't point to stuff that's redundant with what I've</p>
<p style="text-align: right;">Page 167</p> <p>1 product and the method for disconnecting.  2 Q So is it your opinion that the method --  3 claim six is a method claim, or how would you  4 describe it?  5 A Claim six begins by saying that it's a  6 method for healing.  7 Q Okay. And then the method claim of  8 claim six has three steps, broadly speaking,  9 correct?  10 A It comprises three elements, yes.  11 Q Okay. And are you saying that the Sony  12 PlayStation product actually performs these elements  13 or are you just saying that you think it has some  14 functionality that could allow it to perform these  15 functions?  16 A Well, I'm saying --  17 MR. HANNAH: Objection. Form.  18 THE WITNESS: -- that, you know, the  19 evidence shows Sony intends for the product to be  20 used in a way that, as it appears, would implement  21 the method described in claim six.  22 BY MR. TOMASULO:  23 Q So my question was are you saying that  24 Sony actually performs the three elements of  25 claim six or are you saying it has the capability --</p>	<p style="text-align: right;">Page 169</p> <p>1 said earlier.  2 But, for example, on page 11 there's a  3 description of what's called a mesh-based network,  4 and in that description of a mesh-based network it's  5 describing, you know, a pool of players, a  6 matchmaking that occurs amongst that pool of players  7 in this mesh network. And as part of -- of forming  8 this mesh network based on play- -- people who are,  9 quote, physically located near you, the network  10 would necessarily have a capability of deciding not  11 only who should be part of the broadcast channel,  12 but who should not be part of the broadcast channel,  13 which means it would have the ability to both allow  14 for as well as to force disconnections of nodes from  15 a particular broadcast channel.  16 Q Okay. So it says here, going back to the  17 page 1 of your chart that you prepared -- it says:  18 "The match server, host server, or peer will  19 communicate with another player that had an  20 established communication channel with the  21 disconnecting play --" I expect he means the player.  22 It says "play."  23 A "Disconnecting player," yes.  24 Q Okay. And that can be connected to the  25 game session to maintain and optimize game session</p>

<p style="text-align: right;">Page 170</p> <p>1 or match and to create an optimized connectivity 2 mesh of players." 3 What do you mean here? 4 Let me see if I can ask a shorter 5 question. 6 Do you see that sentence and did you write 7 that? The one I just read, did you write that? 8 A Those are my thoughts about the Sony 9 PlayStation product, and this was actually written 10 in conjunction with the attorneys. 11 Q Okay. And so you say that the match 12 server, host server, or peer -- do you mean that all 13 of those three do that -- do the rest of this 14 sentence or do you mean one of the three might do 15 it? What do you mean when you've identified three 16 things: match server, host server, or peer? 17 A Well, the match server, host server, and 18 peer are part of the broadcast channel, and, as 19 such, because they are part of the broadcast 20 channel, they are communicating with other players 21 and are -- and are part of the method for healing a 22 disconnection. So any one of those three can be 23 used for communicating with another player. 24 Q Okay. So those three are part of the 25 broadcast channel, and they -- one of them will</p>	<p style="text-align: right;">Page 172</p> <p>1 need to do any of that, right? If someone leaves, 2 it's still a full mesh? Someone joins, they make a 3 connection to everybody, it's now a full mesh; is 4 that right? 5 MR. HANNAH: Objection. Form. 6 THE WITNESS: So if a node leaves a -- a 7 network, it's not necessarily true that all of the 8 links will be considered down at the same time. The 9 network will react to the disconnection of the node 10 potentially at different times for different 11 lengths, and, based upon that, will figure out how 12 to heal itself as it goes through that transient 13 state before settling in on a final state of the 14 network topology. 15 BY MR. TOMASULO: 16 Q And does that happen in all networks or 17 just the Sony PlayStation product? The way you said 18 it it sounded pretty general. 19 MR. HANNAH: Objection. Form. 20 THE WITNESS: That's just due to the 21 nature that the network nodes are distributed and 22 not synchronized in all of their actions so that if 23 a network node goes down, it is not necessarily true 24 that all the other nodes in the network will respond 25 in perfect synchrony to that disconnection across</p>
<p style="text-align: right;">Page 171</p> <p>1 communicate with another player that had an 2 established communication channel with the 3 disconnecting player. Okay. 4 And so are you saying that the -- the 5 match server, host server, or peer will communicate 6 with another player that is already a member of the 7 broadcast channel? 8 A Yes. 9 Q Okay. And that -- and then it says: 10 "that can be connected to the game session to 11 maintain an optimized game session." What do you 12 mean by that? If it's already connected to the 13 broadcast channel, what other connection does it 14 need to make? 15 A So if a particular node was connecting 16 with another node over the broadcast channel and 17 suddenly that link were to go away and -- which is 18 called disconnection, then the packets would have to 19 get rerouted through another means to reach that 20 destination node because that link that was 21 connected has now gone down. So that rerouting of 22 the communications through other parts of the 23 broadcast channel is what's described here so that 24 the game session can continue. 25 Q Now, if it's a full mesh, you wouldn't</p>	<p style="text-align: right;">Page 173</p> <p>1 all of the links that were connected to the node 2 that went down. 3 BY MR. TOMASULO: 4 Q Okay. And then you say that -- and it's 5 your opinion that the Sony PlayStation works that 6 way, the way you've just described as general node, 7 you know, synchronization? 8 A I'm saying this as a general matter as a 9 person of ordinary skill, understanding how network 10 communication works across distributed nodes, that 11 those nodes are typically not time synchronized. So 12 they respond to events in the network at slightly 13 different times, which means there's a transient 14 period of time before the network nodes all figure 15 out that a particular node is disconnected and 16 adjusts their communications. And once that has -- 17 transient time has expired, then the network is in a 18 steady-state condition. 19 Q So are you saying that you believe that 20 the alleged use of the claims occurs in this 21 transient condition? 22 MR. HANNAH: Objection. Form. 23 THE WITNESS: I'm saying that during this 24 transient period the -- the node that is 25 disconnected from the network invokes a procedure or</p>

<p style="text-align: right;">Page 174</p> <p>1 a method in the other nodes to handle that  2 disconnection before the network settles down into  3 its final steady-state condition of connectivity.  4 BY MR. TOMASULO:  5 Q I'm sorry. Are you saying that the Sony  6 PlayStation does this or are you just talking about  7 general networks?  8 A I'm talking in general about how  9 communication networks happen between nodes such as  10 the PlayStation products operating over a  11 point-to-point communications network, such as the  12 Internet.  13 Q Okay. So you don't know if this happens  14 in the Sony PlayStation networks or not? You just  15 -- it's just a general comment?  16 MR. HANNAH: Objection. Form.  17 THE WITNESS: I'm just saying, as a person  18 of ordinary skill who understands how these networks  19 work, it's -- it's highly unlikely that the  20 PlayStation products operate in any other way than  21 in an unsynchronized mode when a particular node is  22 disconnected -- disconnecting all of its links from  23 the network.  24 BY MR. TOMASULO:  25 Q Okay. So -- so now we have the -- it says</p>	<p style="text-align: right;">Page 176</p> <p>1 m-regular graphs that are what we call a full mesh,  2 where every node is -- where it's a complete  3 network? Is that what you're referring to when you  4 talk about an optimized connectivity mesh of  5 players?  6 MR. HANNAH: Objection. Form.  7 THE WITNESS: What I mean by optimized  8 connectivity mesh of players is that every node is  9 connected to m other nodes in an m-regular graph.  10 BY MR. TOMASULO:  11 Q And why is that considered an optimized  12 connectivity mesh of players?  13 A Because the optimal connectivity for the  14 players in a broadcast channel is for every player  15 to have a connection to m other players in the  16 broadcast channel.  17 Q Okay. Optimized according to whom? You?  18 A It's optimized because when all of the  19 players are connected to m other players, then that  20 minimizes the maximum distance that messages need to  21 traverse in order to reach all parts of the  22 broadcast channel.  23 Q So in a ten-person network m would be  24 nine, then, right, to make it an optimum network?  25 That would be the minimum number of hops, correct?</p>
<p style="text-align: right;">Page 175</p> <p>1 here in your sentence -- it says that the -- the  2 match server will -- host server or peer will  3 communicate with another player that already had an  4 established communication to the channel -- so it's  5 someone who is already in the channel -- with the  6 disconnecting player and that can be connected to  7 the game session to maintain an optimized game  8 session or match and to create an optimized  9 connectivity mesh of players.  10 What does that mean and how does that  11 pertain to the claim? What -- why does that have  12 anything to do with the claim limitations?  13 A Well, certainly if your graph is no longer  14 an m-regular graph due to the disconnection of a  15 node, you have a suboptimal graph. The -- the  16 optimal graph will be the m-regular graph in which  17 every node has the same number of connections to  18 other nodes.  19 Q Okay. So, now, in your view does this  20 claim require that the m-regular network be  21 incomplete?  22 A There's nothing in the claim that says the  23 m-regular graph must be incomplete.  24 Q Okay. So when you're referring to  25 m-regular graphs in this chart, are you referring to</p>	<p style="text-align: right;">Page 177</p> <p>1 MR. HANNAH: Objection. Form.  2 THE WITNESS: No, I'm not -- I'm not  3 saying anything about whether the graph is complete  4 or not -- incomplete. I'm simply saying every node  5 needs to have m connections to other nodes in order  6 to minimize the -- the maximum distance that a  7 packet needs to travel to reach any part of the  8 broadcast channel.  9 BY MR. TOMASULO:  10 Q Okay. But wait. If it's a full mesh, the  11 minimum packet distance is one, right?  12 A That's true.  13 Q Okay. So that would be optimum, right?  14 One, that's the smallest possible number?  15 MR. HANNAH: Objection to form.  16 THE WITNESS: For that particular  17 hypothetical, that's true.  18 BY MR. TOMASULO:  19 Q Okay. So the smallest number of hops you  20 can ever have is one, and that's optimal, right?  21 MR. HANNAH: Objection. Form.  22 THE WITNESS: But, again, you have to --  23 you have to realize that there may be situations in  24 which the nodes cannot maintain connections with all  25 other nodes in the broadcast channel.</p>

<p style="text-align: right;">Page 178</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q And that might not be optimal, but if they</p> <p>3 can, then that's a full mesh network and that has a</p> <p>4 diameter of one, right? That's the smallest</p> <p>5 possible diameter?</p> <p>6 A Well, I don't see how this example relates</p> <p>7 to what I was describing earlier. I think it's --</p> <p>8 Q I'm using your words. You said that the</p> <p>9 -- that you want to have -- that optimal refers to</p> <p>10 having the smallest distance between two nodes, and</p> <p>11 I said then doesn't that make a full mesh optimal</p> <p>12 because that has the smallest distance. You've</p> <p>13 agreed with me --</p> <p>14 MR. HANNAH: Objection to form.</p> <p>15 BY MR. TOMASULO:</p> <p>16 Q -- correct?</p> <p>17 A I think you've jumped to a different</p> <p>18 context from what I was describing earlier. What I</p> <p>19 was describing earlier was a context in which all of</p> <p>20 the nodes in the network had the same number m of</p> <p>21 connections to other nodes, and in that context the</p> <p>22 graph could be incomplete or it could be complete.</p> <p>23 So in the case where the graph is</p> <p>24 incomplete, if some nodes had less than m</p> <p>25 connections to other nodes, then the maximum</p>	<p style="text-align: right;">Page 180</p> <p>1 MR. HANNAH: Objection to the form of the</p> <p>2 question.</p> <p>3 THE WITNESS: Only within the context of a</p> <p>4 fully connected graph is that true.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q Right. So when it's a full mesh, you have</p> <p>7 a maximum distance of one, and you said that's an</p> <p>8 important factor, right?</p> <p>9 MR. HANNAH: Objection. Form.</p> <p>10 THE WITNESS: Only for the context of a</p> <p>11 fully connected graph is that true.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. And so you go on to say: "The</p> <p>14 functionality will initiate an attempt by the match</p> <p>15 server, host server, or peer to find a connection</p> <p>16 port to another player that can be used to maintain</p> <p>17 an m-regular graph in the session or match and to</p> <p>18 create an optimized connectivity mesh of players."</p> <p>19 Now, what happens if a node leaves a full</p> <p>20 mesh complete network? What happens then? How does</p> <p>21 this claim get performed?</p> <p>22 A So when a node leaves a full mesh network</p> <p>23 due to an unplanned event, such as a power outage,</p> <p>24 then the other nodes in the network must learn that</p> <p>25 the node has left the network, and that will happen</p>
<p style="text-align: right;">Page 179</p> <p>1 distance to the other nodes in a network is not</p> <p>2 necessarily optimal, and it's only optimal when all</p> <p>3 the nodes have the same number of connections.</p> <p>4 Q So what you said was it's -- I said</p> <p>5 optimized according to whom? You? And you said</p> <p>6 it's optimized because when all of the players are</p> <p>7 connected to m other players, then that minimizes</p> <p>8 the maximum distance that messages need to traverse</p> <p>9 in order to reach all parts of a broadcast channel.</p> <p>10 So what -- I gathered what you were saying</p> <p>11 is that we want to minimize the distance that a</p> <p>12 message needs to travel to reach all parts of the</p> <p>13 broadcast channel, correct?</p> <p>14 MR. HANNAH: Objection. Form.</p> <p>15 THE WITNESS: And that would be true under</p> <p>16 both scenarios of a complete graph as well as an</p> <p>17 incomplete graph.</p> <p>18 BY MR. TOMASULO:</p> <p>19 Q Okay. But it -- under -- if the</p> <p>20 optimization is to get the shortest path between any</p> <p>21 two nodes, then the optimum network is a full mesh</p> <p>22 network as that has a maximum distance of one. All</p> <p>23 nodes have a direct connection to every other node,</p> <p>24 right?</p> <p>25 A Only --</p>	<p style="text-align: right;">Page 181</p> <p>1 at different times for different nodes in the</p> <p>2 network because the nodes in the network are not</p> <p>3 synchronized to learn about the disconnection at the</p> <p>4 -- at exactly the same time all throughout the</p> <p>5 network. So for that reason, there is a transient</p> <p>6 period of time in which the knowledge of the</p> <p>7 departure of a node percolates through the network</p> <p>8 before the network settles on its final steady-state</p> <p>9 configuration with the absence of that node.</p> <p>10 Q But in a full mesh network, okay, do you</p> <p>11 -- can you look at 3A and 3B of your patent? Are</p> <p>12 you there?</p> <p>13 A Yes.</p> <p>14 Q Okay. So let's -- 3A is a full mesh, full</p> <p>15 regular network, correct?</p> <p>16 A Yes.</p> <p>17 Q Okay. So explain to me what 3A would look</p> <p>18 like after the performance of the claim and explain</p> <p>19 to me how that would work.</p> <p>20 MR. HANNAH: Objection. Form and outside</p> <p>21 the scope.</p> <p>22 THE WITNESS: So 3A is a narrow example of</p> <p>23 the full scope of what's possible in the claim, but</p> <p>24 in the 3A scenario, if one of the nodes were to have</p> <p>25 an unplanned event to disconnect it from the</p>

<p style="text-align: right;">Page 182</p> <p>1 network, then that means that all of the four links 2 that were previously established between that node 3 and the other four nodes in the network would also 4 be disconnected, but knowledge of that disconnection 5 would not be known to the other four nodes at 6 exactly the same time. So as the other nodes learn 7 of the disconnection and reroute information 8 accordingly, there is a transient period before you 9 would result in a steady-state situation with four 10 nodes in the network where each node has three 11 connections to the other nodes. 12 BY MR. TOMASULO: 13 Q Okay. And so in that instance would you 14 have viewed the claim to be performed, what you just 15 described? 16 A I would -- 17 MR. HANNAH: Objection. Form. 18 THE WITNESS: I would need more 19 information to determine that. 20 BY MR. TOMASULO: 21 Q Well, it says the -- let's go back to the 22 claim language, and it talks about it needs to be 23 m-regular where m is at least three at the 24 beginning, right? 25 A Okay.</p>	<p style="text-align: right;">Page 184</p> <p>1 BY MR. TOMASULO: 2 Q It doesn't need to be the same m at the 3 end of the graph as at the beginning, right? That's 4 what you're saying? 5 MR. HANNAH: Objection to form. 6 THE WITNESS: I don't see anything in this 7 claim that says m has to be a particular number 8 throughout the entire method. 9 BY MR. TOMASULO: 10 Q Okay. So removal of a node from a full 11 mesh network, which would take it to -- when you 12 remove a node from a full mesh network, it will 13 decrease the regularity of the network by one, 14 correct? 15 MR. HANNAH: Objection. Form. 16 THE WITNESS: If you start with a -- a 17 complete graph and one of the nodes is removed from 18 the complete graph, then the size of the network is 19 reduced and the number m decreases by one. 20 BY MR. TOMASULO: 21 Q Right. Okay. And then if you look at the 22 example on 5 -- 5B, right, that has nine nodes, 23 correct, at the beginning, if we assume this was -- 24 that H was involved in this beforehand, which is 25 what they've described?</p>
<p style="text-align: right;">Page 183</p> <p>1 Q Okay? And then at the end it says: "so as 2 to maintain an m-regular graph," right? 3 A Okay. 4 Q So in this example, the one we just 5 described, we would have gone from a 4-regular graph 6 to a 3-regular graph, correct? 7 MR. HANNAH: Objection. Form. 8 THE WITNESS: For that particular example, 9 that's what would happen, yes. 10 BY MR. TOMASULO: 11 Q Okay. So now m was -- and so is it your 12 opinion that m can change during the performance of 13 the claim? In other words, at the beginning it's a 14 4-regular graph, and now you say to maintain an 15 m-regular graph and now it's a 3-regular graph. Has 16 it been maintained as an m-regular graph or not? 17 A As long as m is -- 18 MR. HANNAH: Objection. Form. 19 THE WITNESS: -- is at least 3, yes. 20 BY MR. TOMASULO: 21 Q So m can change during the performance of 22 the claim? That's your opinion? 23 MR. HANNAH: Objection. Form. 24 THE WITNESS: M simply needs to be at 25 least three. That's all the claim requires.</p>	<p style="text-align: right;">Page 185</p> <p>1 A So 5D shows eight nodes. 2 Q 5B shows nine nodes? Well -- 3 A 5B. 4 Q 5B. Yes. I'm sorry. 5 A Okay. 5B. 5B there are nine nodes. 6 Q It's showing the departure of node H, 7 right? 8 A Well, it shows nine nodes, and it shows 9 one node H without any connections. 10 Q And if you read the -- are you aware that 11 this was a representative example of an unplanned 12 departure? If you're not -- if you're not familiar 13 with this figure, that's fine. Let's just go back 14 to your charts. It sounds like you don't remember 15 this figure. 16 So going back to the first page of your 17 charts, you say the functionality creates m-regular 18 topologies of players when setting up logical and 19 physical network topologies. 20 What do you mean by m-regular topologies 21 of players? 22 A So the Sony PlayStation product allows for 23 a particular network node to engage in multiple 24 broadcast channels simultaneously, each one of those 25 broadcast channels being an m-regular topology</p>

<p style="text-align: right;">Page 186</p> <p>1 within -- that overlays the underlying  2 point-to-point communications network.  3 Q So each of these topologies that you've  4 identified below is an m-regular topology?  5 A No. What I'm saying is that an m-regular  6 topology may be, for example, associated with, as  7 shown in the slides, a public bubble within which  8 multiple participants are able to communicate, but a  9 particular node can have multiple of these occurring  10 simultaneously, each one with its own topology so  11 that a network node is not necessarily only  12 associated with one broadcast channel at a time but  13 may be associated with a plurality of broadcast  14 channels at a given time, each broadcast channel  15 representing an m-regular topology.  16 Q Okay. So can you identify for me every  17 broadcast channel that you have determined to be an  18 m-regular topology? Let's just list them off, and  19 then we can go through why you know that they are  20 m-regular topologies. Can you do that?  21 A So in this char I have not proven that the  22 PlayStation product definitively has an m-regular  23 topology. I'm simply saying that the evidence shows  24 there's a very high likelihood that there is an  25 m-regular topology in the product based on the way</p>	<p style="text-align: right;">Page 188</p> <p>1 topology. So just identify one. There are so many.  2 It shouldn't be a problem.  3 A So as I've outlined here, you know, the  4 public bubble topology is a topology for a broadcast  5 channel.  6 Q Okay. So are all of these -- there are  7 one, two, three, four, five, six, seven, eight -- I  8 don't know if the -- what are the participants in  9 the broadcast channel that you're looking at on page  10 2? So let's go through that. And show me how  11 that's m-regular.  12 A Well, as I said before, I have not done a  13 detailed analysis to prove definitively that the  14 evidence shows an m-regular graph. I am simply  15 saying that the evidence shows that it is highly  16 likely that the products are practicing the '147  17 invention, including it is highly likely that within  18 the accused products one would find an m-regular  19 graph if one were to do the discovery work necessary  20 to examine those products.  21 Q So is it -- is it correct that this  22 actually -- your -- your chart here that you've  23 reproduced on page 2, that doesn't show an m-regular  24 graph, right?  25 MR. HANNAH: Objection. Form.</p>
<p style="text-align: right;">Page 187</p> <p>1 in which the products are described in this  2 evidence.  3 Q Okay. So -- but what -- what is -- what's  4 a -- what are the broadcast channels that you  5 believe are highly likely to be m-regular? Can you  6 just tell me the broadcast channels because I need  7 to know what they are and what they comprise. What  8 are the participants? What are the edges? How do  9 we find them? We need to verify what you say.  10 A The -- there's quite a bit of evidence in  11 these charts describing these topologies. If you --  12 Q No, no, no.  13 A -- for example, look at the very next  14 page, page 2, you can actually see a plurality of,  15 for example, public bubbles and users associated  16 with public bubbles through activity hosts such that  17 any particular user can be associated with more than  18 one at the same time and -- which is a capability of  19 the product that's being described, which allows for  20 multiple users not only to be associated with a  21 given public bubble, but for multiple public bubbles  22 to be associated with a given user.  23 Q Can you identify -- let's just start with  24 one. Just identify one broadcast channel with  25 specificity that you believe is an m-regular</p>	<p style="text-align: right;">Page 189</p> <p>1 THE WITNESS: It is not proving that an  2 m-regular graph exists; that's correct.  3 BY MR. TOMASULO:  4 Q Okay. And -- and it doesn't show where --  5 there's no -- is there any member of the broadcast  6 channel here that has more than three connections?  7 A So this is a simplistic example, as I've  8 said earlier, and the evidence --  9 Q I'm sorry. My -- my -- I just wanted an  10 answer to my question. I mean, you will have an  11 opportunity for redirect. So this is really a cross  12 examination, which I know as a savvy expert witness  13 you've experienced that this isn't a deposition.  14 This is a cross-examination. This is my time. I'm  15 not trying to be rude, but I do want to proceed  16 through my questions, and your -- your counsel will  17 have every opportunity to ask, you know, the kinds  18 of questions that you would like to talk about. But  19 with time being short, I respectfully would like  20 just to get answers to my questions, please.  21 A So as I was attempting to say --  22 MR. HANNAH: Well, objection. There's no  23 question pending, and, Counsel, let's avoid the  24 argumentative comments on the record. There's no  25 place for that.</p>



<p style="text-align: right;">Page 190</p> <p>1 MR. TOMASULO: Could you please re-read my 2 question. 3 (Record read by the reporter as follows: 4 "QUESTION: Okay. And -- and it 5 doesn't show where -- there's no -- is 6 there any member of the broadcast channel 7 here that has more than three 8 connections?") 9 THE WITNESS: So in this simplistic figure 10 that's shown on page 2 there are a number of -- I 11 think I count four different end user nodes that are 12 connected into the world server cloud, but as we 13 know from the evidence that I've presented in this 14 chart, that the PlayStation product works with up to 15 a million players participating with each other 16 through the server cloud. So you can't put a 17 million boxes on this figure and have it be 18 intelligible. So for sake of simplicity, only four 19 were listed, but that doesn't mean the product is 20 limited to only four players interacting at the same 21 time. 22 BY MR. TOMASULO: 23 Q Okay. So you speculate that if you just 24 had more players here, you might be able to draw a 25 broadcast channel that meets the limitations of the</p>	<p style="text-align: right;">Page 192</p> <p>1 nine boxes, as you say, one of them is just labeled 2 "World Server," which is simply a label referring to 3 the cloud. 4 Q So -- 5 A The idea -- 6 Q So that box is not -- 7 A Yeah, but the other eight boxes are 8 describing activity hosts and physics hosts and 9 physics clients, all of which are network nodes that 10 exist in the -- in these public bubbles that are 11 forming broadcast channels. 12 So as you can see from this figure, for 13 example, the physics client is able to communicate 14 with a public bubble labeled "Hell Mouth" and is 15 also able to communicate with activity host patrol 16 through which the physics host "Deborah" connects to 17 the other public bubble "Archers Line." 18 So one network node is able to communicate 19 with more than one public bubble or broadcast 20 channel, for example, but, again, this is a 21 simplistic figure and is not representative of all 22 the ways in which the PlayStation product is used 23 over the Internet to allow up to millions of players 24 to interact. 25 Q Okay. So -- but are all eight of these --</p>
<p style="text-align: right;">Page 191</p> <p>1 claims? Is that what I'm getting? 2 MR. HANNAH: Objection. Form. 3 THE WITNESS: So -- so what I'm saying is 4 that it's pretty clear to a person of ordinary skill 5 that the topology as shown in this figure is not the 6 only possible topology that's possible using the 7 PlayStation products and that many other are 8 possible, including topologies in which there are 9 more than four players. 10 BY MR. TOMASULO: 11 Q Does this show a single topology or, I 12 mean -- I'm sorry -- multiple broadcast channels? 13 one broadcast channel? How do I determine who the 14 participants are and what constitute the edges here? 15 MR. HANNAH: Objection. Form. 16 BY MR. TOMASULO: 17 Q Okay. This is your chart. Let me ask you 18 to explain it. 19 A I think -- 20 Q What -- how many -- are all of the -- 21 there's nine boxes here, right? 22 A Yeah. 23 Q Okay. Are they all participants in a 24 single broadcast channel? 25 A I think what's clear here is that of these</p>	<p style="text-align: right;">Page 193</p> <p>1 so we've eliminated the "World Server" as a 2 potential participant -- is that right? -- because 3 it's -- you said it was just a representation of 4 what these top four bubbles are? 5 A The top four bubbles, if you discount the 6 "World Server" box -- the top four boxes are inside 7 this Internet cloud and are communicating with 8 participants in the bottom four boxes. 9 Q Okay. And so what are the different -- 10 are there -- is this -- are all eight of these other 11 boxes -- are they participating in a single 12 broadcast channel or are there multiple broadcast 13 channels being represented here? 14 A So what's being represented here is shown 15 at least two broadcast channels. 16 Q Okay. What are they? 17 A The public bubble that's labeled "Hell 18 Mouth" and the public bubble named "Archers Line." 19 Q And -- but "Mission Activity Host Strike" 20 and "Mission Activity Host Patrol" -- those are not 21 broadcast channels; is that right? 22 MR. HANNAH: Objection. Form. 23 THE WITNESS: They may or may not be, but 24 it's pretty clear that -- as the evidence shows, 25 that a public bubble is what appears to be likely</p>

<p style="text-align: right;">Page 194</p> <p>1 that of the broadcast channel.</p> <p>2 BY MR. TOMASULO:</p> <p>3 Q What factors do you look at to determine</p> <p>4 whether there's one or more broadcast channels when</p> <p>5 you're looking at something like this?</p> <p>6 A So, for example, evidence that a bubble is</p> <p>7 like a broadcast channel is -- just as one example,</p> <p>8 on page 20 the Exhibit 2029 shows a figure with text</p> <p>9 below it saying that Destiny is a world of</p> <p>10 intersecting, not parallel lines. Most of time</p> <p>11 players are just passing through public bubbles or</p> <p>12 passing through broadcast channels. Any one of</p> <p>13 these players could be the current physics host and</p> <p>14 as soon as she leaves and deinstantiates the bubble,</p> <p>15 we need to host migrate to a new physics host.</p> <p>16 So that relates to the figure we were just</p> <p>17 talking about, which shows physics hosts such as</p> <p>18 Alice and Deborah, and it's saying that these</p> <p>19 physics hosts, which are connected to public</p> <p>20 bubbles, could leave the public bubble, and, as a</p> <p>21 result, the broadcast channel has to proceed through</p> <p>22 a method that deals with that disconnection in order</p> <p>23 to heal itself.</p> <p>24 Q Well, it's -- in your view is it if -- if</p> <p>25 you replace one physics host with another one or</p>	<p style="text-align: right;">Page 196</p> <p>1 the public bubbles that we were just talking about</p> <p>2 in the other figure. And in Exhibit 2029, it</p> <p>3 describes a method for disconnection and healing</p> <p>4 that occurs when a participant leaves a broadcast</p> <p>5 channel or a public bubble, as described by Sony.</p> <p>6 Q So what is the broad -- so we're going to</p> <p>7 -- what is the -- what is a broadcast channel that</p> <p>8 you contend satisfies the performance of -- what we</p> <p>9 would consider the performance of claim six has been</p> <p>10 achieved or is likely to have been achieved?</p> <p>11 A So --</p> <p>12 Q What is a --</p> <p>13 A So in this example the broadcast channel</p> <p>14 would be the public bubble.</p> <p>15 Q Okay. And who are the -- so broadcast</p> <p>16 channel consists of, like all graphs, participants</p> <p>17 and edges, right?</p> <p>18 MR. HANNAH: Objection. Form.</p> <p>19 THE WITNESS: The broadcast channel would</p> <p>20 have nodes and links or edges between them, yes.</p> <p>21 BY MR. TOMASULO:</p> <p>22 Q Okay. And so we wouldn't know whether the</p> <p>23 broadcast channel is m-regular or incomplete unless</p> <p>24 we know who all of the members of the broadcast</p> <p>25 channel are, correct?</p>
<p style="text-align: right;">Page 195</p> <p>1 migrate the people that were attached to a physics</p> <p>2 host to a separate physics host, is that, in your</p> <p>3 view, practicing the claim? Is that healing a</p> <p>4 disconnection?</p> <p>5 A So --</p> <p>6 MR. HANNAH: Objection. Form.</p> <p>7 THE WITNESS: So in my view, I have not</p> <p>8 done the complete analysis to determine an opinion</p> <p>9 on infringement. Rather, what I've shown here is</p> <p>10 that the evidence strongly suggests that it's highly</p> <p>11 likely that the claim elements in claim six are</p> <p>12 being practiced by the PlayStation product.</p> <p>13 BY MR. TOMASULO:</p> <p>14 Q So we -- I had asked you to identify a</p> <p>15 single -- well, I wanted you to take a single</p> <p>16 broadcast channel and carry me through the method</p> <p>17 and show me how, in your view, you have come to the</p> <p>18 conclusion that it is highly likely that this method</p> <p>19 is practiced. So we'll do one single broadcast</p> <p>20 channel that you get to choose. So you'll show me,</p> <p>21 if you can, the broadcast channel, and then show me</p> <p>22 how the method steps are performed. Can you do</p> <p>23 that?</p> <p>24 A Well, as I've said, you know, when you</p> <p>25 looked at page 20, you -- you see a description of</p>	<p style="text-align: right;">Page 197</p> <p>1 MR. HANNAH: Objection. Form.</p> <p>2 THE WITNESS: To be able to prove</p> <p>3 definitively that an m-regular graph is formed, one</p> <p>4 would have to perform an analysis that goes beyond</p> <p>5 what was done in this claim chart.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q Okay. Would you agree -- have you heard a</p> <p>8 graph being defined as a set of vertices or nodes</p> <p>9 and a set of edges? I'm sure you've heard of that,</p> <p>10 right?</p> <p>11 A Yes.</p> <p>12 Q Okay. And what does that mean?</p> <p>13 MR. HANNAH: Objection. Form.</p> <p>14 THE WITNESS: Well, that means that the</p> <p>15 graph topology is composed of nodes which are</p> <p>16 usually represented by circles and edges, which are</p> <p>17 usually represented by line segments that connect</p> <p>18 the circles together.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q And so when -- and to define a graph, you</p> <p>21 need to know all of the two sets or you need to know</p> <p>22 the set vertices and the set of edges? That's what</p> <p>23 defines the graph, right?</p> <p>24 MR. HANNAH: Objection. Objection. Form.</p> <p>25 THE WITNESS: Well, there are other</p>

<p style="text-align: right;">Page 198</p> <p>1 characteristics that go into defining a graph, such  2 as whether or not edges are two-way versus one-way,  3 et cetera, but as a general rule, graphs are  4 depicted as a combination of nodes and line segments  5 between those nodes.  6 BY MR. TOMASULO:  7 Q Okay. And so you need to know all of the  8 numbers of each set? In other words, you need to  9 know all of the vertices and all of the edges in  10 order to determine the topology, right?  11 MR. HANNAH: Objection. Form -- objection  12 to the form of the question.  13 THE WITNESS: Well, as I said earlier, a  14 graph is composed of the nodes and the edges between  15 them. So that's what -- that's how you create the  16 graph.  17 BY MR. TOMASULO:  18 Q Right. And so the answer to my question  19 is, yes, you need to know those things? You can't  20 tell --  21 A At a minimum, yes.  22 Q At a minimum.  23 Okay. And how you define the edge is  24 important, right?  25 A What do you mean, "how you define" it?</p>	<p style="text-align: right;">Page 200</p> <p>1 that overlays a point-to-point communications  2 network.  3 BY MR. TOMASULO:  4 Q And the broadcast channel has to be  5 m-regular where m is at least 3, right?  6 A Yes.  7 Q And so for us to determine whether the  8 broadcast channel is m-regular and m is at least 3,  9 we need to know all of the members of the broadcast  10 channel, correct?  11 MR. HANNAH: Objection to form.  12 THE WITNESS: There would have to be at  13 least one scenario that is analyzed in which you're  14 able to prove that an m-regular graph where m is at  15 least 3 has been formed; that's true.  16 MR. TOMASULO: I'm sorry. Could you  17 repeat my question, please. I'd like an answer to  18 that one.  19 (Record read by the reporter as follows:  20 "QUESTION: And so for us to determine  21 whether the broadcast channel is m-regular  22 and m is at least 3, we need to know all  23 of the members of the broadcast channel,  24 correct?")  25 MR. HANNAH: And what was his answer?</p>
<p style="text-align: right;">Page 199</p> <p>1 Q Well, an edge, when it represents  2 something, is typically either represented by a list  3 or a set of rules, right?  4 MR. HANNAH: Objection to form.  5 THE WITNESS: An edge is simply a link or  6 a connection between two nodes. The way in which a  7 edge is implemented is typically not shown in the  8 graph.  9 BY MR. TOMASULO:  10 Q But when it's represented -- so what  11 you're saying, though, is that the graph is  12 representative of -- of the computer network, right?  13 MR. HANNAH: Objection to form.  14 THE WITNESS: A graph is not necessarily  15 associated with a computer network, but it is --  16 it's showing an interconnection between nodes.  17 BY MR. TOMASULO:  18 Q In this instance there -- the claim isn't  19 to a graph, is it? It's to a method performed on a  20 computer network that, if graphed, has a certain set  21 of properties, right?  22 MR. HANNAH: Objection. Form.  23 THE WITNESS: Well, again, the independent  24 claim six is really directed towards a method in  25 which a node disconnects from a broadcast channel</p>	<p style="text-align: right;">Page 201</p> <p>1 (Record read by the reporter as follows:  2 "ANSWER: There would have to be at  3 least one scenario that is analyzed in  4 which you're able to prove that an  5 m-regular graph where m is at least 3 has  6 been formed; that's true.")  7 BY MR. TOMASULO:  8 Q Are you able to answer my question?  9 A Yes, I believe --  10 MR. HANNAH: He did answer your question.  11 MR. TOMASULO: You're not testifying. I  12 put up with a lot of speaking objections today. You  13 know the rules as well as I do.  14 MR. HANNAH: You ask me questions, I'm  15 going to answer them.  16 MR. TOMASULO: I didn't ask you any  17 question.  18 MR. HANNAH: I haven't had a single  19 speaking objection.  20 BY MR. TOMASULO:  21 Q In order to determine whether a broadcast  22 channel is m-regular and m is at least 3, you need  23 to know who all of the members of the broadcast  24 channel are, correct?  25 MR. HANNAH: Objection. Form of the</p>

<p style="text-align: right;">Page 202</p> <p>1 question.</p> <p>2 THE WITNESS: For the particular scenario</p> <p>3 that you're analyzing, that's correct.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q Okay. And you also need to know all of</p> <p>6 the edges, right?</p> <p>7 MR. HANNAH: Objection to the form of the</p> <p>8 question.</p> <p>9 THE WITNESS: Within the particular</p> <p>10 scenario that you're analyzing, yes.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q Okay. So to determine whether any</p> <p>13 specific broadcast channel meets the m-regular</p> <p>14 topology requirement where m is at least 3, we need</p> <p>15 to know who the members of the broadcast channel are</p> <p>16 and the complete set of edges that connect those</p> <p>17 members, right?</p> <p>18 MR. HANNAH: Objection to form.</p> <p>19 THE WITNESS: Within that broadcast</p> <p>20 channel, that's correct.</p> <p>21 BY MR. TOMASULO:</p> <p>22 Q Correct. Correct. So within that</p> <p>23 broadcast channel.</p> <p>24 So what can you -- can you identify a</p> <p>25 broadcast channel that meets -- where you can</p>	<p style="text-align: right;">Page 204</p> <p>1 A Yes.</p> <p>2 Q Okay. And then you say: "Because it</p> <p>3 attempts to send messages from a first computer to a</p> <p>4 second computer within m-regular connectivity meshes</p> <p>5 of players during different network game sessions</p> <p>6 and for different game session data and make sure</p> <p>7 that each player is optimally connected to other</p> <p>8 players to ensure that all nodes are connected to</p> <p>9 the same number of nodes to ensure that no node is</p> <p>10 overloaded," right?</p> <p>11 A Yes.</p> <p>12 Q That's your testimony?</p> <p>13 A Yes.</p> <p>14 Q And then you go on and you say in the next</p> <p>15 paragraph -- you say: "The Sony PlayStation product</p> <p>16 includes functionality that attempts to send</p> <p>17 messages from a first computer to a second computer</p> <p>18 within m-regular connectivity meshes of players</p> <p>19 during different network game sessions and for</p> <p>20 different game session data and make sure that each</p> <p>21 of the players is optimally connected to other</p> <p>22 players to ensure that all nodes are connected to</p> <p>23 the same number of nodes to ensure that no node is</p> <p>24 overloaded, as shown in the screenshots below," and</p> <p>25 then you have a screenshot.</p>
<p style="text-align: right;">Page 203</p> <p>1 identify all of the participants on all of the edges</p> <p>2 and show how it is m-regular or m is at least 3? Is</p> <p>3 it in your chart?</p> <p>4 A No, it's not in the chart.</p> <p>5 Q Okay. Can you do it sitting here today,</p> <p>6 identify just one broadcast channel where you can</p> <p>7 identify all the participants and explain why it</p> <p>8 meets that topology requirement?</p> <p>9 A At this time, no.</p> <p>10 Q Okay. Let's go to claim element 6B.</p> <p>11 Okay.</p> <p>12 Do you see that?</p> <p>13 A Yes.</p> <p>14 Q Okay. So then you say here that -- in the</p> <p>15 second paragraph: "The Sony PlayStation product --"</p> <p>16 let's go up to the first -- you say: "The Sony</p> <p>17 PlayStation --" I'm sorry. Are you there? I don't</p> <p>18 want to -- we're on page 9.</p> <p>19 A Yes, I'm here.</p> <p>20 Q Okay. So you say: "The Sony PlayStation</p> <p>21 product meets the recited claim language," right?</p> <p>22 That's what you say?</p> <p>23 A Yes.</p> <p>24 Q But, again, you're not making an</p> <p>25 allegation of infringement, right?</p>	<p style="text-align: right;">Page 205</p> <p>1 Is that right?</p> <p>2 A Yes.</p> <p>3 Q And, then, so Exhibit 2030 and 2031, those</p> <p>4 are your evidence for that?</p> <p>5 A Let's see. For claim element 6B I use</p> <p>6 Exhibits 2030, 2031, 2028, 2023, 2034, 2024, 2035,</p> <p>7 2029, 2037, 2036, and 2032.</p> <p>8 Q Okay. But it includes 2030 and 31, which</p> <p>9 are the ones that are on this page, right?</p> <p>10 A On this page, that's correct.</p> <p>11 Q Okay. And you're talking about the Sony</p> <p>12 PlayStation product and the functionality that that</p> <p>13 PlayStation product has, right?</p> <p>14 A Yes.</p> <p>15 Q And then you've used this screenshot below</p> <p>16 to show what you contend is the Sony PlayStation</p> <p>17 functionality, right?</p> <p>18 A That's part of the evidence that I looked</p> <p>19 at, yes.</p> <p>20 Q And then -- but if we look at what 2030 is</p> <p>21 and what 2031 is, can you see that the -- it says</p> <p>22 here: "For use only with Xbox 360"? Do you see</p> <p>23 that?</p> <p>24 A Yes.</p> <p>25 Q Okay. What's Xbox 360?</p>

<p style="text-align: right;">Page 206</p> <p>1 A That's a game console.</p> <p>2 Q And who makes that?</p> <p>3 A Microsoft.</p> <p>4 Q So you would agree that that doesn't have</p> <p>5 anything to do with how the Sony PlayStation works,</p> <p>6 right?</p> <p>7 A It appears from the writing that it's</p> <p>8 limited to the Microsoft Xbox 360.</p> <p>9 Q All right. So it doesn't have anything to</p> <p>10 do with proving what you've said in that prior</p> <p>11 paragraph, anything about the Sony PlayStation</p> <p>12 product, right?</p> <p>13 MR. HANNAH: Objection. Form.</p> <p>14 THE WITNESS: Well, the -- although that</p> <p>15 sentence does indicate that what is shown in the</p> <p>16 screenshot is for use only with Microsoft Xbox 360,</p> <p>17 this came from a link online describing the Destiny</p> <p>18 product.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q But what's the Destiny product?</p> <p>21 A Well, it's not the Microsoft Xbox 360,</p> <p>22 so --</p> <p>23 Q What's --</p> <p>24 A I'm just saying that, you know, this</p> <p>25 sentence that says "For use only with Xbox 360" is</p>	<p style="text-align: right;">Page 208</p> <p>1 Q Okay. So, again, that wouldn't have any</p> <p>2 evidence at all as to how the Sony PlayStation</p> <p>3 works --</p> <p>4 MR. HANNAH: Objection. Form.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q -- because this is a Microsoft product?</p> <p>7 A Well, certainly the Destiny game</p> <p>8 application can run on a variety of game console</p> <p>9 platforms and is not limited to only operating in</p> <p>10 the context of an Xbox 360.</p> <p>11 Q Well, you would agree that Exhibit 2031</p> <p>12 does not support the statement above, which says:</p> <p>13 "The PlayStation product includes functionality --"</p> <p>14 and so on and so forth "-- as shown in the</p> <p>15 screenshots below"? Those screenshots below do not</p> <p>16 support the statement above, correct?</p> <p>17 MR. HANNAH: Objection to form.</p> <p>18 THE WITNESS: Only indirectly; that's</p> <p>19 correct.</p> <p>20 BY MR. TOMASULO:</p> <p>21 Q How do they even support it indirectly?</p> <p>22 You said you don't know anything about the Microsoft</p> <p>23 Xbox, right?</p> <p>24 A What these exhibits are showing is the</p> <p>25 Destiny product, and the Destiny product runs on</p>
<p style="text-align: right;">Page 207</p> <p>1 not necessarily all the evidence that I'm pointing</p> <p>2 to.</p> <p>3 Q Be that as it may, but you would agree</p> <p>4 that this is not any evidence at all of how the Sony</p> <p>5 PlayStation product works, right? It can't be. It</p> <p>6 has to do with Xbox.</p> <p>7 MR. HANNAH: Objection to form.</p> <p>8 THE WITNESS: Yeah, it does look like it's</p> <p>9 limited to Xbox 360 usage, you know, but, again, I</p> <p>10 mean, this is only one of a number of exhibits that</p> <p>11 I've given for this claim element.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q And another one is 2031, right?</p> <p>14 A Yes.</p> <p>15 MR. TOMASULO: Let's mark that.</p> <p>16 (Exhibit 8 was marked for identification</p> <p>17 by the court reporter.)</p> <p>18 MR. TOMASULO: This would be what exhibit</p> <p>19 number?</p> <p>20 THE REPORTER: 8.</p> <p>21 BY MR. TOMASULO:</p> <p>22 Q And, again, this is an Xbox -- this is --</p> <p>23 looks -- appears to be cover art from an Xbox 360</p> <p>24 version of the Destiny game, right?</p> <p>25 A Yes.</p>	<p style="text-align: right;">Page 209</p> <p>1 multiple game consoles, not just the Xbox 360</p> <p>2 console.</p> <p>3 Q Do you know if it runs the same on each</p> <p>4 console?</p> <p>5 A The Destiny product is an online</p> <p>6 multiplayer game regardless of which game console</p> <p>7 it's running on.</p> <p>8 Q So it would -- as far as these claims are</p> <p>9 concerned, the Xbox functionality is, in your view,</p> <p>10 going to be the same as the Sony functionality?</p> <p>11 A With respect to the features described in</p> <p>12 the '147 patent, they both are online gaming</p> <p>13 platforms that support applications -- or game</p> <p>14 applications such as Destiny to perform the</p> <p>15 functions described in claim six.</p> <p>16 Q Do you think it's reasonable to use</p> <p>17 information about Microsoft-compatible games to</p> <p>18 infer how the Sony PlayStation works? Do you think</p> <p>19 that's reasonable?</p> <p>20 A Not in isolation, which is why I included</p> <p>21 other evidence to also support this nexus view.</p> <p>22 Q Did you choose these exhibits knowing that</p> <p>23 they were Microsoft Xbox exhibits --</p> <p>24 A I chose --</p> <p>25 Q -- or was this a mistake?</p>

<p style="text-align: right;">Page 210</p> <p>1 A I chose these exhibits in combination with  2 the other exhibits for this claim element to show  3 that there's a highly likelihood that the  4 PlayStation product, which also supports the Destiny  5 game, is likely to perform in the same manner.  6 Q But you don't mention that in your charts?  7 You don't say: "I'm using a Microsoft-compatible  8 software to show how the PlayStation works"? I  9 mean, you don't -- you don't explain that, right?  10 MR. HANNAH: Objection to form.  11 THE WITNESS: That's not described in the  12 summary chart, no; that's correct.  13 BY MR. TOMASULO:  14 Q Okay. In any of the Destiny materials  15 that you've relied on, did you determine whether the  16 game was operating the same in the context of the  17 Sony PlayStation or the Microsoft Xbox? Did you  18 determine that?  19 A I did not determine what differences there  20 are between the operation of a game application on  21 the two different platforms.  22 Q But when you read -- you know, you have  23 some exhibit from Destiny or you watch a YouTube  24 video, were you watching it with an eye towards  25 determining whether it was actually talking about</p>	<p style="text-align: right;">Page 212</p> <p>1 A Yes, at that link, yes.  2 Q Okay. And then who -- who made the video  3 or what -- you know, what is the reliability of the  4 video?  5 MR. HANNAH: Objection to form.  6 THE WITNESS: What do you mean by  7 "reliability"?  8 BY MR. TOMASULO:  9 Q Well, what is the video?  10 A It's showing a scene in which multiple  11 participants are communicating over the Internet.  12 Q And what game is this?  13 A Within the context of a broadcast channel.  14 Q And what game is this that's being shown?  15 A I'm trying to remember. I don't remember  16 the exact name of this particular game.  17 Q So it's a screenshot you didn't make from  18 a video you didn't make for a game you can't  19 remember?  20 MR. HANNAH: Objection. Argumentative.  21 THE WITNESS: It's just one in a series of  22 evidences presented in this -- for this claim  23 element that's showing that it's highly likely that  24 the Sony product is -- includes the functionality of  25 the claim limitation.</p>
<p style="text-align: right;">Page 211</p> <p>1 the Sony PlayStation or whether it could have been  2 talking about the Microsoft Xbox or the Wii or a PC  3 version?  4 A Again, as I've said, there are a number of  5 exhibits that I've cited in reference to this  6 particular claim element and not just these first  7 two because, through the preponderance of the  8 evidence, I'm showing that it's highly likely that  9 the PlayStation products are performing these  10 functions, and it was for that reason that this art  11 -- this -- these exhibits are showing Destiny  12 running on the Xbox 360 that I did not stop with  13 these two exhibits but included additional exhibits  14 as well as part of showing the preponderance of  15 evidence.  16 Q Okay. Let's go to Exhibit 2033. Do you  17 see that? That's on page 12.  18 What does Exhibit 2033 refer to?  19 A This is a YouTube video that can be found  20 at this link.  21 Q And did you make this screenshot?  22 A This screenshot was itself captured and  23 shown to me by the attorneys.  24 Q Okay. So not your screenshot.  25 Did you watch the video?</p>	<p style="text-align: right;">Page 213</p> <p>1 BY MR. TOMASULO:  2 Q How does that screenshot show that there's  3 attempting to send a message from a first computer  4 to the second computer?  5 A Well, you can see in this screenshot it's,  6 for example, showing one participant waving to  7 another participant in two different instances.  8 Q Okay. So is -- is it -- if this was a  9 game that was pure client server and the first  10 computer sent the message to the server and then the  11 server sent the message to the second computer,  12 would that meet the claim limitation, in your view?  13 MR. HANNAH: Objection. Form.  14 THE WITNESS: It depends.  15 BY MR. TOMASULO:  16 Q Well, don't -- don't the -- isn't a  17 requirement that the first computer and the second  18 computer be connected to the broadcast channel?  19 A Yes.  20 Q Okay. So can the second computer, then,  21 in this instance be a server?  22 A It's possible.  23 Q Okay. So the second computer could be a  24 server, and that would make the server a member of  25 the broadcast channel?</p>

<p style="text-align: right;">Page 214</p> <p>1 A It's possible.</p> <p>2 Q Okay. So if the server was a member of</p> <p>3 the broadcast channel, could it ever be m-regular</p> <p>4 with m greater than 3?</p> <p>5 A It's possible.</p> <p>6 Q How would -- how would that happen?</p> <p>7 A It depends on the context, but certainly</p> <p>8 possible for any node in a broadcast channel to be</p> <p>9 considered a server.</p> <p>10 Q Okay. So -- but if it -- if -- let's just</p> <p>11 say -- if there was just a single server, then would</p> <p>12 it be possible, if the server was a member of the</p> <p>13 broadcast channel, for the -- for the broadcast</p> <p>14 channel to be m-regular with m greater than 3?</p> <p>15 A It's certainly possible.</p> <p>16 MR. HANNAH: Objection to form.</p> <p>17 BY MR. TOMASULO:</p> <p>18 Q If it's -- if all of the connections are</p> <p>19 only client server so that the players are connected</p> <p>20 directly to the server and not to each other, would</p> <p>21 it be possible for it to be m-regular with m greater</p> <p>22 than 3?</p> <p>23 MR. HANNAH: Objection to form.</p> <p>24 THE WITNESS: For example, if you had a</p> <p>25 plurality of servers, then you can have participants</p>	<p style="text-align: right;">Page 216</p> <p>1 for game play data have just one connection to the</p> <p>2 server and no connections to each other for game</p> <p>3 play data, then that -- that broadcast channel is</p> <p>4 not m-regular with m being at least 3, right?</p> <p>5 MR. HANNAH: Objection. Form.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q Because each of the --</p> <p>8 A So I understand your question, you're</p> <p>9 saying if you were to hypothetically create a</p> <p>10 network that's not an m-regular graph network, it</p> <p>11 is, therefore -- isn't it, therefore, not an</p> <p>12 m-regular graph? And I would say, by definition,</p> <p>13 it's not if you've created a graph that's not an</p> <p>14 m-regular network.</p> <p>15 Q Well --</p> <p>16 A By definition it's not an m-regular graph.</p> <p>17 Q Well, I didn't create a graph. I was just</p> <p>18 hypothesizing about a network.</p> <p>19 So if the network is a client -- you're</p> <p>20 familiar with client server network, right?</p> <p>21 A Yes.</p> <p>22 Q Okay. And in a client server network each</p> <p>23 of the clients is connected to the server but not to</p> <p>24 each other, right?</p> <p>25 A Yes.</p>
<p style="text-align: right;">Page 215</p> <p>1 connecting to server nodes in an m-regular fashion</p> <p>2 and, as such, you would still maintain your</p> <p>3 m-regular graph.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q Okay. So let's assume, though, that</p> <p>6 there's just one server managing the game play data</p> <p>7 and so that all of these players are connected to a</p> <p>8 single server -- one and only server -- and they're</p> <p>9 not connected to each other. The only send and</p> <p>10 receive data from that server. In that instance, if</p> <p>11 the server was a member of the broadcast channel,</p> <p>12 then the broadcast channel is not m-regular with m</p> <p>13 greater than 3, right?</p> <p>14 MR. HANNAH: Objection to form.</p> <p>15 THE WITNESS: So what you're saying is if</p> <p>16 you hypothetically create a network that's not an</p> <p>17 m-regular graph, is it, therefore, not an m-regular</p> <p>18 graph, and I would say yes.</p> <p>19 BY MR. TOMASULO:</p> <p>20 Q Okay. So in this instance how many</p> <p>21 players are there in this screenshot 2033? One,</p> <p>22 two, three, four, five, six -- at least six? Is</p> <p>23 that about right?</p> <p>24 A Seven.</p> <p>25 Q Okay. So if all seven of those players</p>	<p style="text-align: right;">Page 217</p> <p>1 Q Okay. And so in that instance if there</p> <p>2 are more -- if there are several clients and one</p> <p>3 server, then -- and if the server is a member of the</p> <p>4 broadcast channel, then that broadcast channel is</p> <p>5 not m-regular, right?</p> <p>6 MR. HANNAH: Objection. Form.</p> <p>7 THE WITNESS: It may not be true in all</p> <p>8 cases.</p> <p>9 BY MR. TOMASULO:</p> <p>10 Q Okay. In what case could it possibly be</p> <p>11 m-regular if the server is a member -- if there's</p> <p>12 one server and eight clients -- or seven clients --</p> <p>13 if there's one server and seven clients and each of</p> <p>14 the clients is connected to the server and not to</p> <p>15 each other, in what instance can it be m-regular?</p> <p>16 A It depends on the number of total nodes in</p> <p>17 the broadcast channel.</p> <p>18 Q Well, in this instance we've identified</p> <p>19 eight.</p> <p>20 A So what you're saying is you want to</p> <p>21 create a broadcast channel that's not m-regular, and</p> <p>22 the question is is it not m-regular?</p> <p>23 Q No. That's not my question. My question</p> <p>24 is -- is if there's seven players and they're all</p> <p>25 connected to a single server and not to each other,</p>

<p style="text-align: right;">Page 218</p> <p>1 I just want you to acknowledge that that's not 2 m-regular. 3 MR. HANNAH: Objection. Form. 4 THE WITNESS: It really depends. 5 BY MR. TOMASULO: 6 Q Well, I've given you all of the facts. 7 What -- is there some other fact that you are 8 unclear on in my hypothetical? 9 A So in your hypothetical what you're 10 describing is the interconnections of a 11 point-to-point communications network that has eight 12 nodes in it, and overlaid on top of that 13 point-to-point communications network would be a 14 broadcast channel, and since the broadcast channel 15 is an overlay on top of the point-to-point 16 communications network, then a direct link in the 17 broadcast channel does not necessarily correspond to 18 a single link in the point-to-point communications 19 network. 20 Q What is your evidence -- 21 MR. HANNAH: Counsel, we've been going 22 another hour and a half. 23 MR. TOMASULO: Well, do you want to take a 24 break? That's fine. How much time have we -- have 25 we done on the record?</p>	<p style="text-align: right;">Page 220</p> <p>1 Do you see that element? 2 A Yes. 3 Q And then you have said that the Sony 4 PlayStation product meets the recited claim language 5 because when the attempt to send the message is 6 unsuccessful, that includes functionality to 7 broadcast from the first computer a port search 8 message indicating the first computer needs a 9 connection port, right? That's your testimony? 10 A Yes. 11 Q And then you go on to say that "It 12 includes functionality that broadcast from the first 13 computer a connection port search message indicating 14 that the first computer needs a connection when the 15 attempt to send the message is unsuccessful by 16 initiating an attempt by the match server, host 17 server, or peer server to find a connection port to 18 another player that can be used to maintain an 19 m-regular graph in the game session or match or to 20 create an optimized connectivity mesh of players and 21 keep games running whenever PlayStation consoles 22 disconnect from the game by electing a new physics 23 host from one of the remaining players then to get a 24 new authoritative simulation state from the new 25 host, as described in the screenshots below."</p>
<p style="text-align: right;">Page 219</p> <p>1 THE VIDEOGRAPHER: Five hours and fifteen 2 minutes. 3 MR. TOMASULO: Okay. 4 THE VIDEOGRAPHER: Going off record at 5 4:16 p.m. 6 (Recess.) 7 THE VIDEOGRAPHER: Back on record at 8 p.m. 9 BY MR. TOMASULO: 10 Q Can we go to page 17 of your chart, which 11 is Exhibit -- what number is that for the record? 12 MR. TOMASULO: 8. 13 BY MR. TOMASULO: 14 Q 8. Exhibit 8, which is Exhibit 2016 as 15 marked. 16 Are you there? 17 A Yes. 18 Q Okay. So on page 17. And then claim 19 element 6C says that "When the attempt to send the 20 message is unsuccessful --" and that's referring to 21 the message that's referred to element 6B, right? 22 A Yes. 23 Q "Broadcasting from the first computer a 24 port search message indicating that the first 25 computer needs a connection."</p>	<p style="text-align: right;">Page 221</p> <p>1 That's your testimony? 2 A Yes. 3 Q Okay. What is the first computer that 4 broadcasts the port search message? 5 A The first computer would be any of the 6 remaining computers in the broadcast channel which 7 attempts to send a message across the broadcast 8 channel. 9 Q So can -- can you identify a specific -- 10 is it going to be a player? a PlayStation? What -- 11 what specifically are you referring to in this when 12 you say "the first computer"? 13 A The first computer would be, in the 14 context of this chart, the Sony PlayStation product 15 that had connected to the broadcast channel. 16 Q Okay. And -- and does the port selection 17 message -- that goes out on the broadcast channel or 18 it goes out wherever? 19 A The -- 20 MR. HANNAH: Objection. Form. 21 THE WITNESS: The connection port search 22 message is broadcast on the broadcast channel. 23 BY MR. TOMASULO: 24 Q Okay. And that's what the claim requires? 25 A I haven't looked into the full scope of</p>



<p style="text-align: right;">Page 222</p> <p>1 claim six with respect to whether or not a  2 connection port search message can be transmitted  3 outside of the broadcast channel and still meet the  4 claim limitation, but certainly if the connection  5 port search message is transmitted within the  6 broadcast channel, then that would be part of --  7 that would fall within the scope of claim 6C.  8 Q And is that what you're contending is  9 happening here, that the broadcast message is being  10 sent on the broadcast -- I'm sorry -- that the  11 connection port search message is being sent on the  12 broadcast channel? Is that what you're contending  13 is happening here in the page 17?  14 A From the evidence that I've cited, it  15 appears that connection port search messages are  16 being sent within the context of the broadcast  17 channel that is overlaying the underlying Internet  18 and not sent across the entire Internet to any node  19 on the Internet.  20 Q Okay. And then when you're talking about  21 host migration, how is it that host migration if --  22 this claim is directed to the removal of a node,  23 right, and healing a disconnection?  24 A Yes, the healing of the network after a  25 node has been disconnected in an unplanned fashion.</p>	<p style="text-align: right;">Page 224</p> <p>1 the claim?  2 A Well, when you say "satisfy the claim," to  3 me it sounds like you're saying does that prove  4 infringement of the claim. And for that to happen,  5 every claim element needs to be -- needs to be  6 satisfied and not just a node was disconnected and a  7 node was added, but there's a -- the claim elements  8 are very specific about the method for disconnection  9 and healing that need to take place in order to  10 prove infringement.  11 Q Okay. Let's suppose that no node is  12 removed. Does that mean that the claim hasn't been  13 performed?  14 MR. HANNAH: Objection. Form.  15 THE WITNESS: Well, I think, you know,  16 what the claim requires in claim element 6A is for a  17 first computer to be disconnected.  18 BY MR. TOMASULO:  19 Q So you don't agree that this is a process  20 for actually removing a node, claim six?  21 A As I just said, claim element 6A states  22 that the method includes the disconnection of a  23 first computer.  24 Q Okay. And do you agree that it is this --  25 this claim six is directed to removing the node from</p>
<p style="text-align: right;">Page 223</p> <p>1 Q Okay. And so what -- what is the node  2 that you're saying is removed here? A host?  3 A The -- there's a physics host that is  4 disconnected from the broadcast channel, and when  5 that happens, a new physics host has to be  6 determined. So the old physics host is what was  7 disconnected.  8 Q And then they join up with a new physics  9 host, right?  10 A A new physics host is elected for the  11 broadcast channel, yes.  12 Q And is that new physics host already a  13 member of the broadcast channel or can it be someone  14 who is not a member of the broadcast channel?  15 A During this transitory state, I haven't  16 reached an opinion as to whether or not the physics  17 host was -- the new physics host that was elected  18 was already part of the broadcast channel or became  19 connected to the broadcast channel during that  20 transitory state.  21 Q So is there -- is it -- the claim requires  22 removal of a node, right, at a minimum?  23 A Yes.  24 Q Okay. So if you remove a host and replace  25 it with a new host, in your view, does that satisfy</p>	<p style="text-align: right;">Page 225</p> <p>1 the broadcast channel?  2 A Claim six is directed towards an entire  3 method, which includes, as one of its elements, the  4 disconnection of a first computer, but there are  5 many other components that make up claim six besides  6 simply the disconnection of a first computer.  7 Q Do you -- is it -- do you -- so is this a  8 correct statement or not: The -- that claim six is  9 a method for removing a node or participant from an  10 existing network?  11 MR. HANNAH: Objection to form.  12 THE WITNESS: Well, as I said earlier,  13 claim -- there are a number of elements in claim six  14 and a number of things required to satisfy  15 claim six. The disconnection of a first computer is  16 only one of the things that is required in order to  17 meet claim six.  18 BY MR. TOMASULO:  19 Q Okay. So in -- when you're talking about  20 host migration, what -- what is the port connection  21 message that you contend is broadcasting?  22 A The connection port configuration message  23 -- no, the connection port search message is  24 necessarily part of the process of migrating to a  25 new physics host.</p>

<p style="text-align: right;">Page 226</p> <p>1 Q So where is the evidence that a first 2 computer -- well, when you say "broadcast," it means 3 that it goes to everybody on the channel, right? 4 MR. HANNAH: Objection to form. 5 THE WITNESS: A broadcast channel message 6 is called a broadcast because that message is 7 typically distributed throughout all the nodes in 8 the network, but it is not necessarily required that 9 every single node must receive the message for it to 10 be a broadcast message. 11 BY MR. TOMASULO: 12 Q So where -- what do you contend satisfies 13 the requirement that the first computer broadcasts a 14 port search message indicating that the first 15 computer needs a connection? Where is -- where is 16 it shown in your chart that such a message is 17 broadcast by a first computer? 18 A So on page 18 it says: "A host migration 19 occurs whenever the physics hosting console 20 disconnects from the game. In order to keep the 21 game running, we need to elect a new physics host 22 from one of the remaining players," which indicates 23 that any of the remaining nodes that are connected 24 to the broadcast channel can potentially become the 25 new physics host. For that to happen, then a</p>	<p style="text-align: right;">Page 228</p> <p>1 if you're the physics host, then you're actually 2 running two processes. One is that you are the 3 host, and the other is that you are a player, right? 4 A But, again, as we saw -- 5 MR. HANNAH: Form. 6 THE WITNESS: -- at a high level, a 7 physics host is one box called physics host. Within 8 that box there could be a plurality of processes, 9 but at the abstraction of the evidence, a physics 10 host is a single box. 11 BY MR. TOMASULO: 12 Q And a player is a single box? They're 13 different boxes, right? 14 A Not necessarily. They could be coincident 15 on the same hardware platform. 16 Q But they would be different processes on 17 the same hardware platform? 18 A Depending on implementation. 19 Q And so when you add a new physics host, 20 you've added a new process or a new member to the 21 broadcast channel, right? 22 A Not necessarily. 23 Q Okay. What -- under what circumstances 24 would you say that that is not the case? 25 A One could add a new physics host in a</p>
<p style="text-align: right;">Page 227</p> <p>1 connection port search message, you know, is 2 broadcast on the broadcast channel. 3 Q So where is your evidence that the 4 connection ports -- so if -- is the physics host -- 5 what does that mean to be a physics host? Does that 6 mean that they are acting as a server? 7 A The full extent of the physics host 8 functionality is not known at this time but could be 9 ascertained through confidential information that I 10 do not have access to. 11 Q So -- but what do you interpret it to be? 12 Is the physics host -- what does it mean to be a 13 host? What are your interpretation of these -- of 14 the evidence that you have now? What did you think 15 it meant? 16 A So the physics host is required in order 17 to maintain a broadcast channel, and, as is 18 described in the charts, a physics host keeps the 19 simulation state synchronized across all of the 20 participants on a broadcast channel. So without a 21 physics host, there is no synchronization of the 22 game across all of the participants on a particular 23 broadcast channel. 24 Q Isn't a physics host a separate process 25 that's being run so that you are -- if you have --</p>	<p style="text-align: right;">Page 229</p> <p>1 variety of ways. One could do it by adding a new 2 node to the broadcast channel that has a new physics 3 host in it, or one could do it by starting a process 4 on an existing node that is a player and simply 5 adding a new process that's a physics host process, 6 and there are potentially other ways that physics 7 hosts can be introduced into the broadcast channel. 8 Q So your -- is it your contention that when 9 a host migration occurs at the -- that there is a 10 message that constitutes or metes the limitation of 11 a port -- a connection port search message that's 12 broadcast to the existing members of that broadcast 13 channel? 14 A From what the -- what appears in the 15 evidence, the connection port search message of the 16 Sony PlayStation products is broadcast within the 17 scope of the broadcast channel since the underlying 18 point-to-point communications network is the entire 19 Internet, and it does not appear from this evidence 20 that the Sony PlayStation products are sending 21 messages to every node across the entire Internet. 22 Q What is the significance of -- on page 23 21 -- the bubble swap figure? Once you get there, I 24 have a different question. Are you on page 21? 25 A Yes.</p>

<p style="text-align: right;">Page 230</p> <p>1 Q Okay. So you say: "The Sony PlayStation 2 product includes functionality to create m-regular 3 topologies of players." 4 Do you see that? 5 A Yes. 6 Q And you say: "When setting up logical and 7 physical network topologies." 8 Do you see that? 9 A Yes. 10 Q And what's a physical network topology? 11 What do you mean by that? Did you write those 12 words? 13 A Yes, but I'm trying to make sure that I 14 give an accurate explanation of the sentence. 15 A logical topology within the context of 16 the '147 patent would be a topology that relates to 17 the logical broadcast channel, whereas a physical 18 network topology would relate to topologies that 19 exist for the point-to-point communications network. 20 Q Okay. So what is -- what does it mean to 21 set up a physical topology to handle activity in 22 fail-over states? 23 A That would be to establish links in the 24 point-to-point communications network for 25 communication.</p>	<p style="text-align: right;">Page 232</p> <p>1 MR. HANNAH: Objection. Form. 2 THE WITNESS: Within the context of the 3 '147 patent and what the specification teaches, a 4 TCP/IP connection is a link in a network topology. 5 BY MR. TOMASULO: 6 Q Okay. But a T -- a TCP/IP connection is 7 not a physical connection, right? That's what I'm 8 trying to get at. 9 MR. HANNAH: Objection to form. 10 THE WITNESS: A TCP/IP connection is 11 established as part of a point-to-point 12 communications network. 13 BY MR. TOMASULO: 14 Q But it's not a physical connection, right? 15 It's not like a plug? 16 MR. HANNAH: Objection to form. 17 BY MR. TOMASULO: 18 Q It's not wires? 19 A But, again, as part of what the '147 20 patent describes it to be, it is saying that TCP/IP 21 links are part of the network topology of the 22 point-to-point system. 23 Q I'm sorry. But my -- my question is 24 pretty simple. 25 A TCP/IP connection is not a physical</p>
<p style="text-align: right;">Page 231</p> <p>1 Q And that's at the lower levels of the 2 protocol stack -- of the OSI layer? 3 A The point -- 4 MR. HANNAH: Objection. Form. 5 THE WITNESS: The point-to-point 6 communications network underlies the logical 7 broadcast channel. 8 BY MR. TOMASULO: 9 Q Okay. And so what level is the physical 10 network topology that you're referring to here? 11 A So the physical network topology would be 12 the topology that's associated with links in the 13 point-to-point communications network. 14 Q Isn't the point-to-point communication 15 network still a logical connection, a TCP/IP 16 connection? Isn't that a logical connection? 17 MR. HANNAH: Objection to form. 18 THE WITNESS: In the context of the '147 19 patent, there's a distinction between a logical 20 broadcast channel and a point-to-point 21 communications network, but they're not one and the 22 same. 23 BY MR. TOMASULO: 24 Q I understand, but what -- a TCP/IP 25 connection is still a logical construct, isn't it?</p>	<p style="text-align: right;">Page 233</p> <p>1 connection, is it? 2 MR. HANNAH: Objection to form. 3 THE WITNESS: Again, we're talking about 4 the '147 patent. 5 BY MR. TOMASULO: 6 Q We're talking about TCP/IP connection. Is 7 it or is it not a physical connection? 8 A Well, if we want to have a separate 9 discussion outside of the context of the '147 10 patent, then the TCP/IP connection that is formed 11 forms a connection between two computers over an 12 arbitrary network, and underneath the TCP/IP layer 13 you would have additional OSI stack layers leading 14 down to what's called the physical layer, and it's 15 at the physical layer where you would have either 16 wires or wireless communication taking place. 17 Q Okay. And so when you say that "The Sony 18 PlayStation product includes functionality to create 19 m-regular topologies of players when setting up 20 logical and physical network topologies," what do 21 you mean by physical network topologies? 22 A What I'm describing there is that the 23 point-to-point communications network has physical 24 -- has a physical topology to it, that it's a 25 network -- point-to-point communications network</p>

<p style="text-align: right;">Page 234</p> <p>1 such as, for example, the Internet. The Internet is  2 not just some logical, ethereal thing. The Internet  3 is made up of -- of real hardware that is  4 interconnected by real cables and real wireless  5 media, and at -- that are -- that are physical and  6 tangible in nature.  7 So a point-to-point communications network  8 has physical -- a physical topology to it. So  9 that's why I use the word "physical network  10 topologies," to emphasize that this is describing a  11 topology that's actually physical as opposed to a  12 logical one which overlays physical connections.  13 Q Does the Sony PlayStation product set up a  14 physical network topology?  15 A The Sony PlayStation product includes the  16 functionality that's used when one is setting up  17 logical and physical network topologies.  18 Q How does the Sony PlayStation product  19 include functionality that one uses to set up a  20 physical network topology?  21 A So, for example, the matchmaker technology  22 is functionality that is used to establish these  23 logical and physical network topologies. In -- in  24 addition to that, the -- the host migration process  25 is another functionality that's used to set up</p>	<p style="text-align: right;">Page 236</p> <p>1 top of the point-to-point communications network and  2 that it is used by applications for forming logical  3 connections over this underlying point-to-point  4 communications network.  5 Q So do you need to know anything about the  6 physical layer to determine infringement?  7 MR. HANNAH: Objection. Form.  8 BY MR. TOMASULO:  9 Q Or the physical topology as -- physical  10 network topology?  11 Does the physical network topology have  12 anything to do with whether the Sony PlayStation  13 meets this element 6C of the claim?  14 A Whether or not a physical network topology  15 is required by the claim element, I -- I have not  16 reached an opinion on. What I'm saying here is I'm  17 describing not the claim element or the '147 patent.  18 What I'm describing is the Sony PlayStation product.  19 And what I'm saying is that in the process of the  20 PlayStation product establishing physical -- a  21 physical network topology and a logical topology on  22 top of such physical network topology, that it is  23 meeting the nexus requirement for claim element 6C.  24 Q If you go to page 1, you -- let me know  25 when you're there.</p>
<p style="text-align: right;">Page 235</p> <p>1 logical and physical network topologies, and  2 potentially other functions that -- that I haven't  3 mentioned are also part of that whole process.  4 Q What's a physical network topology that  5 Sony sets up?  6 A So, for example, when a PlayStation  7 product communicates to the Internet, it does so  8 using some form of physical media, whether it's a  9 wired physical media or a wireless media, but there  10 needs to be a physical media over which the  11 PlayStation product connects to the point-to-point  12 communications network of the Internet.  13 Q So what does the physical network topology  14 have to do with whether or not this claim limitation  15 is met?  16 A Well, because you have to have a -- a  17 topology of the point-to-point communications  18 network in order to overlay a broadcast channel  19 that's an m-regular graph.  20 Q Now, I thought that the patent, in your  21 view, was directed at the application layer, that it  22 was the connections amongst applications that were  23 edges? I thought that was your testimony?  24 A So it was my testimony from earlier today  25 that the broadcast channel is an overlay channel on</p>	<p style="text-align: right;">Page 237</p> <p>1 A I'm there.  2 Q You say: "The functionality creates  3 m-regular topologies of players when setting up  4 logical and physical network topologies in order to  5 do the following."  6 Are you saying that the functionality  7 creates an m-regular physical topology?  8 A What I'm saying here is that the Sony  9 PlayStation product appears to be establishing  10 m-regular topologies that are a combination of  11 logical and physical network topologies.  12 Q So going back to page 21, this is --  13 what's going on in this? You have -- you say here  14 at the top: "To handle activity in fail-over states  15 when player are -- players are no longer connected  16 or leave via host migration to a new physics host."  17 What is being represented here in this  18 Exhibit 2029?  19 A So in this exhibit -- this exhibit is  20 showing that there is a transient state to the  21 broadcast channel within which host migration  22 occurs. So before the fail-over begins, the network  23 was an m-regular -- had an m-regular topology and  24 that during host migration there's a period of time  25 where the network is being reconfigured, and then</p>


<p style="text-align: right;">Page 238</p> <p>1 after host migration has completed its functions,  2 then what we're left with is a -- again, an  3 m-regular topology.  4 Q Okay. And there's a new host; is that  5 right?  6 A With a new physics host, yes.  7 Q Okay. And so how does that affect the  8 removal of a node from a network if they just have a  9 change from one physics host to another? What does  10 that do to affect the removal of a node -- or does  11 it?  12 A Well, a physics host is a node in the  13 network. So when a new physics host is chosen,  14 you're necessarily disconnecting the old physics  15 host so that messages are not sent to the old  16 physics host in an inadvertent or incorrect fashion.  17 Q So host migration is not something new,  18 right? The patent didn't invent host migration;  19 would you agree with that?  20 MR. HANNAH: Objection to form.  21 THE WITNESS: The patent doesn't use the  22 words "host migration." However, I -- I haven't  23 done an infringement analysis to show whether or not  24 the functionality of host migration is specifically  25 claimed in the asserted claims.</p>	<p style="text-align: right;">Page 240</p> <p>1 specifically as to whether or not the host migration  2 functionality infringes any claim element in the  3 asserted claims.  4 BY MR. TOMASULO:  5 Q But right now you're just not able to do  6 that?  7 A Right now I can't establish that there is  8 a nexus between what's in host migration and the  9 '147 patent based upon evidence in this chart and  10 the fact that a license was taken on the '147 patent  11 at a time when a license didn't necessarily have to  12 be taken.  13 Q Let's go to claim element 6D. But before  14 we do 6D, I have a question.  15 What is UDP?  16 A UDP stands for the User Datagram Protocol.  17 Q Okay. And in User Datagram Protocol, or  18 UDP, when one computer sends another computer a UDP  19 message, there's no acknowledgment returned, right?  20 A The UDP protocol itself does not require  21 that an acknowledgment be sent to a UDP instance;  22 that's correct.  23 Q Okay. So if -- in UDP, when the first  24 computer tries to send a message to a second  25 computer, it doesn't know if the second computer got</p>
<p style="text-align: right;">Page 239</p> <p>1 BY MR. TOMASULO:  2 Q So you're not saying that this actually  3 meets the limitations of the claim? You're just  4 saying it's possible? It's likely? Something like  5 that? What's the point of this?  6 A What I'm showing in this claim chart is  7 that there is a nexus between the functionality in  8 the Sony PlayStation product and the '147 patent  9 inventions.  10 Q Is there a way to do host migration  11 without infringing this claim six of the '147  12 patent?  13 A I don't --  14 MR. HANNAH: Objection. Form.  15 THE WITNESS: I don't know.  16 BY MR. TOMASULO:  17 Q But it's not your testimony that all host  18 migration would meet the limitations of the '147  19 patent, is it?  20 MR. HANNAH: Objection. Form.  21 THE WITNESS: I have not looked at the  22 confidential information regarding the specific  23 functionality of the host migration functionality in  24 the Sony PlayStation product, but if given a chance  25 to do so, then I would be able to render an opinion</p>	<p style="text-align: right;">Page 241</p> <p>1 it, right?  2 MR. HANNAH: Objection. Form.  3 THE WITNESS: The UDP entity itself does  4 not know whether or not the message arrived.  5 BY MR. TOMASULO:  6 Q Right. In TCP/IP there is some  7 verification of arrival process, right?  8 A So for the TCP protocol, the TCP entity  9 waits for an acknowledgment message to be received  10 acknowledging the receipt of the transmitted packet.  11 Q So in the instance if a -- if the  12 communications are being sent by UDP, the sender  13 won't know if its message got to the second  14 computer? The first computer sends a message to the  15 second computer. It won't know if that message was  16 unsuccessful, right?  17 MR. HANNAH: Objection. Form.  18 THE WITNESS: You can't say one way or the  19 other based purely on -- on that information.  20 BY MR. TOMASULO:  21 Q But UDP -- if -- UDP does not include a  22 method for the sender to know if the -- if the  23 second computer received the message from the first  24 computer? UDP just doesn't have that as part of its  25 protocol, right?</p>

<p style="text-align: right;">Page 242</p> <p>1 A Right.</p> <p>2 MR. HANNAH: Objection. Form.</p> <p>3 THE WITNESS: Within the context of UDP,</p> <p>4 there's -- there's no ability to communicate an</p> <p>5 acknowledgment; that's correct.</p> <p>6 BY MR. TOMASULO:</p> <p>7 Q Okay. And if there's a UDP -- let's say</p> <p>8 there's a game where there's -- let's say, game data</p> <p>9 is being sent by UDP and voice data is being sent by</p> <p>10 TCP/IP. Would that -- would those be separate</p> <p>11 broadcast channels, in your view?</p> <p>12 MR. HANNAH: Objection to form.</p> <p>13 THE WITNESS: Maybe yes; maybe no.</p> <p>14 BY MR. TOMASULO:</p> <p>15 Q Okay. So game data and voice data could</p> <p>16 be on the same broadcast channel even if they're</p> <p>17 sent by different protocols?</p> <p>18 A Possibly.</p> <p>19 Q And so what would you look at to make the</p> <p>20 determination in such a scenario -- let's assume a</p> <p>21 very simple scenario where there is a number of</p> <p>22 players that are communicating voice data by TCP/IP</p> <p>23 and game data by UDP. So assume just that.</p> <p>24 What would you look at to determine</p> <p>25 whether that was one, two, or some other number of</p>	<p style="text-align: right;">Page 244</p> <p>1 the '147 patent would inform how many such broadcast</p> <p>2 channels are present in the accused products.</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q What if there's a red team and a blue team</p> <p>5 and the red team can do its -- do a voice chat</p> <p>6 amongst the red team or it can do a voice chat</p> <p>7 amongst everybody? Would those be two separate</p> <p>8 broadcast channels, one for everybody and one for</p> <p>9 just the red team? Are those the same broadcast</p> <p>10 channel?</p> <p>11 MR. HANNAH: Objection. Form. Outside</p> <p>12 the scope.</p> <p>13 THE WITNESS: I would have to look in</p> <p>14 detail at the -- at the products to understand how</p> <p>15 they're performing their functions to be able to the</p> <p>16 answer that question.</p> <p>17 BY MR. TOMASULO:</p> <p>18 Q What would you have to look at?</p> <p>19 A I would have to look at confidential</p> <p>20 information about the products that would be</p> <p>21 included in technical documents. It would be</p> <p>22 included in deposition testimony of engineers at the</p> <p>23 company and potentially even looking at source code.</p> <p>24 Q And what -- what about testing? You could</p> <p>25 test for it, right?</p>
<p style="text-align: right;">Page 243</p> <p>1 broadcast channels? How would you determine that?</p> <p>2 MR. HANNAH: Objection. Form.</p> <p>3 THE WITNESS: Well, first, I would have to</p> <p>4 go back and review the '147 patent specification to</p> <p>5 see what limitations may be described there with</p> <p>6 respect to the transmission of different message</p> <p>7 types using different protocols as to whether or not</p> <p>8 they could be coincident on the same broadcast</p> <p>9 channel or if they necessarily must be transmitted</p> <p>10 on separate broadcast channels, and then I would</p> <p>11 look to the -- the evidence in the accused products</p> <p>12 to determine exactly how these different message</p> <p>13 types are actually transmitted.</p> <p>14 BY MR. TOMASULO:</p> <p>15 Q And then what would that tell you? How</p> <p>16 would that get you to a conclusion about whether</p> <p>17 something was or was not a broadcasted channel?</p> <p>18 MR. HANNAH: Objection. Form. Outside</p> <p>19 the scope.</p> <p>20 THE WITNESS: So, again, once -- so I've</p> <p>21 looked into this question of the full scope of the</p> <p>22 broadcast channel with respect to whether or not</p> <p>23 message -- messages formed with different protocols</p> <p>24 can coexist within a given broadcast channel,</p> <p>25 knowing whether or not that's possible according to</p>	<p style="text-align: right;">Page 245</p> <p>1 MR. HANNAH: Objection. Form.</p> <p>2 THE WITNESS: Depending on the</p> <p>3 implementation, it may or may not be possible to</p> <p>4 accurately test for that condition.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q So 6D -- go to page 28. You say: "The</p> <p>7 Sony PlayStation product meets the recited claim</p> <p>8 language because it includes functionality to have a</p> <p>9 third computer not already connected to said first</p> <p>10 computer respond to said connection port search</p> <p>11 message in the manner as to maintain an m-regular</p> <p>12 graph."</p> <p>13 Do you see that?</p> <p>14 A Yes, yes.</p> <p>15 Q And it's your opinion that the Sony</p> <p>16 PlayStation product meets the requirements of claim</p> <p>17 D because it includes functionality to do that? Is</p> <p>18 that your testimony?</p> <p>19 A Yes.</p> <p>20 Q But you're not saying that it -- that the</p> <p>21 Sony PlayStation product actually performed this</p> <p>22 step? You never observed that it was actually</p> <p>23 performed? You're just saying it has this function,</p> <p>24 right?</p> <p>25 MR. HANNAH: Objection. Form.</p>

<p style="text-align: right;">Page 246</p> <p>1 THE WITNESS: Yeah. What I'm saying is</p> <p>2 that it appears that the -- the functionality of the</p> <p>3 product appears to perform what's called for in</p> <p>4 claim 6D.</p> <p>5 BY MR. TOMASULO:</p> <p>6 Q And so you're saying to have -- it</p> <p>7 includes functionality that a third computer not</p> <p>8 already connected to the first computer respond to</p> <p>9 the connection port search message in a manner to</p> <p>10 maintain the m-regular graph, right?</p> <p>11 A Yes.</p> <p>12 Q So what's the third computer that you rely</p> <p>13 on here in -- in your analysis of element 6D? What</p> <p>14 is -- specifically, what is the third computer?</p> <p>15 A That would be the new -- for example, in</p> <p>16 one of the scenarios that' -- that's disclosed in</p> <p>17 the evidence, the third computer would be the new</p> <p>18 physics host.</p> <p>19 Q And it doesn't matter whether that physics</p> <p>20 host was already a member of the broadcast channel</p> <p>21 or not, in your view?</p> <p>22 A I haven't looked at this claim to</p> <p>23 determine whether or not the new third -- the third</p> <p>24 computer had to have been part of the broadcast</p> <p>25 channel prior to the transmission of the connection</p>	<p style="text-align: right;">Page 248</p> <p>1 graph, although it does not appear in the claim</p> <p>2 chart, certainly the m-regular graph is described at</p> <p>3 length in the '147 patent, which was licensed.</p> <p>4 BY MR. TOMASULO:</p> <p>5 Q Right. So the patent discloses what it</p> <p>6 means to perform the claim, but your chart does not</p> <p>7 include a depiction of what you contend is the final</p> <p>8 product that would meet the m-regular limitation</p> <p>9 after the performance of element 6D, right? It</p> <p>10 doesn't show that?</p> <p>11 MR. HANNAH: Objection. Form.</p> <p>12 THE WITNESS: Well, as I said, even though</p> <p>13 the chart does not have a figure which expressly</p> <p>14 shows an m-regular graph implementation for the</p> <p>15 soft- -- the Sony PlayStation products, my opinion</p> <p>16 about there being a nexus is based on the</p> <p>17 combination of the evidence disclosed in this chart</p> <p>18 and the fact that a license to an m-regular graph</p> <p>19 patent, namely the '147 patent, was taken in</p> <p>20 addition to the development of the functionality</p> <p>21 described in this chart.</p> <p>22 BY MR. TOMASULO:</p> <p>23 Q Okay. So let's just look -- page -- page</p> <p>24 29 you have the three boxes, right: Physics host</p> <p>25 Alice, physics client Bob, physics client Charley,</p>
<p style="text-align: right;">Page 247</p> <p>1 port search message.</p> <p>2 Q Now, are you able to show me what the</p> <p>3 configuration that you are relying on looks like</p> <p>4 after the completion of claim element 6D? Is that</p> <p>5 in your chart or does your chart show a -- a final</p> <p>6 product where the graph has been maintained as</p> <p>7 m-regular?</p> <p>8 MR. HANNAH: Objection to form.</p> <p>9 THE WITNESS: Well, so as I've said, the</p> <p>10 m-regular graph topology is the optimized topology</p> <p>11 for the connectivity mesh of players. So after the</p> <p>12 connection port search message has been sent and a</p> <p>13 new physics host has been selected, then the Sony</p> <p>14 PlayStation products would attempt to achieve that</p> <p>15 optimum state again by again creating an m-regular</p> <p>16 graph that was there prior to the disconnection of</p> <p>17 the physics host.</p> <p>18 BY MR. TOMASULO:</p> <p>19 Q Your chart doesn't actually show a picture</p> <p>20 of an m-regular graph at the end of this, though,</p> <p>21 right? None of the elements in 6D actually show a</p> <p>22 picture of an m-regular graph, right, let alone an</p> <p>23 m-regular graph where m is at least 3?</p> <p>24 MR. HANNAH: Objection to form.</p> <p>25 THE WITNESS: The picture of the m-regular</p>	<p style="text-align: right;">Page 249</p> <p>1 right?</p> <p>2 A Yes.</p> <p>3 Q And that is not an m-regular graph where m</p> <p>4 is at least 3, right?</p> <p>5 MR. HANNAH: Objection to form.</p> <p>6 THE WITNESS: What that is showing is</p> <p>7 three players who are connected over a</p> <p>8 point-to-point communications network in a public</p> <p>9 bubble. The logical broadcast channel that overlays</p> <p>10 that point-to-point communications network is not</p> <p>11 shown.</p> <p>12 BY MR. TOMASULO:</p> <p>13 Q Okay. So this does not show an m-regular</p> <p>14 graph, let alone an m-regular graph where m is at</p> <p>15 least 3, right? It just doesn't?</p> <p>16 A It's showing the point-to-point</p> <p>17 communications network between those three players</p> <p>18 without showing the overlaid logical broadcast</p> <p>19 channel.</p> <p>20 Q Okay. So it doesn't show it, correct?</p> <p>21 MR. HANNAH: Objection. Form.</p> <p>22 THE WITNESS: This figure allows for any</p> <p>23 logical broadcast channel that you want to be</p> <p>24 overlaid on top of the shown point-to-point</p> <p>25 communications network.</p>

<p style="text-align: right;">Page 250</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q Okay. And then going on to the next page,</p> <p>3 page 30, this does not depict an m-regular broadcast</p> <p>4 channel either, does it?</p> <p>5 MR. HANNAH: Objection to form.</p> <p>6 THE WITNESS: So, again, this figure is</p> <p>7 showing the presence of a point-to-point</p> <p>8 communications network which allows for the</p> <p>9 overlaying of a logical broadcast channel that can</p> <p>10 be an m-regular graph.</p> <p>11 BY MR. TOMASULO:</p> <p>12 Q And you don't show the logical overlay</p> <p>13 that is an m-regular graph? It's just not here in</p> <p>14 your chart, right?</p> <p>15 MR. HANNAH: Objection. Form.</p> <p>16 THE WITNESS: I have not shown an</p> <p>17 m-regular graph in this figure.</p> <p>18 BY MR. TOMASULO:</p> <p>19 Q And the same is true for page 31 and 32 as</p> <p>20 well, right? You don't -- you don't show an</p> <p>21 m-regular logical overlay or an m-regular broadcast</p> <p>22 channel or any m regularity at all, right?</p> <p>23 MR. HANNAH: Objection to form.</p> <p>24 THE WITNESS: So what I -- what I show is</p> <p>25 a point-to-point communications network over which</p>	<p style="text-align: right;">Page 252</p> <p>1 figure.</p> <p>2 Q Okay. So you can't do -- and you have</p> <p>3 these charts in here, but you can't draw the</p> <p>4 m-regular logical overlay that you contend meets the</p> <p>5 claim limitation, right? I just want to be very</p> <p>6 clear that you can't do it, sitting here.</p> <p>7 MR. HANNAH: Objection. Form.</p> <p>8 THE WITNESS: In order to prove the</p> <p>9 presence of an m-regular graph, you know, I would</p> <p>10 need access to confidential information regarding</p> <p>11 technical documents and access to engineers and</p> <p>12 potentially source code to be able to determine</p> <p>13 definitively if an m-regular graph is present in the</p> <p>14 Sony PlayStation products.</p> <p>15 BY MR. TOMASULO:</p> <p>16 Q When you're saying "m-regular graph," you</p> <p>17 mean a broadcast channel that is m-regular and m is</p> <p>18 at least 3, right? Not a graph, but a broadcast</p> <p>19 channel, right?</p> <p>20 MR. HANNAH: Objection. Form.</p> <p>21 THE WITNESS: It would be a logical</p> <p>22 broadcast channel that is an m-regular graph where m</p> <p>23 is at least 3 as an overlay to the underlying</p> <p>24 point-to-point communications network.</p> <p>25 //</p>
<p style="text-align: right;">Page 251</p> <p>1 can be overlaid an m-regular graph such as is</p> <p>2 described in the '147 patent.</p> <p>3 BY MR. TOMASULO:</p> <p>4 Q Okay. But you don't show an m -- an</p> <p>5 m-regular broadcast channel in this chart, right, or</p> <p>6 on page 32? You just don't show that, right?</p> <p>7 MR. HANNAH: Objection. Form.</p> <p>8 THE WITNESS: Well, again, what I'm</p> <p>9 showing is the required point-to-point</p> <p>10 communications network that's required by the '147</p> <p>11 patent so that a logical broadcast channel can be</p> <p>12 overlaid.</p> <p>13 BY MR. TOMASULO:</p> <p>14 Q So since you haven't shown the logical</p> <p>15 overlay and you haven't shown the logical broadcast</p> <p>16 channel that's m-regular in the chart, are you able</p> <p>17 to -- to do it right now -- to draw it on top of</p> <p>18 this and show us the logical overlay that would be</p> <p>19 m-regular and where m would be at least 3? Are you</p> <p>20 able to do that --</p> <p>21 MR. HANNAH: Objection. Form.</p> <p>22 BY MR. TOMASULO:</p> <p>23 Q -- since you haven't shown it?</p> <p>24 A I don't think I have sufficient time to do</p> <p>25 a proper infringement analysis based upon this</p>	<p style="text-align: right;">Page 253</p> <p>1 BY MR. TOMASULO:</p> <p>2 Q And you need that information to do that?</p> <p>3 That's your testimony?</p> <p>4 MR. HANNAH: Objection. Form.</p> <p>5 THE WITNESS: To be able to prove</p> <p>6 definitively whether or not the products infringe</p> <p>7 the asserted claims, that's true.</p> <p>8 BY MR. TOMASULO:</p> <p>9 Q Okay. And -- but to even draw it on</p> <p>10 here -- you can't even do that without that</p> <p>11 information? That's your testimony? Just to draw</p> <p>12 the logical broadcast channel and show that it's</p> <p>13 m-regular where m is at least 3, you can't do that</p> <p>14 now if I give you the pen?</p> <p>15 MR. HANNAH: Objection. Form.</p> <p>16 THE WITNESS: I can draw hypothetical</p> <p>17 things on a figure, but for me to reach an opinion</p> <p>18 on infringement, I would require access to the</p> <p>19 confidential information I stated earlier.</p> <p>20 MR. TOMASULO: Okay. Can we take five or</p> <p>21 ten minutes, just kind of see where we are? Maybe</p> <p>22 we don't need to take much more time. I'm not sure.</p> <p>23 MR. HANNAH: Okay.</p> <p>24 THE VIDEOGRAPHER: Going off record at</p> <p>25 5:29 p.m.</p>



<p style="text-align: right;">Page 254</p> <p>1 (Recess.)</p> <p>2 THE VIDEOGRAPHER: Back on record at</p> <p>3 p.m.</p> <p>4 MR. TOMASULO: No further questions.</p> <p>5 MR. HANNAH: We don't have any questions</p> <p>6 for -- further questions for Dr. Bims at this time,</p> <p>7 but we will review and sign the transcript.</p> <p>8 THE VIDEOGRAPHER: Okay. We are off</p> <p>9 record at 5:40 p.m., and this concludes today's</p> <p>10 testimony given by Dr. Harry Bims. Media will be</p> <p>11 retained by Veritext Legal Solutions. Thank you.</p> <p>12 (TIME NOTED: 5:40 P.M.)</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p style="text-align: right;">Page 256</p> <p>1 I, the undersigned, a Certified Shorthand</p> <p>2 Reporter of the State of California, do hereby</p> <p>3 certify:</p> <p>4 That the foregoing proceedings were taken</p> <p>5 before me at the time and place herein set forth;</p> <p>6 that any witnesses in the foregoing proceedings,</p> <p>7 prior to testifying, were administered an oath; that</p> <p>8 a record of the proceedings was made by me using</p> <p>9 machine shorthand which was thereafter transcribed</p> <p>10 under my direction; that the foregoing is a true</p> <p>11 record of the testimony given.</p> <p>12 Further, that if the foregoing pertains to the</p> <p>13 original transcript of a deposition in a Federal</p> <p>14 Case, before completion of the proceedings, review</p> <p>15 of the transcript [ ] was [ ] was not requested.</p> <p>16 I further certify that I am neither</p> <p>17 financially interested in the action nor a relative</p> <p>18 or employee of any attorney or any party to this</p> <p>19 action.</p> <p>20 IN WITNESS WHEREOF, I have this date</p> <p>21 subscribed my name.</p> <p>22 Dated: 2/10/17</p> <p>23</p> <p>24  Catherine A. Kyan, RMR, CRR</p> <p>25 CSR No. 8239</p>																																										
<p style="text-align: right;">Page 255</p> <p>1 ACKNOWLEDGMENT OF DEPONENT</p> <p>2 I, Harry Bims, Ph.D., do hereby certify</p> <p>3 that I have read the foregoing transcript of my</p> <p>4 testimony, and further certify that it is a true</p> <p>5 and accurate record of my testimony (with the</p> <p>6 exception of the corrections listed below):</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Page</th> <th style="width: 10%;">Line</th> <th style="width: 80%;">Correction</th> </tr> </thead> <tbody> <tr><td>8</td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td></tr> <tr><td>11</td><td></td><td></td></tr> <tr><td>12</td><td></td><td></td></tr> <tr><td>13</td><td></td><td></td></tr> <tr><td>14</td><td></td><td></td></tr> <tr><td>15</td><td></td><td></td></tr> <tr><td>16</td><td></td><td></td></tr> <tr><td>17</td><td></td><td></td></tr> <tr><td>18</td><td></td><td></td></tr> <tr><td>19</td><td></td><td></td></tr> <tr><td>20</td><td></td><td></td></tr> </tbody> </table> <p>21</p> <p>22 Signed under the pains and penalties of perjury</p> <p>23 this ____ day of _____, 20__.</p> <p>24</p> <p>25</p>	Page	Line	Correction	8			9			10			11			12			13			14			15			16			17			18			19			20			
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# Appendix A

**EXHIBIT**

**1**

**Bims**

2/7/2017 C.A.R.



**Dr. Harry V. Bims**  
**1314 Chilco Street**  
**Menlo Park, CA 94025**  
[harrybims@me.com](mailto:harrybims@me.com)  
**650-283-4174**

## PROFESSIONAL SUMMARY

Harry Bims, PhD, EE, provides expert witness support services for telecommunications-related intellectual property litigation. These services include deposition and court testimony, expert reports, and infringement research, for patent, copyright, and trade secret litigation matters. He has 17+ years of telecommunications industry experience, and holds eighteen US patents in network architecture and chip design for wireless communications.

## EMPLOYMENT HISTORY

**12/2001 - 05/2004   AirFlow Networks, Inc. LLC   •   Sunnyvale, California**

**Position:** *CEO/CTO & Founder*

As the sole founder of the company, created the original business plan, raised venture capital, and hired the core engineering team. Grew the company to 32 people and shipped products for revenue in the US and overseas. Fifteen patents on the core technology have issued. These patents, which relate to wireless network infrastructure based on the 802.11 specification, have been sold to Broadcom.

**03/2001 - 12/2001   Bay Partners LLC   •   Cupertino, California**

**Position:** *Entrepreneur in Residence*

Reported to the partners of this VC firm as a technology expert on a range of wireless and networking subjects. Reviewed business plans and participated in due diligence activities related to several startups seeking funding. Developed a business plan for a startup that builds network infrastructure for 802.11 enterprise networks.

**09/1999 - 03/2001   Symmetry Communications Systems LLC   •   San Jose, California**

**Position:** *Director, Software Architecture*

Reporting to the CEO, responsible for the software architecture of their core

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SGSN and GGSN products for the GPRS market. Formulated a software technology roadmap, showing the evolution from 2.5G to 3G SGSN and GGSN products. Management responsibility for Firmware, Hardware, Performance, and Systems Engineering Groups. Provided management support of early field trials of the system on a global basis.

07/1999 - 09/1999 **T-SPAN Systems Corporation LLC • Palo Alto, California**

Position: *Member of Technical Staff*

Designed a wireless home LAN protocol for the company. Also designed and built a PC-based platform to demonstrate their technology. Company is now publicly traded as Atheros Communications.

07/1992 - 12/1998 **Glenayre Technologies-Wireless Access Group • San Jose, California**

Position: *Member of Technical Staff; Sr. Member of Technical Staff; Manager of NOC Systems*

Employee #6 at the company, which was acquired by Glenayre Technologies, Nov 1997. Designed and built a 4-channel ReFLEX50 pager demonstration in 1 week. Participated in early field trials and feasibility studies, culminating in a Pioneer's Preference license award from the FCC to SkyTel Corporation for Narrowband PCS development.

Invented, designed, and built from concept through full implementation, a patented two-way pager test system for the ReFLEX50 and ReFLEX25 protocols. This system was used throughout company operations for performance testing of the ReFLEX pager designs from Wireless Access, and Motorola. Over 16 systems were deployed around the country for manufacturing tests, engineering protocol tests, antenna tests, and pager repair tests.

The project required technical skills in PC hardware design, C++, object-oriented programming, signal processing techniques, NT device driver development, Win32 user interface development, real-time, multi-threaded control, and proficiency with wireless communications lab equipment. Three patents have been issued based on technical inventions in this capacity.

Co-developed a wireless application protocol for sending and receiving encrypted email messages over the paging channel. Led the project team that deployed a software encryption module based on this protocol for government agencies.

### Bims Laboratories, LLC Work History

6/2009 – 7/2009 **Eastman Kodak Company • Rochester, NY**

Position: *Technology Consultant*

Providing technology assessment on certain wireless communication patents.

10/2009 – Present **IEEE 802.16 Working Group**

Position: *Task Group Secretary, Task Group Vice-Chair, Task Group Chair, Working Group Vice-Chair & Secretary*

Served in several leadership capacities within this group that is working on improvements to the IEEE 802.16 standard, otherwise known as WiMAX.

2/2014 – Present **Access Network Protocol Development**

Position: *Technical Lead Developer*

Developing a C++14-based DES of SDRs for wired and wireless network protocols, that includes IMT-2020 channel models. Implementations of the IEEE 802 and LTE protocol families, plus digital cable, Bluetooth, DSL, frame relay and many more are managed nodes for smart grid and vertical IoT applications.

### Protocomm Systems, LLC Consulting History

04/1999–07/1999 **Gigabit Wireless, Inc. • San Jose, California**

Position: *Technical Leader*

Technical leader for the Wireless MAC design group. Responsible for comparative analysis of competing wireless MAC protocol standards. Responsible for the creation of a proprietary MAC protocol specification document, simulation of the protocol, and implementation in a prototype. Participated in early 802.16 protocol standards. This company was acquired by Intel Corporation.

3/2007 – 10/2009 **Apple, Inc. • Cupertino, CA**

Position: *Technology Consultant*

Participating in IEEE 802.16 standards meetings as an affiliate of the client.

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7/2003 – Present **Various expert witness engagements (see below)**

Position: *Technical Expert Witness*

Testified as a wireless technology expert in patent infringement cases. For a list of such cases, see below.

### **Technical Expert Witness Experience**

12/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Acceleration Bay, LLC.)**

Case: Activision Blizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., 2K Sports, Inc., Rockstar Games, Inc., and Bungie, Inc., Petitioner v. Acceleration Bay, LLC, Patent Owner.

Case IPR2015-01951, Case IPR2015-01953, Case IPR2015-01964, Case IPR2015-01970, Case IPR2015-01996

Location: UNITED STATES PATENT AND TRADEMARK OFFICE

Testifying expert in this IPR patent case involving internet data broadcasting.

Expert Declaration:

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,714,966;  
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,829,634;  
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,701,344;  
Secondary Considerations of Non-Obviousness

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Ongoing

12/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Sophos, Inc.

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Civil Action No. 3:14-cv-01197-WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

December 21, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

February 22, 2016

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Case settled

9/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Proofpoint, Inc. and Armorize Technologies, Inc.

Civil Action No. 13:cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

October 7, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

November 6, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Quinn Emanuel

Status: Jury award.

10/2014 – 2/2015 **Client: Alston & Bird (representing Microsoft Corporation)**

Case: Microsoft Corporation. v. IPR Licensing, Inc.

Location: INTER PARTES REVIEW BEFORE THE PATENT TRIAL AND APPEAL BOARD

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Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

10-16-14 Supplemental Declaration ISO Petition for Inter Partes Review of U.  
S. Patent No. 8,380,244

Attorneys: For Plaintiff: Alston & Bird LLP

For Defendant:

Status: Case settled

9/2014 – 4/2015 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc.

Civil Action No. 2:13-cv-883-JRG-RSP

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS MARSHALL DIVISION

Testifying expert in this patent case involving package delivery notification  
systems.

Expert Reports:

2-10-15 Expert Report on Infringement

2-24-15 Supplemental Expert Report on Infringement

Videotaped Deposition:

2-25-15

Declaration:

3-20-15 Declaration ISO Response to Opposition Motion

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Greenberg Traurig LLP

Status: Case settled

5/2014 – 7/2015 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Blue Coat Systems, Inc.

Civil Action No. 3:13-cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF

CALIFORNIA SAN JOSE DIVISION

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

January 12, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

March 18, 2015

Live Jury Trial Testimony: July 20, 2015.

Live Bench Trial on Laches Testimony: September 8, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Wilson Sonsini

Status: Jury award.

2/2013 – Present **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. BlackBerry Corporation.

Civil Action No. 3:12-cv-1652-M

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF TEXAS DALLAS DIVISION

Testifying expert in this patent case involving package delivery notification systems.

Expert Reports:

9-3-15 Expert Report on Infringement

Videotaped Depositions:

Attorneys: For Plaintiff: Baker Botts, LLP

For Defendant: Reed & Scardino LLP

Status: Jury verdict of non-infringement.

4/2014 – Present **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. United Parcel Service, Inc.

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Civil Action No. 1:12-cv-03222-AT

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF  
GEORGIA ATLANTA DIVISION

Testifying expert in this patent case involving package delivery notification  
systems.

Expert Reports:

7-3-14 Opening Expert Report regarding Infringement

8-11-14 Rebuttal Expert Report regarding Infringement

Videotaped Depositions:

10-7-14

Declaration:

11-24-14 Declaration ISO Response to MSJ

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Alston & Bird LLP

Status: Case settled.

1/2014 – Present **Client: Fish & Richardson P.C. (representing Samsung)**

Case: Telefonaktiebolaget LM Ericsson v Samsung Electronics Co., Ltd, et. al.

Civil Action No. 6:12-cv-894

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS

Testifying expert in this patent case involving satellite radio technology.

Expert Declarations and Reports:

None.

Attorneys: For Plaintiff:

For Defendant: Fish & Richardson P.C.

Status: Case settled.

12/2013 – **Client: Brinks Gilson & Lione LLP (representing ZTE Corp, and ZTE**  
09/2015 **(USA), Inc.)**

Case: ZTE Corporation and ZTE (USA) Inc. v. InterDigital Technology Corporation

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Location: INTER PARTES REVIEW BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

3-21-14 Declaration in support of the Petition for Inter Partes Review of U. S. Patent No. 8,380,244

Attorneys: For Plaintiff: Brinks Gilson & Lione

For Defendant: Latham & Watkins, LLP

Status: IPR Hearing before PTAB: All disputed claims are unpatentable.

12/2013 – 4/2014 **Client: Kramer Levin Naftalis & Frankel LLP (representing Sirius XM Radio Inc.)**

Case: Catch a Wave Technologies, Inc. v. Sirius XM Radio Inc.

Case No. 3:12-cv-05791-WHA

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

Testifying expert in this patent case involving satellite radio systems.

Expert Reports:

2-14-2014 Expert Report regarding non-infringement

Attorneys: For Plaintiff: Freitas Tseng & Kaufman LLP

For Defendant: Kramer Levin LLP

Status: Case settled

2/2013 – 10/2013 **Client: Seyfarth Shaw LLP (representing Motorola Mobility LLC)**

Case: University of Florida Research Foundation, Inc. and Rapid mobile Technologies, Inc. v. Motorola Mobility LLC

Civil Action No. 13-cv-61120-KMM-EGT

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA

Testifying expert in this employment law case involving mobile device testing systems.

Expert Reports:

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3-1-13 Expert Report regarding Non-Infringement

4-1-13 Declaration in Opposition to Plaintiff's MSJ

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Seyfarth Shaw LLP

Status: Case settled

9/2013 – 1/2014 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies, LLC v Clearwire Corporation

Civil Action No. 2:12-CV-308

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS MARSHALL DIVISION

Testifying expert in this patent case involving wireless networking signals.

Expert Reports:

11-11-13 Rebuttal report regarding validity

Videotaped Depositions:

12-5-13

Declarations:

1-23-14 Declaration before the Patent Trial and Appeal Board in Case IPR2013-00306

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Shook, Hardy & Bacon, LLP

Status: Case settled

10/2013 – 5/2015 **Client: Foley & Lardner, LLP (representing Motorola Mobility, LLC)**

Case: University of Florida Research Foundation Inc., and Rapid Mobile Technologies, Inc. v Motorola Mobility, LLC.

Case No. 13-cv-61120-KMM-EGT

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA FORT LAUDERDALE DIVISION

Testifying expert in this patent case involving mobile device testing systems.

Expert Reports:

None.

Declarations:

11-21-13 Declaration ISO Motorola's Responsive Claim Construction Brief

Attorneys: For Plaintiff: Meltzer & Meksraitis

For Defendant: Foley & Lardner LLP

Status: Case settled

7/2013 – 6/2015 **Client: WilmerHale (representing Broadcom)**

Case: Inter Partes Review of US Patent 6,424,625; 6,772,215; and 6,466,568 owned by Ericsson

Docket No. 0111168-0240

Location: UNITED STATES PATENT AND TRADEMARK OFFICE

Testifying expert in this Inter Partes Review regarding ARQ mechanisms.

Expert Declarations:

9-19-13 Declaration regarding US Patent 6,772,215

9-19-13 Declaration regarding US Patent 6,466,568

9-29-13 Declaration regarding US Patent 6,424,625

Videotaped Deposition:

5-29-14, and 5-30-14

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Wilmer Cutler Pickering Hale and Dorr LLP

Status: Case settled

4/2013 – 4/2015 **Client: Kilpatrick Townsend & Stockton LLP (representing Google Inc. and Motorola Mobility LLC)**

Case: Fujifilm Corporation v. Motorola Mobility LLC

Case No. 3:12-cv-03587 WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

Testifying expert in this patent case involving smartphone technology.

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Expert Declarations:

4-23-14 Declaration ISO Motion for Protective Order

12-9-14 Declaration ISO MSJ

Expert Reports:

10-3-14 Opening Expert Report Regarding Invalidity

10-31-14 Rebuttal Expert Report on non-infringement

10-31-14 Appendix A to Rebuttal Report of Dr. Alan Bovik

Videotaped Deposition:

11-19-14, and 11-20-14

Trial Testimony:

April 28, 2015 Non-infringement and invalidity of '970 Patent

Attorneys: For Plaintiff: Morgan, Lewis & Bockius LLP

For Defendant: Kilpatrick Townsend & Stockton LLP

Status: Jury verdict: '970 Patent claims not infringed and invalid.

8/2012 – 4/2013 **Client: Paul Hastings LLP (representing Apple, Inc.)**

Case: SmartPhone Technologies, LLC v Research in Motion Corporation, et. al.

Case No. 6:10-cv-00074

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving 3GPP technology.

Expert Reports:

12-31-12 Appendix A to Rebuttal Expert Report of Dr. David Wilson

3-13-13 Appendix A to Supplemental Expert Report of Dr. David Wilson

Attorneys: For Plaintiff: Mintz Levin Cohn Ferris Glovsky and Popeo PC

For Defendant: Paul Hastings LLP

Status: Case settled

8/2012 – 9/2013 **Client: Reed & Scardino, LLP (representing EON Corp. IP Holdings, LLC)**

Case: EON Corp. IP Holdings, LLC v. SKYGUARD, LLC et. al.

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Case No. 6:11-cv-00015-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

2-15-13 Expert Report regarding Infringement

4-09-13 Videotaped deposition

Attorneys: For Plaintiff: Reed & Scardino, LLP

For Defendant: K&L GATES LLP

Status: Case settled

5/2012 – 6/2014 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Landis+Gyr, Inc., et. al.

Case No. 6:09-cv-00317-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks, before Judge Love.

Expert Report:

7-8-13 Expert Report regarding Infringement by Silver Spring Networks, Inc.

7-8-13 Expert Report regarding Infringement by Itron, Inc.

6-2-14 – 6-6-14 District Court trial testimony.

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Dentons, LLP

Status: Jury award. All patents found valid and infringed.

3/2012 – 3/2014 **Client: Perkins Coie (representing Intel Corporation)**

Case: Stragent LLC, et. al. v. Intel Corp.,

Case No. 6:11-cv-421-LED (E.D. Tex.)

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving the use of error detection technology in computer networking, before Judge Dyk.

Expert Reports:

08-23-13 Expert Report regarding Invalidity

09-23-13 Expert Report regarding Non-Infringement

Videotaped Deposition:

10-08-13, and 10-09-13

Jury trial testimony:

3-13-2014 Live trial testimony on non-infringement and invalidity before Judge Timothy Dyk

Attorneys: For Plaintiff: Nelson, Bumgardner & Casto

For Defendant: Perkins Coie

Status: Jury verdict for non-infringement and invalidity

2/2012 – 09/2015 **Client: Dewey & LeBoeuf LLP (representing Harris Corporation)**

Case: Harris Corporation v. Ruckus Wireless, Inc.

Case No. 6:11-cv-00618-CEM-CRS

Location: UNITED STATES DISTRICT COURT FOR THE MIDDLE DISTRICT OF FLORIDA ORLANDO DIVISION

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

3-5-12 Expert Report regarding Infringement

3-6-12 Supplemental Expert Report regarding Infringement

4-6-12 Expert Report regarding Validity

Declarations:

5-30-12 Declaration ISO Claim Construction

6-18-12 Declaration ISO Markman Motion

1-23-15 Declaration ISO Responsive Markman Brief

3-6-15 Supplemental Expert Report regarding Infringement

4-3-15 Rebuttal Expert Report regarding Validity

Videotaped Deposition:

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4-30-12

Attorneys: For Plaintiff: Dewey & LeBeouf LLP

For Defendant: Lewis and Roca LLP

Status: Case settled

2/2012 – 2/2012 **Client: Common-Interest-Group (representing Nokia, Huawei, ZTE)**

Case: InterDigital Communications LLC, et. al. v. Huawei Tech Co., LTD., et. al.

Certain Wireless Devices With 3G Capabilities and Components Thereof

U.S. Int'l Trade Commission Inv. No. 337-TA-800

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION

Testifying expert in this patent case involving 3G wireless, WiFi, and WCDMA technology.

Expert Reports:

11-30-12 Expert Report regarding Non-infringement

7-31-12 Expert Report regarding Invalidity

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Videotaped Deposition:

12-14-12, 12-15-12

ITC Trial testimony:

2-15-12 Non-infringement and Invalidity witness statements, live testimony

Attorneys: For Plaintiff: Latham & Watkins, LLP

For Defendant: Alston & Bird, Covington & Burling, Brinks Hofer

Status: ITC hearing verdict: All patents not infringed and invalid

9/2010 – 4/2011 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Sensus USA, Inc., et. al.

Case No. 6:09-cv-00116-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks

Expert Report:

10-22-10 Expert Report regarding Infringement (Sensus USA, Inc)

11-7-10 Expert Report regarding Infringement (Bell Industries)

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Declaration:

12-28-10, 1-18-11

Videotaped Deposition:

12-8-10, 2-3-11

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Jones Day

Status: Case settled

8/2010 – 6/2011 **Client: Sidley Austin LLP (representing Research in Motion Limited)**

Case: SimpleAir, Inc. v. Research in Motion Limited and Research in Motion Corporation, et. al.

Case No. 2:09-cv-00289-CE

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks

Declaration:

5-13-11

Videotaped Deposition:

5-24-11

Attorneys: For Plaintiff: Dovel & Luner, LLP

For Defendant: Sidley Austin LLP

Status: Case settled

10/2009 – 2/2010 **Client: White & Case LLP (representing Marvell)**

Case: Marvell Semiconductor, Inc., et. al. v. Commonwealth Scientific Industrial Research Organisation



Case No. 6:07-CV-204 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving wireless LAN protocols.

Expert Report:

11-24-09 Rebuttal Expert Report

Videotaped Deposition:

01-07-10

Attorneys: For Plaintiff: White & Case LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Case settled

9/2009 – 2/2010 **Client: Perkins Coie Brown & Bain PA (representing Intel)**

Case: Saxon Innovations, LLC v. Apple, Inc., et. al.

Case No. 6:08-cv-00265-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS TYLER DIVISION

Testifying expert in this patent case involving wireless technology.

Declarations:

12-04-09 Declaration Regarding Claim Construction

Videotaped Deposition:

01-19-10

Attorneys: For Plaintiff: Susman Godfrey LLP

For Defendant: Perkins Coie Brown & Bain LLP

Status: Case settled

8/2008 – 10/2009 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Verizon Clinton Center Drive Corp., et. al.

Case No. 6:08-cv-00385

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks

Expert Report:

06-22-10 Expert Report

08-16-10 Supplemental Expert Report

Videotaped Depositions:

08-18-10, 08-26-10

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Simpson Thacher & Bartlett LLP

Status: Case settled

4/2008 – 3/2009 **Client: McDermott, Will & Emery LLP (representing GE Licensing)**

Case: CIF Licensing, LLC d/b/a GE Licensing v. Agere Systems, Inc.

Case No. 07-170 (JJF)

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Testifying expert in this patent case involving modem technology.

Expert Report:

09-05-08 Rebuttal Expert Report

Non-videotaped Depositions:

9-24-08, 9-26-08

Jury trial testimony:

2-04-09

Attorneys: For Plaintiff: McDermott, Will & Emery LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Jury award. 2 patents infringed and valid, remaining 2 patents non-infringed

2/2008 – 5/2010, **Client: Simpson Thacher & Bartlett LLP (representing Cisco Systems, Inc.)**  
2/2011 – 4/2011

Case: Commil USA, LLC v. Cisco Systems, Inc., et. al.

Case No. 2:07-CV-341-DF-CE

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert on invalidity regarding short range communication protocols.

Opening Expert Report

12-23-09

Videotaped Depositions:

02-09-10

Attorneys: For Plaintiff: Sayles Werbner

For Defendant: Simpson Thacher & Bartlett LLP

Status: Jury award for original trial and retrial: patents found valid and infringed.

6/2007 – 4/2009 **Client: Common Interest Group of Co-Defendants**

11/2010 – 4/2012 **Client: Common Interest Group of Co-Defendants**

Case: Commonwealth Scientific and Industrial Research Organisation v. Toshiba America Information Systems, Inc., et. al.

Case No. 6:06-cv-00550-LED

Case No. 6:09-CV-0399 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving wireless LAN technology.

Declarations:

06-05-08 Regarding claim construction

12-17-08 Supporting opposition to summary judgment

04-05-09 Supporting motion for reconsideration

02-24-12 Supporting opposition to summary judgment

Expert Reports:

10-08-08 Rebuttal Expert Reports- Re: TI Chips, Re: Marvell Chips, Re: Airgo Chips, Re: Broadcom Chips, Re: Conexant Chips, Re: Ralink Chips, Re: Atheros Chips

01-27-12 Rebuttal Expert Reports- Re: TI Chips, Re: Broadcom Chips, Re: Ralink Chips, Re: Atheros Chips

Videotaped Depositions:

11-1-08, 11-2-08, 02-14-12

Attorneys: For Plaintiff: Townsend & Townsend LLP

Last Update: November 25 2016

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For Defendant: Keker & Van Nest, LLP

Status: Jury trial: patents found valid and infringed.

10/2006 – 8/2009 **Client: Keker & Van Nest (representing Comcast Corporation)**

Case: Rembrandt Technologies, Inc. v. Comcast Corporation

Case No. 2-05CV-000443 (TJW)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert in this patent case involving physical layer and data link layer communication protocols for cable networks.

Declaration:

01-10-07 Support of Claim Construction Brief

Videotaped Deposition:

12-22-06 Regarding claim construction opinions

Attorneys: For Plaintiff: McKool Smith

For Defendant: Keker & Van Nest

Status: Case settled

3/2007 – 5/2007 **Client: Niro, Scavone, Haller and Niro (representing MLR, LLC)**

Case: MLR, LLC v. Kyocera Wireless Corporation and Novatel Wireless, Inc.

Case No. 05-CV-0935 B (AJB)

Location: UNITED STATES DISTRICT COURT SOUTHERN DISTRICT OF  
CALIFORNIA

Testifying expert in this patent case involving cellular phone technology.

Expert Report:

04-20-07 Expert Report regarding infringement

Attorneys: For Plaintiff: Niro, Scavone, Haller, and Niro

For Defendant: Hogan & Hartson, LLP

Status: Case settled

6/2006 – 10/2006 **Client: Thompson & Knight (representing Ericsson, Inc.)**

Case: Fenner Investments, Ltd., v. Juniper Networks, Inc. et. al.  
Case No. 2:05–CV–05 JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert in this patent case involving wireless communications services.

Expert report regarding infringement and invalidity

5-23-06 Rebuttal expert report regarding infringement and invalidity

Attorneys: For Plaintiff: Fulbright & Jaworski

For Defendant Ericsson: Thompson & Knight

Status: Case settled

12/2003 – 5/2006 **Client: Howrey LLP/ Winston & Strawn LLP (representing McKesson Information Solutions, Inc.)**

Case: McKesson Information Solutions, Inc. vs. Bridge Medical, Inc.  
Case No. CIV S-02-2669 FCD KJM

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF  
CALIFORNIA

Testifying expert in this patent case involving a patient on a patient identification  
and verification system that incorporates wireless technology.

Inequitable Conduct Trial live testimony:

5-04-06

Markman Hearing live testimony:

6-29/30-05

Videotaped Depositions:

2-14-04, 6-3-05

Declarations:

12-1-03 Dec. in support of MISI's Opening/Opposition re Claim Construction

12-24-04 Dec. in support of MISI's Motion for Preliminary Injunction

3-1-04 Dec. in support of Claim Construction

6-29-04 Dec. re meaning of "Communication"

7/15/05 Dec. in support of MISI's Opposition to Bridge's Motion for  
Summary Judgment

Attorneys: For Defendant: Morrison & Foerster

Last Update: November 25 2016

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For Plaintiff: Howrey Simon, Winston & Strawn, Morgan Lewis

Status: Bench trial on inequitable conduct: Verdict found inequitable conduct.

07/2003–02/2006 **Client: Heller Ehrman LLP (representing Texas Instruments, Inc.)**

Case: Texas Instruments, Inc. and Stanford University vs. GlobespanVirata, Inc.

Provided discovery of evidence used at trial, concerning the structure and operation of Globespan's ADSL products, and supported litigators in depositions of Globespan engineers.

Attorneys: For Plaintiff: Heller Ehrman

For Defendant: Covington & Burling, LLP

Status: Jury award.

### Patents

<u>Patent Number</u>	<u>Date Issued</u>	<u>Title</u>
8,995,996	March 31, 2015	Methods and apparatus for performance optimization of heterogeneous wireless system communities
8,935,580	January 13, 2015	Multimedia-aware quality-of-service and error correction provisioning
8,468,426	June 18, 2013	Multimedia-aware quality-of-service and error correction provisioning
8,189,538	May 29, 2012	Reconfiguration of a communication system
8,144,640	March 27, 2012	Location tracking in a wireless communication system using power levels of packets received by repeaters
8,064,380	November 22, 2011	Reconfiguration of a communication system
8,027,637	September 27, 2011	Single frequency wireless communication system
7,957,741	June 7, 2011	Token-based receiver diversity
7,876,704	January 25, 2011	Tunneling protocols for wireless communications
7,689,210	March 30, 2010	Plug-n-playable wireless communication system
7,672,274	March 2, 2010	Mobility support via routing
7,668,542	February 23, 2010	Token-based receiver diversity
7,515,557	Apr 7, 2009	Reconfiguration of a communication system

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7,236,470	Jun 26, 2007	Tracking multiple interface connections by mobile stations
7,149,196	Dec 12, 2006	Location tracking in a wireless communication system using power levels of packets received by repeater
6,965,769	Nov 15, 2005	Testing Center
6,862,448	Mar 1, 2005	Token-based receiver diversity
6,788,658	Sep 7, 2004	Wireless communication system architecture having split MAC layer
6,760,318	Jul 6, 2004	Receiver diversity in a communication system
6,557,134	Apr 29, 2003	ARQ method for wireless communication
6,259,911	Jul 10, 2001	Network operations center hardware and software design

### Education

Year	College/University	Degree
1993	Stanford University	PhD, Electrical Engineering Thesis: "Trellis Coding for Multi-Level, Partial-Response Continuous Phase Modulation with Precoding"
1988	Stanford University	MS, Electrical Engineering
1985	Rensselaer Polytechnic Institute	BS, Computer and Systems Engineering

### Publications

Goldhamer, M., Grandblaise, D., Bims, H., Feng, S., Piggini, P., Sydor, J., and Wu, X. "Coexistence between 802.16 Systems Operating in Shared Bands", *Radio Resource Management in WiMAX*, John Wiley & Sons, 2009.

Bims, Harry. "Surveying the Wireless LANDscape. Or Why Large Wi-Fi Networks Require Good Planning." *Xchange*. [Online] Available <http://www.xchangemag.com/articles/391supsys1.html>, September 1, 2003.

Bims, Harry. "Building Voice-Ready Wireless LANs" *Wireless Week*. [Online] Available <http://www.wirelessweek.com/article/CA319429.html?spacedesc=Departments>, September 1, 2003.

Bims, Harry. "Enabling Voice over WLANs". White Paper. [Online] Available. [http://airflownetworks.com/solutions/pdf/vowlan\\_wp.pdf](http://airflownetworks.com/solutions/pdf/vowlan_wp.pdf). September 2003.

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Bims, Harry. "Securing Enterprise WLANs". White Paper. [Online] Available.  
[http://web.archive.org/web/20040303212529/airflownetworks.com/solutions/pdf/securing\\_wlans\\_wp.pdf](http://web.archive.org/web/20040303212529/airflownetworks.com/solutions/pdf/securing_wlans_wp.pdf). August 2003.

Bims, H. and Cioffi. J. "Trellis Coding for Full-Response CPM", *Third Generation Wireless Information Networks*, Kluwer Academic Publishers, 1992.

Bims, H. and Cioffi. J. "Trellis Coding for Full-Response CPM", *WINLAB WORKSHOP*, East Brunswick, NJ. October 18-19, 1990.

Bims, H. and Cioffi, J. "Trellis Coding for Partial-Response CPM", *1991 International Symposium on Information Theory*, Budapest, Hungary. June 24-28, 1991.

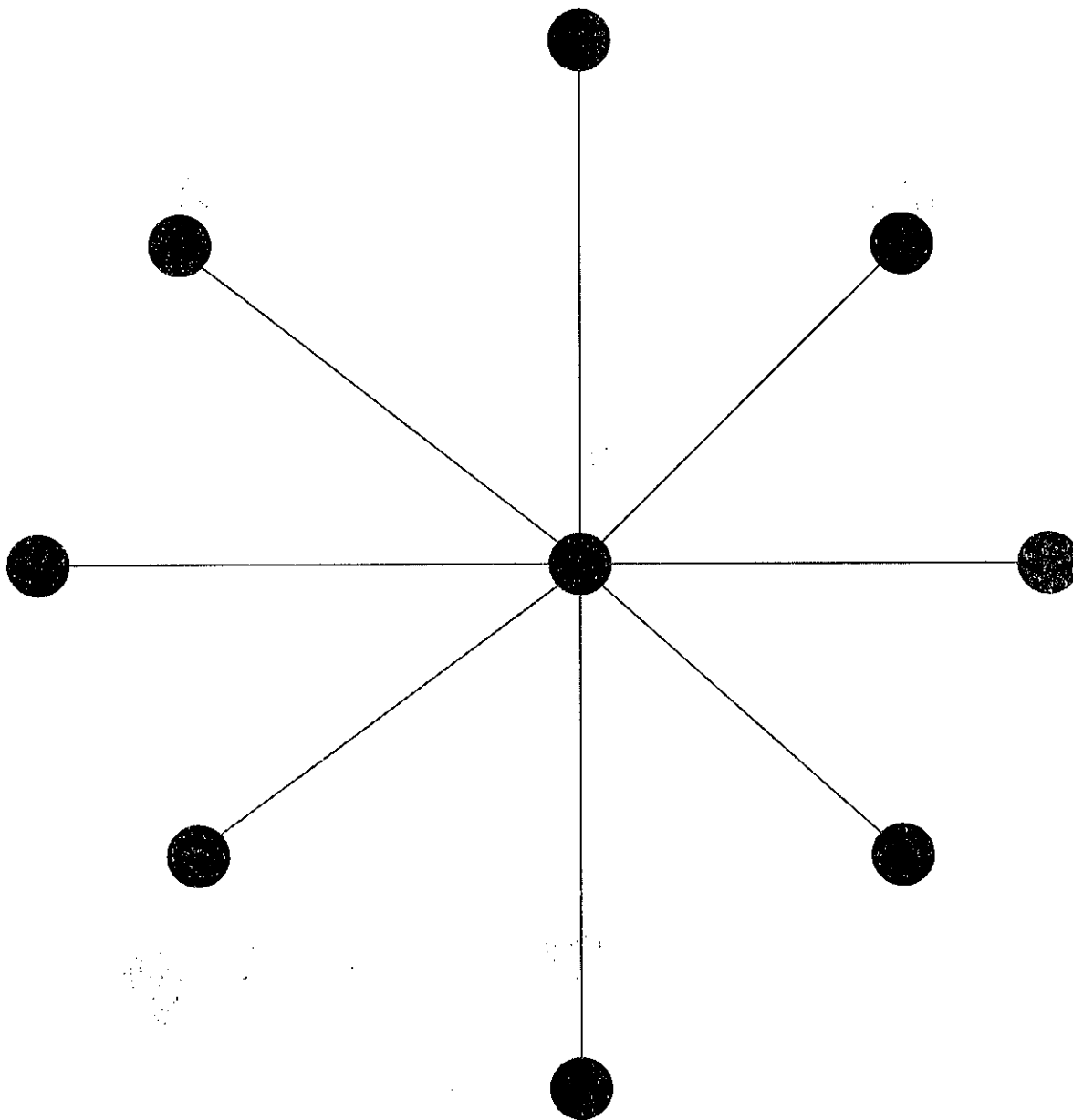
Bims, H. and Cioffi, J. "Trellis Coding with M-ary MSK Constraints", *GLOBECOM '89*, Dallas TX. Nov. 1989.

### Professional Associations and Achievements

- Jan 2009 – Present Vice-Chair and Board of Directors, Menlo Park Chamber of Commerce
- Nov 2007 – Sep 2010 Vice-Chair and Secretary, IEEE 802.16h License Exempt Group
- Feb 2002 – Jan 2011 Member, City of Menlo Park Planning Commission  
 (2006 Chairperson, 2005 Vice-Chairperson)
- Feb 2012 – Present Senior Member, IEEE
- Jan 2000 – Dec 2000 Chair, IEEE Engineering Management Society – Silicon Valley Chapter
- Jun 1985 - Jun 1991 AT&T Bell Laboratories Cooperative Research Fellow







EXHIBIT

**2**

Bims

2/7/2017 C.A.R.

EXHIBIT

3

Bims

2/7/2017 C.A.R.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ACTIVISION BLIZZARD, INC.,  
ELECTRONIC ARTS INC.,  
TAKE-TWO INTERACTIVE SOFTWARE, INC.,  
2K SPORTS, INC., and  
ROCKSTAR GAMES, INC.,  
Petitioner

v.

ACCELERATION BAY, LLC,  
Patent Owner

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Case IPR2016-00747  
Patent 6,732,147

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**DECLARATION OF DR. HARRY BIMS  
IN SUPPORT OF PATENT OWNER'S RESPONSE**

I, Harry Bims, Ph.D., declare as follows:

**I. QUALIFICATIONS**

1. I make this Declaration based upon my own personal knowledge, information, and belief, and I would and could competently testify to these matters set forth if called upon to do so.

2. I received a Bachelor of Science ("BS") degree in Computer and Systems Engineering from Rensselaer Polytechnic Institute in 1985.

3. I received a Masters of Science ("MS") degree in Electrical Engineering from Stanford University in 1989.

4. I received a Doctor of Philosophy ("PhD") degree in Electrical Engineering from Stanford University in 1993. My dissertation was entitled, "Trellis Coding for Multi-Level, Partial-Response Continuous Phase Modulation with Precoding."

5. I was the Founder, Chief Executive Officer, and Chief Technical Officer at AirFlow Networks, Inc. LLC from December of 2001 to May 2004. While there, we developed 802.11 access points that provided wireless internet access in a campus deployment. As part of the access point solution, we incorporated network security for mobile devices connected to the network in the form of VPN and firewall technology, as well as encryption technology that was part of the 802.11 standard. The United States Patent and Trademark office issued

AirFlow Networks, Inc. LLC fifteen patents, all of which relate to wireless network infrastructure. In 2001, I was an Entrepreneur in Residence at Bay Partners LLC, where I was a technology expert on a range of wireless and networking subjects.

6. During the 1998 timeframe, I was the project lead for a network security project in Glenayre Technologies' Wireless Access Group. This project was to develop and deploy a software encryption module for use by government agencies as a secure e-mail solution. As part of this project, a networking protocol at the application layer was developed for sending and receiving encrypted e-mail messages.

7. During the 2000 timeframe, I was a Director of Engineering at Symmetry Communications, where we developed core network equipment for the digital cellular market. This equipment included networking routers that provided network security for data communications to and from mobile handsets.

8. The details of my work experience and research are summarized in my CV attached as Appendix A of this declaration.

9. I have reviewed in detail U.S. Patent No. 6,732,147 (Ex. 1001, "the '147 Patent"); all of the files in the record for *Inter Partes* Review of the '147 Patent filed in Case No. IPR2016-00747; Sony's PlayStation 3 and 4 running the online PlayStation game, Destiny; "Bungie Weekly Update Archive" Webpage

(Exhibit 2023); “Help: How to Join or Create a Fireteam | Bungie.net” Webpage (Exhibit 2024); “Matchmaking Updates > News | Bungie.net” Webpage (Exhibit 2025); “Solved: Port Numbers, which do I need to open” Webpage (Exhibit 2026); “Test Internet Connection | Playstation4 User’s Guide” Webpage (Exhibit 2027); “The Matchmaking Technology of Destiny” Webpage (Exhibit 2028); “Shared World Shooter: Destiny’s Networked Mission Architecture” Presentation (Exhibit 2029); Box Art (Exhibit 2030); Full size Destiny box cover (Exhibit 2031); “Voice Chat [Beta] in Destiny > News | Bungie.net” Webpage (Exhibit 2032); YouTube Screenshot for Destiny (Exhibit 2033); YouTube Screenshot for Destiny (Exhibit 2034); YouTube Screenshot for Destiny (Exhibit 2035); YouTube Screenshot (Exhibit 2035); YouTube Screenshot (Exhibit 2036); YouTube Screenshot (Exhibit 2037); the Declaration of Dr. Michael Goodrich (Exhibit 2003).

10. I understand that I am submitting a declaration in connection with the above-referenced *Inter Partes* review (“IPR”) proceeding involving the ’147 Patent.

## II. SCOPE OF ASSIGNMENT AND APPROACH

11. I have been retained as an expert on behalf of Patent Owner, Acceleration Bay, LLC. (“Acceleration Bay”), to provide information and opinions to the Patent Trial and Appeal Board (“the Board”) to assist in the determination of the validity of certain patent claims of the ’147 Patent for which the Board has

instituted an IPR proceeding. I understand that the Board has instituted *inter partes* review based on claims 6–10 of the '147 Patent on the grounds of obviousness over Shoubridge, Denes, Rufino, and Todd. Specifically, counsel for Acceleration Bay asked me to provide opinions regarding the validity of the claims based on secondary considerations of non-obviousness.

### **III. PERSON HAVING ORDINARY SKILL IN THE ART (PHOSITA)**

12. Counsel has informed me, and I understand, that the “person having ordinary skill in the art” (“PHOSITA”) is a hypothetical person who is presumed to be familiar with the relevant scientific field and its literature at the time of the invention. This hypothetical person is also a person of ordinary creativity capable of understanding the scientific principles applicable to the pertinent field.

13. Counsel has informed me, and I understand, that the level of ordinary skill in the art may be determined by reference to certain factors, including (1) the type of problems encountered in the art, (2) prior art solutions to those problems, (3) the rapidity with which innovations are made, (4) the sophistication of the technology, and (5) the educational level of active workers in the field. I further understand that the face of the '147 Patent claims a priority date of July 31, 2000.

14. It is my opinion that the person of ordinary skill in the art in the field of the '147 Patent would have been someone with a bachelor's degree in computer

science or related field, and either (1) two or more years of industry experience and/or (2) an advanced degree in computer science or related field.

15. Based on my training and experience, I am (and was as of July 2000) a person having greater than ordinary skill in the relevant art, which permits me to give an opinion about the qualifications of one having ordinary skill at the time of the invention.

16. I note that Dr. Karger opines that a person having ordinary skill in the art is as follows:

In my opinion, a POSITA at the time of the alleged inventions claimed by the '147 and '069 patents would have a minimum of: (i) a bachelor's degree in computer science, computer engineering, applied mathematics, or a related field of study; and (ii) four or more years of industry experience relating to networking protocols or network topologies. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

Karger Decl. at ¶19.

17. My opinions stated in this declaration would be the same if rendered from the perspective of a person of ordinary skill in the art as set out by Dr. Karger.



#### IV. CLAIM CONSTRUCTIONS

18. Acceleration Bay's counsel informed me and I understand that claims must be "given their broadest reasonable interpretation consistent with the specification" in inter partes review. The broadest reasonable interpretation does not mean the broadest possible interpretation. Instead, the meaning given to a claim term must be consistent with the use of the claim term in the specification and drawings. Thus, even under the broadest reasonable interpretation, the board's construction cannot be divorced from the specification and the record evidence, and must be consistent with the one that those skilled in the art would reach.

19. I reviewed the claim constructions that Dr. Michael Goodrich provided in his declaration, attached to the Patent Owner Response as Exhibit 2003, and it is my opinion that a PHOSITA would adopt the same claim constructions, which are consistent with the broadest reasonable interpretation of the '147 Patent. Goodrich Decl. at ¶¶ 45–56.

**A. "healing a disconnection of a first computer from a second computer"**

20. In my opinion, a PHOSITA would understand the term "healing a disconnection of a first computer from a second computer" is properly construed in the context of the '147 Patent as "connecting a first computer to another computer in order to maintain an m-regular network after the second computer has involuntarily been disconnected."

21. The specification supports this construction. The '147 Patent discloses that a computer connected to a broadcast channel can leave in a planned or unplanned manner. '147 Patent at 2:59-63, 8:66-9:51; Figs. 5A, 5B. "[H]ealing a disconnection of a first computer from a second computer" is shown in Figure 5B of the '147 Patent, which demonstrates that this refers to the situation where a computer leaves in an unplanned manner.

**B. "broadcast channel"**

22. In my opinion, a PHOSITA would understand the term "broadcast channel" is properly construed as a "logical channel that overlays an underlying point-to-point communications network."

23. The specification of the '147 Patent supports this construction. *See* '147 Patent at 4:5-24 (discussing the broadcast channel as an overlay over the network layer), 4:32-36 (describing sending messages using the broadcast channel).

**C. "connected/connection"**

24. In my opinion, a PHOSITA would understand the term "connected" as "having a connection," and the term "connection" to mean "an edge between two application programs connected to a logical broadcast channel that overlays an underlying network."

25. The specification of the '147 Patent supports these constructions. Specifically, the specification of the '147 Patent explains that the term "connected" refers to the edge connecting participants. '147 Patent 4:51–53 ("each of the edges represents an 'edge' connection between two computers of the broadcast channel."); Fig. 1. Further the specification identifies that application programs interface with a broadcaster component to connect to the broadcast channel. The broadcaster component may be included as part of the application program process. '147 Patent at 15:15-47.

#### **V. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS**

26. Acceleration Bay's counsel informed me and I understand that evidence of licensing, commercial success, praise, and copying, when there is a nexus between the claimed invention and commercial success, are a few of the factors that support non-obviousness of the patented invention. Otherwise, had the invention been obvious to persons skilled in the art, it would have been successfully brought to market sooner given the market demand.

#### **VI. LICENSING AND COMMERCIAL SUCCESS**

27. I have been informed and I understand that a prima facie case of nexus is made when the patentee shows both (1) that the product is a commercial success and (2) that the commercially successful product is the invention disclosed and claimed in the patent. Based on my review of the license between Boeing and

Sony Computer Entertainment America Inc. ("Sony") (Exhibit 2009), I understand that Boeing has entered into a license agreement that covers the '147 Patent. [REDACTED]

[REDACTED]

[REDACTED]

28. In my opinion, based on the public information contained within the license, Sony utilizes the inventions disclosed in the '147 Patent. Based on my review, Sony markets and sells those products covered under at least one claim of the '147 Patent in the same market as Petitioner. To show the nexus between the technology of the '147 Patent licensed under the Sony and Acceleration Bay License Agreement and the Sony products, I have created, using publicly available information, a chart that maps the claims of the '147 Patent with the technology in the Sony products. This chart is attached as Exhibit 2016. As indicated in the chart, PlayStation 3 and PlayStation 4 are covered by the '147 Patent.

29. For example, it is my opinion that Sony's PlayStation 3 and PlayStation 4, which run the online game Destiny, utilize the invention described in at least one claim of the '147 Patent because they enabled players from different locations around the world to communicate and interact with each other by sending data received from neighboring players to other neighboring players.

30. As such, a successful licensing program based on the patented invention described in the '147 Patent demonstrates that the '147 Patent was not obvious.

31. Further, Sony's commercial success based on the '147 Patent is shown in the SEC Filings for the fiscal year ending in March 31, 2008 (Exhibit 2022). Sony's Game division sales increased by 267.5 billion yen. Specifically, Sony's hardware unit sales of PlayStation 3 were 9.24 million units, was an increase of 5.63 million units sold over the previous year. It is my opinion that the increase in sales were due in part because of Sony's license to the '147 Patent. These sales are indicative of the commercial success of the inventions disclosed in the '147 Patent because Sony has utilized the invention in products that have been commercially successful. As such, it is my opinion that the '147 Patent is not obvious due to licensing and commercial success.

## **VII. PRAISE**

32. Counsel has informed me and I understand that the number of forward citations to a patent is often used as a measure of a patent's significance. The citation of the '147 Patent by inventors of other patents constitutes praise of the inventions disclosed in the '147 Patent. Exhibit 2020 is a document that shows 9 patents that cite to the '147 Patent from companies such as Sony Computer Entertainment Inc. and Samsung Electronics Co., Ltd. Based on my review of the

forward citations of the '147 Patent, it is my opinion that the '147 Patent describes the process for disconnecting a node, whether it is planned or unplanned, from a broadcast channel.

33. Further, it is my opinion that the citation of the '147 Patent by companies in the gaming industry demonstrates that the gaming industry appreciates the significance of the invention described in the '147 Patent.

34. Therefore, it is my opinion that the '147 Patent was not obvious because others have praised the invention disclosed in the '147 Patent.

#### **VIII. LONG-FELT BUT UNRESOLVED NEED, RECOGNITION OF A PROBLEM AND FAILURE BY OTHERS**

35. Counsel has informed me and I understand that a long-felt but unmet need for an invention supports the non-obviousness of the invention. If the inventions under consideration were obvious, the long-felt need would have been met before the time of the inventions.

36. I have reviewed the Boeing Invention Disclosure Form and the '147 Patent, the declaration of Virgil Bourassa, a co-inventor of the '147 Patent, and it is my opinion that the inventors had recognized a problem. Exhibit 2006 (Mr. Bourassa's Declaration) at ¶¶ 3-7; Exhibit 2008 (Invention Disclosure Form). They realized that the technologies that were available could not support a high number of network participants without the risk of bottlenecking or even the complete failure of an entire network if a server failed. Specifically, the '147

Patent addresses the problem of dealing with planned and unplanned disconnections from an m-regular network. In particular, they recognized a solution to maintain an m-regular network. *See generally* '147 Patent at 8:65-11:39.

37. Accordingly, in my opinion, a long-felt but unmet need for a network that could handle a large number of users across the country with high reliability and low latency, such as that disclosed in the '147 Patent, existed at the time of the invention. In particular, Boeing recognized the need for a solution that would support collaborative sharing of information simultaneously between a large number of wide-area network computers without causing significant delays in the sharing of information or risking the failure of the entire network if a participant was disconnected or a server failed.

38. Based on Mr. Bourassa's declaration, it is my opinion that Boeing solved a long felt need as the systems at the time did not support the collaboration of many participants, nor did they handle planned and unplanned disconnections in a reliable manner. Bourassa's Declaration at ¶¶ 3-7. None of the alternate technology available would have been capable of providing communications for a large number of network participants without running into the issues described above. For example, multicast networking protocols would have required the use of a special type of router, which would have taken years or even decades to

accommodate the problems the invention described in the '147 Patent was able to address.

39. In my opinion, based on the Invention Disclosure Form (Exhibit 2008), which shows that the date the invention was conceived on November 1996 and the date it was satisfactorily tested as September 16, 1999, the length of time it actually took—3 years—along with the lack of capabilities of the prior art, demonstrate that the invention described in the '147 Patent was not obvious, and supported a long-felt need because they were required to invent the system described in the '147 Patent—methods and systems for disconnecting a node from a broadcast channel—in order to create a robust network of participants that could join and leave the network without causing any communications failure. *See* Ex. 2008 (Invention Disclosure Form) at 1.

40. It is also my opinion that failure by others supports that the patented invention was not obvious. As described above, the availability of the technology at the time demonstrates that others could not solve the problem of allowing for peer-to-peer communications in a wide area that would perform in a robust way.

#### **IX. UNEXPECTEDLY SUPERIOR RESULTS**

41. Counsel informed me and I understand that unexpected results are other indicators that support the non-obviousness of the inventions. I understand that it took three years from the conception of the invention for the inventors to



reduce it to practice in [REDACTED] and the [REDACTED],  
programs at Boeing. Ex. 2008 (Invention Disclosure Form); *see also* Bourassa  
Decl. at ¶¶4 – 39.

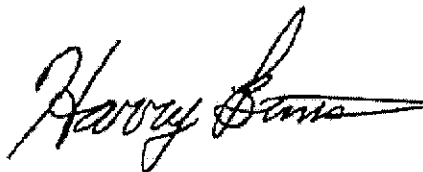
42. The fact that it took them three years to successfully create the invention described in the ‘147 Patent—namely, a network that can support participants interacting and communicating with each other by sending data received from neighboring players to other neighboring players—also demonstrates that the ‘147 Patent was not obvious.

43. Based on these reasons, it is my opinion that the ‘147 Patent is not obvious because it yielded unexpected results.

**DECLARATION**

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed in Palo Alto, CA on December 15, 2016.

A handwritten signature in black ink, appearing to read "Harry Bims", with a long horizontal flourish extending to the right.

---

Harry V. Bims, Ph.D.

# Appendix A

**Dr. Harry V. Bims**  
1314 Chilco Street  
Menlo Park, CA 94025  
harrybims@me.com  
650-283-4174

## PROFESSIONAL SUMMARY

Harry Bims, PhD, EE, provides expert witness support services for telecommunications-related intellectual property litigation. These services include deposition and court testimony, expert reports, and infringement research, for patent, copyright, and trade secret litigation matters. He has 17+ years of telecommunications industry experience, and holds eighteen US patents in network architecture and chip design for wireless communications.

## EMPLOYMENT HISTORY

12/2001 - 05/2004 **AirFlow Networks, Inc. LLC • Sunnyvale, California**

Position: *CEO/CTO & Founder*

As the sole founder of the company, created the original business plan, raised venture capital, and hired the core engineering team. Grew the company to 32 people and shipped products for revenue in the US and overseas. Fifteen patents on the core technology have issued. These patents, which relate to wireless network infrastructure based on the 802.11 specification, have been sold to Broadcom.

03/2001 - 12/2001 **Bay Partners LLC • Cupertino, California**

Position: *Entrepreneur in Residence*

Reported to the partners of this VC firm as a technology expert on a range of wireless and networking subjects. Reviewed business plans and participated in due diligence activities related to several startups seeking funding. Developed a business plan for a startup that builds network infrastructure for 802.11 enterprise networks.

09/1999 - 03/2001 **Symmetry Communications Systems LLC • San Jose, California**

Position: *Director, Software Architecture*

Reporting to the CEO, responsible for the software architecture of their core

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SGSN and GGSN products for the GPRS market. Formulated a software technology roadmap, showing the evolution from 2.5G to 3G SGSN and GGSN products. Management responsibility for Firmware, Hardware, Performance, and Systems Engineering Groups. Provided management support of early field trials of the system on a global basis.

07/1999 - 09/1999 **T-SPAN Systems Corporation LLC • Palo Alto, California**

Position: *Member of Technical Staff*

Designed a wireless home LAN protocol for the company. Also designed and built a PC-based platform to demonstrate their technology. Company is now publicly traded as Atheros Communications.

07/1992 - 12/1998 **Glenayre Technologies-Wireless Access Group • San Jose, California**

Position: *Member of Technical Staff; Sr. Member of Technical Staff; Manager of NOC Systems*

Employee #6 at the company, which was acquired by Glenayre Technologies, Nov 1997. Designed and built a 4-channel ReFLEX50 pager demonstration in 1 week. Participated in early field trials and feasibility studies, culminating in a Pioneer's Preference license award from the FCC to SkyTel Corporation for Narrowband PCS development.

Invented, designed, and built from concept through full implementation, a patented two-way pager test system for the ReFLEX50 and ReFLEX25 protocols. This system was used throughout company operations for performance testing of the ReFLEX pager designs from Wireless Access, and Motorola. Over 16 systems were deployed around the country for manufacturing tests, engineering protocol tests, antenna tests, and pager repair tests.

The project required technical skills in PC hardware design, C++, object-oriented programming, signal processing techniques, NT device driver development, Win32 user interface development, real-time, multi-threaded control, and proficiency with wireless communications lab equipment. Three patents have been issued based on technical inventions in this capacity.

Co-developed a wireless application protocol for sending and receiving encrypted email messages over the paging channel. Led the project team that deployed a software encryption module based on this protocol for government agencies.

### Bims Laboratories, LLC Work History

6/2009 – 7/2009 **Eastman Kodak Company • Rochester, NY**

Position: *Technology Consultant*

Providing technology assessment on certain wireless communication patents.

10/2009 – Present **IEEE 802.16 Working Group**

Position: *Task Group Secretary, Task Group Vice-Chair, Task Group Chair, Working Group Vice-Chair & Secretary*

Served in several leadership capacities within this group that is working on improvements to the IEEE 802.16 standard, otherwise known as WiMAX.

2/2014 – Present **Access Network Protocol Development**

Position: *Technical Lead Developer*

Developing a C++14-based DES of SDRs for wired and wireless network protocols, that includes IMT-2020 channel models. Implementations of the IEEE 802 and LTE protocol families, plus digital cable, Bluetooth, DSL, frame relay and many more are managed nodes for smart grid and vertical IoT applications.

### Protocomm Systems, LLC Consulting History

04/1999–07/1999 **Gigabit Wireless, Inc. • San Jose, California**

Position: *Technical Leader*

Technical leader for the Wireless MAC design group. Responsible for comparative analysis of competing wireless MAC protocol standards. Responsible for the creation of a proprietary MAC protocol specification document, simulation of the protocol, and implementation in a prototype. Participated in early 802.16 protocol standards. This company was acquired by Intel Corporation.

3/2007 – 10/2009 **Apple, Inc. • Cupertino, CA**

Position: *Technology Consultant*

Participating in IEEE 802.16 standards meetings as an affiliate of the client.

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7/2003 – Present **Various expert witness engagements (see below)**

Position: *Technical Expert Witness*

Testified as a wireless technology expert in patent infringement cases. For a list of such cases, see below.

### Technical Expert Witness Experience

12/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Acceleration Bay, LLC.)**

Case: Activision Blizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., 2K Sports, Inc., Rockstar Games, Inc., and Bungie, Inc., Petitioner v. Acceleration Bay, LLC, Patent Owner.

Case IPR2015-01951, Case IPR2015-01953, Case IPR2015-01964, Case IPR2015-01970, Case IPR2015-01996

Location: UNITED STATES PATENT AND TRADEMARK OFFICE

Testifying expert in this IPR patent case involving internet data broadcasting.

Expert Declaration:

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,714,966;  
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,829,634;  
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,701,344;  
Secondary Considerations of Non-Obviousness

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Ongoing

12/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Sophos, Inc.

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Civil Action No. 3:14-cv-01197-WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

December 21, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

February 22, 2016

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Case settled

9/2015 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Proofpoint, Inc. and Armorize Technologies, Inc.

Civil Action No. 13:cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

October 7, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

November 6, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Quinn Emanuel

Status: Jury award.

10/2014 – 2/2015 **Client: Alston & Bird (representing Microsoft Corporation)**

Case: Microsoft Corporation. v. IPR Licensing, Inc.

Location: INTER PARTES REVIEW BEFORE THE PATENT TRIAL AND APPEAL BOARD

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Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

10-16-14 Supplemental Declaration ISO Petition for Inter Partes Review of U.  
S. Patent No. 8,380,244

Attorneys: For Plaintiff: Alston & Bird LLP

For Defendant:

Status: Case settled

9/2014 – 4/2015 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc.

Civil Action No. 2:13-cv-883-JRG-RSP

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS MARSHALL DIVISION

Testifying expert in this patent case involving package delivery notification  
systems.

Expert Reports:

2-10-15 Expert Report on Infringement

2-24-15 Supplemental Expert Report on Infringement

Videotaped Deposition:

2-25-15

Declaration:

3-20-15 Declaration ISO Response to Opposition Motion

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Greenberg Traurig LLP

Status: Case settled

5/2014 – 7/2015 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Blue Coat Systems, Inc.

Civil Action No. 3:13-cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF

CALIFORNIA SAN JOSE DIVISION

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

January 12, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

March 18, 2015

Live Jury Trial Testimony: July 20, 2015.

Live Bench Trial on Laches Testimony: September 8, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Wilson Sonsini

Status: Jury award.

2/2013 – Present **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. BlackBerry Corporation.

Civil Action No. 3:12-cv-1652-M

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF TEXAS DALLAS DIVISION

Testifying expert in this patent case involving package delivery notification systems.

Expert Reports:

9-3-15 Expert Report on Infringement

Videotaped Depositions:

Attorneys: For Plaintiff: Baker Botts, LLP

For Defendant: Reed & Scardino LLP

Status: Jury verdict of non-infringement.

4/2014 – Present **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. United Parcel Service, Inc.

Civil Action No. 1:12-cv-03222-AT

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF  
GEORGIA ATLANTA DIVISION

Testifying expert in this patent case involving package delivery notification  
systems.

Expert Reports:

7-3-14 Opening Expert Report regarding Infringement

8-11-14 Rebuttal Expert Report regarding Infringement

Videotaped Depositions:

10-7-14

Declaration:

11-24-14 Declaration ISO Response to MSJ

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Alston & Bird LLP

Status: Case settled.

1/2014 – Present **Client: Fish & Richardson P.C. (representing Samsung)**

Case: Telefonaktiebolaget LM Ericsson v Samsung Electronics Co., Ltd, et. al.

Civil Action No. 6:12-cv-894

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS

Testifying expert in this patent case involving satellite radio technology.

Expert Declarations and Reports:

None.

Attorneys: For Plaintiff:

For Defendant: Fish & Richardson P.C.

Status: Case settled.

12/2013 – **Client: Brinks Gilson & Lione LLP (representing ZTE Corp, and ZTE**  
09/2015 **(USA), Inc.)**

Case: ZTE Corporation and ZTE (USA) Inc. v. InterDigital Technology Corporation

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Location: INTER PARTES REVIEW BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

3-21-14 Declaration in support of the Petition for Inter Partes Review of U. S. Patent No. 8,380,244

Attorneys: For Plaintiff: Brinks Gilson & Lione

For Defendant: Latham & Watkins, LLP

Status: IPR Hearing before PTAB: All disputed claims are unpatentable.

12/2013 – 4/2014 **Client: Kramer Levin Naftalis & Frankel LLP (representing Sirius XM Radio Inc.)**

Case: Catch a Wave Technologies, Inc. v. Sirius XM Radio Inc.

Case No. 3:12-cv-05791-WHA

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

Testifying expert in this patent case involving satellite radio systems.

Expert Reports:

2-14-2014 Expert Report regarding non-infringement

Attorneys: For Plaintiff: Freitas Tseng & Kaufman LLP

For Defendant: Kramer Levin LLP

Status: Case settled

2/2013 – 10/2013 **Client: Seyfarth Shaw LLP (representing Motorola Mobility LLC)**

Case: University of Florida Research Foundation, Inc. and Rapid mobile Technologies, Inc. v. Motorola Mobility LLC

Civil Action No. 13-cv-61120-KMM-EGT

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA

Testifying expert in this employment law case involving mobile device testing systems.

Expert Reports:

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3-1-13 Expert Report regarding Non-Infringement

4-1-13 Declaration in Opposition to Plaintiff's MSJ

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Seyfarth Shaw LLP

Status: Case settled

9/2013 – 1/2014 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies, LLC v Clearwire Corporation

Civil Action No. 2:12-CV-308

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS MARSHALL DIVISION

Testifying expert in this patent case involving wireless networking signals.

Expert Reports:

11-11-13 Rebuttal report regarding validity

Videotaped Depositions:

12-5-13

Declarations:

1-23-14 Declaration before the Patent Trial and Appeal Board in Case IPR2013-00306

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Shook, Hardy & Bacon, LLP

Status: Case settled

10/2013 – 5/2015 **Client: Foley & Lardner, LLP (representing Motorola Mobility, LLC)**

Case: University of Florida Research Foundation Inc., and Rapid Mobile Technologies, Inc. v Motorola Mobility, LLC.

Case No. 13-cv-61120-KMM-EGT

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA FORT LAUDERDALE DIVISION

Testifying expert in this patent case involving mobile device testing systems.

Expert Reports:

None.

Declarations:

11-21-13 Declaration ISO Motorola's Responsive Claim Construction Brief

Attorneys: For Plaintiff: Meltzer & Meksraitis

For Defendant: Foley & Lardner LLP

Status: Case settled

7/2013 – 6/2015 **Client: WilmerHale (representing Broadcom)**

Case: Inter Partes Review of US Patent 6,424,625; 6,772,215; and 6,466,568 owned by Ericsson

Docket No. 0111168-0240

Location: UNITED STATES PATENT AND TRADEMARK OFFICE

Testifying expert in this Inter Partes Review regarding ARQ mechanisms.

Expert Declarations:

9-19-13 Declaration regarding US Patent 6,772,215

9-19-13 Declaration regarding US Patent 6,466,568

9-29-13 Declaration regarding US Patent 6,424,625

Videotaped Deposition:

5-29-14, and 5-30-14

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Wilmer Cutler Pickering Hale and Dorr LLP

Status: Case settled

4/2013 – 4/2015 **Client: Kilpatrick Townsend & Stockton LLP (representing Google Inc. and Motorola Mobility LLC)**

Case: Fujifilm Corporation v. Motorola Mobility LLC

Case No. 3:12-cv-03587 WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION

Testifying expert in this patent case involving smartphone technology.

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Expert Declarations:

4-23-14 Declaration ISO Motion for Protective Order

12-9-14 Declaration ISO MSJ

Expert Reports:

10-3-14 Opening Expert Report Regarding Invalidity

10-31-14 Rebuttal Expert Report on non-infringement

10-31-14 Appendix A to Rebuttal Report of Dr. Alan Bovik

Videotaped Deposition:

11-19-14, and 11-20-14

Trial Testimony:

April 28, 2015 Non-infringement and invalidity of '970 Patent

Attorneys: For Plaintiff: Morgan, Lewis & Bockius LLP

For Defendant: Kilpatrick Townsend & Stockton LLP

Status: Jury verdict: '970 Patent claims not infringed and invalid.

8/2012 – 4/2013 **Client: Paul Hastings LLP (representing Apple, Inc.)**

Case: SmartPhone Technologies, LLC v Research in Motion Corporation, et. al.

Case No. 6:10-cv-00074

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving 3GPP technology.

Expert Reports:

12-31-12 Appendix A to Rebuttal Expert Report of Dr. David Wilson

3-13-13 Appendix A to Supplemental Expert Report of Dr. David Wilson

Attorneys: For Plaintiff: Mintz Levin Cohn Ferris Glovsky and Popeo PC

For Defendant: Paul Hastings LLP

Status: Case settled

8/2012 – 9/2013 **Client: Reed & Scardino, LLP (representing EON Corp. IP Holdings, LLC)**

Case: EON Corp. IP Holdings, LLC v. SKYGUARD, LLC et. al.

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Case No. 6:11-cv-00015-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

2-15-13 Expert Report regarding Infringement

4-09-13 Videotaped deposition

Attorneys: For Plaintiff: Reed & Scardino, LLP

For Defendant: K&L GATES LLP

Status: Case settled

5/2012 – 6/2014 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Landis+Gyr, Inc., et. al.

Case No. 6:09-cv-00317-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks, before Judge Love.

Expert Report:

7-8-13 Expert Report regarding Infringement by Silver Spring Networks, Inc.

7-8-13 Expert Report regarding Infringement by Itron, Inc.

6-2-14 – 6-6-14 District Court trial testimony.

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Dentons, LLP

Status: Jury award. All patents found valid and infringed.

3/2012 – 3/2014 **Client: Perkins Coie (representing Intel Corporation)**

Case: Stragent LLC, et. al. v. Intel Corp.,

Case No. 6:11-cv-421-LED (E.D. Tex.)

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION



Testifying expert in this patent case involving the use of error detection technology in computer networking, before Judge Dyk.

Expert Reports:

08-23-13 Expert Report regarding Invalidity

09-23-13 Expert Report regarding Non-Infringement

Videotaped Deposition:

10-08-13, and 10-09-13

Jury trial testimony:

3-13-2014 Live trial testimony on non-infringement and invalidity before Judge Timothy Dyk

Attorneys: For Plaintiff: Nelson, Bumgardner & Casto

For Defendant: Perkins Coie

Status: Jury verdict for non-infringement and invalidity

2/2012 – 09/2015 **Client: Dewey & LeBoeuf LLP (representing Harris Corporation)**

Case: Harris Corporation v. Ruckus Wireless, Inc.

Case No. 6:11-cv-00618-CEM-CRS

Location: UNITED STATES DISTRICT COURT FOR THE MIDDLE DISTRICT OF FLORIDA ORLANDO DIVISION

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

3-5-12 Expert Report regarding Infringement

3-6-12 Supplemental Expert Report regarding Infringement

4-6-12 Expert Report regarding Validity

Declarations:

5-30-12 Declaration ISO Claim Construction

6-18-12 Declaration ISO Markman Motion

1-23-15 Declaration ISO Responsive Markman Brief

3-6-15 Supplemental Expert Report regarding Infringement

4-3-15 Rebuttal Expert Report regarding Validity

Videotaped Deposition:

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4-30-12

Attorneys: For Plaintiff: Dewey & LeBeouf LLP

For Defendant: Lewis and Roca LLP

Status: Case settled

2/2012 – 2/2012 **Client: Common-Interest-Group (representing Nokia, Huawei, ZTE)**

Case: InterDigital Communications LLC, et. al. v. Huawei Tech Co., LTD., et. al.

Certain Wireless Devices With 3G Capabilities and Components Thereof

U.S. Int'l Trade Commission Inv. No. 337-TA-800

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION

Testifying expert in this patent case involving 3G wireless, WiFi, and WCDMA technology.

Expert Reports:

11-30-12 Expert Report regarding Non-infringement

7-31-12 Expert Report regarding Invalidity

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Videotaped Deposition:

12-14-12, 12-15-12

ITC Trial testimony:

2-15-12 Non-infringement and Invalidity witness statements, live testimony

Attorneys: For Plaintiff: Latham & Watkins, LLP

For Defendant: Alston & Bird, Covington & Burling, Brinks Hofer

Status: ITC hearing verdict: All patents not infringed and invalid

9/2010 – 4/2011 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Sensus USA, Inc., et. al.

Case No. 6:09-cv-00116-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks

Expert Report:

10-22-10 Expert Report regarding Infringement (Sensus USA, Inc)

11-7-10 Expert Report regarding Infringement (Bell Industries)

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Declaration:

12-28-10, 1-18-11

Videotaped Deposition:

12-8-10, 2-3-11

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Jones Day

Status: Case settled

8/2010 – 6/2011 **Client: Sidley Austin LLP (representing Research in Motion Limited)**

Case: SimpleAir, Inc. v. Research in Motion Limited and Research in Motion Corporation, et. al.

Case No. 2:09-cv-00289-CE

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving two-way wireless networks

Declaration:

5-13-11

Videotaped Deposition:

5-24-11

Attorneys: For Plaintiff: Dovel & Luner, LLP

For Defendant: Sidley Austin LLP

Status: Case settled

10/2009 – 2/2010 **Client: White & Case LLP (representing Marvell)**

Case: Marvell Semiconductor, Inc., et. al. v. Commonwealth Scientific Industrial Research Organisation

Case No. 6:07-CV-204 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving wireless LAN protocols.

Expert Report:

11-24-09 Rebuttal Expert Report

Videotaped Deposition:

01-07-10

Attorneys: For Plaintiff: White & Case LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Case settled

9/2009 – 2/2010 **Client: Perkins Coie Brown & Bain PA (representing Intel)**

Case: Saxon Innovations, LLC v. Apple, Inc., et. al.

Case No. 6:08-cv-00265-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS TYLER DIVISION

Testifying expert in this patent case involving wireless technology.

Declarations:

12-04-09 Declaration Regarding Claim Construction

Videotaped Deposition:

01-19-10

Attorneys: For Plaintiff: Susman Godfrey LLP

For Defendant: Perkins Coie Brown & Bain LLP

Status: Case settled

8/2008 – 10/2009 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Verizon Clinton Center Drive Corp., et. al.

Case No. 6:08-cv-00385

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF  
TEXAS TYLER DIVISION

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Testifying expert in this patent case involving two-way wireless networks

Expert Report:

06-22-10 Expert Report

08-16-10 Supplemental Expert Report

Videotaped Depositions:

08-18-10, 08-26-10

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Simpson Thacher & Bartlett LLP

Status: Case settled

4/2008 – 3/2009 **Client: McDermott, Will & Emery LLP (representing GE Licensing)**

Case: CIF Licensing, LLC d/b/a GE Licensing v. Agere Systems, Inc.

Case No. 07-170 (JJF)

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Testifying expert in this patent case involving modem technology.

Expert Report:

09-05-08 Rebuttal Expert Report

Non-videotaped Depositions:

9-24-08, 9-26-08

Jury trial testimony:

2-04-09

Attorneys: For Plaintiff: McDermott, Will & Emery LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Jury award. 2 patents infringed and valid, remaining 2 patents non-infringed

2/2008 – 5/2010, **Client: Simpson Thacher & Bartlett LLP (representing Cisco Systems, Inc.)**  
2/2011 – 4/2011

Case: Commil USA, LLC v. Cisco Systems, Inc., et. al.

Case No. 2:07-CV-341-DF-CE

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert on invalidity regarding short range communication protocols.

Opening Expert Report

12-23-09

Videotaped Depositions:

02-09-10

Attorneys: For Plaintiff: Sayles Werbner

For Defendant: Simpson Thacher & Bartlett LLP

Status: Jury award for original trial and retrial: patents found valid and infringed.

6/2007 – 4/2009 **Client: Common Interest Group of Co-Defendants**

11/2010 – 4/2012 **Client: Common Interest Group of Co-Defendants**

Case: Commonwealth Scientific and Industrial Research Organisation v. Toshiba  
America Information Systems, Inc., et. al.

Case No. 6:06-cv-00550-LED

Case No. 6:09-CV-0399 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
TYLER DIVISION

Testifying expert in this patent case involving wireless LAN technology.

Declarations:

06-05-08 Regarding claim construction

12-17-08 Supporting opposition to summary judgment

04-05-09 Supporting motion for reconsideration

02-24-12 Supporting opposition to summary judgment

Expert Reports:

10-08-08 Rebuttal Expert Reports- Re: TI Chips, Re: Marvell Chips, Re: Airgo  
Chips, Re: Broadcom Chips, Re: Conexant Chips, Re: Ralink Chips, Re: Atheros  
Chips

01-27-12 Rebuttal Expert Reports- Re: TI Chips, Re: Broadcom Chips, Re:  
Ralink Chips, Re: Atheros Chips

Videotaped Depositions:

11-1-08, 11-2-08, 02-14-12

Attorneys: For Plaintiff: Townsend & Townsend LLP

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For Defendant: Keker & Van Nest, LLP

Status: Jury trial: patents found valid and infringed.

10/2006 – 8/2009 **Client: Keker & Van Nest (representing Comcast Corporation)**

Case: Rembrandt Technologies, Inc. v. Comcast Corporation

Case No. 2-05CV-000443 (TJW)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert in this patent case involving physical layer and data link layer communication protocols for cable networks.

Declaration:

01-10-07 Support of Claim Construction Brief

Videotaped Deposition:

12-22-06 Regarding claim construction opinions

Attorneys: For Plaintiff: McKool Smith

For Defendant: Keker & Van Nest

Status: Case settled

3/2007 – 5/2007 **Client: Niro, Scavone, Haller and Niro (representing MLR, LLC)**

Case: MLR, LLC v. Kyocera Wireless Corporation and Novatel Wireless, Inc.

Case No. 05-CV-0935 B (AJB)

Location: UNITED STATES DISTRICT COURT SOUTHERN DISTRICT OF  
CALIFORNIA

Testifying expert in this patent case involving cellular phone technology.

Expert Report:

04-20-07 Expert Report regarding infringement

Attorneys: For Plaintiff: Niro, Scavone, Haller, and Niro

For Defendant: Hogan & Hartson, LLP

Status: Case settled

6/2006 – 10/2006 **Client: Thompson & Knight (representing Ericsson, Inc.)**

Case: Fenner Investments, Ltd., v. Juniper Networks, Inc. et. al.  
Case No. 2:05–CV–05 JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION

Testifying expert in this patent case involving wireless communications services.

Expert report regarding infringement and invalidity

5-23-06 Rebuttal expert report regarding infringement and invalidity

Attorneys: For Plaintiff: Fulbright & Jaworski

For Defendant Ericsson: Thompson & Knight

Status: Case settled

12/2003 – 5/2006 **Client: Howrey LLP/ Winston & Strawn LLP (representing McKesson Information Solutions, Inc.)**

Case: McKesson Information Solutions, Inc. vs. Bridge Medical, Inc.  
Case No. CIV S-02-2669 FCD KJM

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF  
CALIFORNIA

Testifying expert in this patent case involving a patient on a patient identification  
and verification system that incorporates wireless technology.

Inequitable Conduct Trial live testimony:  
5-04-06

Markman Hearing live testimony:  
6-29/30-05

Videotaped Depositions:  
2-14-04, 6-3-05

Declarations:  
12-1-03 Dec. in support of MISI's Opening/Opposition re Claim Construction  
12-24-04 Dec. in support of MISI's Motion for Preliminary Injunction  
3-1-04 Dec. in support of Claim Construction  
6-29-04 Dec. re meaning of "Communication"  
7/15/05 Dec. in support of MISI's Opposition to Bridge's Motion for  
Summary Judgment

Attorneys: For Defendant: Morrison & Foerster



For Plaintiff: Howrey Simon, Winston & Strawn, Morgan Lewis

Status: Bench trial on inequitable conduct: Verdict found inequitable conduct.

07/2003–02/2006 **Client: Heller Ehrman LLP (representing Texas Instruments, Inc.)**

Case: Texas Instruments, Inc. and Stanford University vs. GlobespanVirata, Inc.

Provided discovery of evidence used at trial, concerning the structure and operation of Globespan's ADSL products, and supported litigators in depositions of Globespan engineers.

Attorneys: For Plaintiff: Heller Ehrman

For Defendant: Covington & Burling, LLP

Status: Jury award.

### Patents

Patent Number	Date Issued	Title
8,995,996	March 31, 2015	Methods and apparatus for performance optimization of heterogeneous wireless system communities
8,935,580	January 13, 2015	Multimedia-aware quality-of-service and error correction provisioning
8,468,426	June 18, 2013	Multimedia-aware quality-of-service and error correction provisioning
8,189,538	May 29, 2012	Reconfiguration of a communication system
8,144,640	March 27, 2012	Location tracking in a wireless communication system using power levels of packets received by repeaters
8,064,380	November 22, 2011	Reconfiguration of a communication system
8,027,637	September 27, 2011	Single frequency wireless communication system
7,957,741	June 7, 2011	Token-based receiver diversity
7,876,704	January 25, 2011	Tunneling protocols for wireless communications
7,689,210	March 30, 2010	Plug-n-playable wireless communication system
7,672,274	March 2, 2010	Mobility support via routing
7,668,542	February 23, 2010	Token-based receiver diversity
7,515,557	Apr 7, 2009	Reconfiguration of a communication system

Last Update: November 25 2016

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7,236,470	Jun 26, 2007	Tracking multiple interface connections by mobile stations
7,149,196	Dec 12, 2006	Location tracking in a wireless communication system using power levels of packets received by repeater
6,965,769	Nov 15, 2005	Testing Center
6,862,448	Mar 1, 2005	Token-based receiver diversity
6,788,658	Sep 7, 2004	Wireless communication system architecture having split MAC layer
6,760,318	Jul 6, 2004	Receiver diversity in a communication system
6,557,134	Apr 29, 2003	ARQ method for wireless communication
6,259,911	Jul 10, 2001	Network operations center hardware and software design

### Education

Year	College/University	Degree
1993	Stanford University	PhD, Electrical Engineering Thesis: "Trellis Coding for Multi-Level, Partial-Response Continuous Phase Modulation with Precoding"
1988	Stanford University	MS, Electrical Engineering
1985	Rensselaer Polytechnic Institute	BS, Computer and Systems Engineering

### Publications

Goldhamer, M., Grandblaise, D., Bims, H., Feng, S., Piggin, P., Sydor, J., and Wu, X. "Coexistence between 802.16 Systems Operating in Shared Bands", *Radio Resource Management in WiMAX*, John Wiley & Sons, 2009.

Bims, Harry. "Surveying the Wireless LANDscape. Or Why Large Wi-Fi Networks Require Good Planning." *Xchange*. [Online] Available <http://www.xchangemag.com/articles/391supsys1.html>, September 1, 2003.

Bims, Harry. "Building Voice-Ready Wireless LANs" *Wireless Week*. [Online] Available <http://www.wirelessweek.com/article/CA319429.html?spacedesc=Departments>, September 1, 2003.

Bims, Harry. "Enabling Voice over WLANs". White Paper. [Online] Available. [http://airflownetworks.com/solutions/pdf/vowlan\\_wp.pdf](http://airflownetworks.com/solutions/pdf/vowlan_wp.pdf). September 2003.

Last Update: November 25 2016

Page A-23

Bims, Harry. "Securing Enterprise WLANs". White Paper. [Online] Available.  
[http://web.archive.org/web/20040303212529/airflownetworks.com/solutions/pdf/securing\\_wlans\\_wp.pdf](http://web.archive.org/web/20040303212529/airflownetworks.com/solutions/pdf/securing_wlans_wp.pdf). August 2003.

Bims, H. and Cioffi. J. "Trellis Coding for Full-Response CPM", *Third Generation Wireless Information Networks*, Kluwer Academic Publishers, 1992.

Bims, H. and Cioffi. J. "Trellis Coding for Full-Response CPM", *WINLAB WORKSHOP*, East Brunswick, NJ. October 18-19, 1990.

Bims, H. and Cioffi, J. "Trellis Coding for Partial-Response CPM", *1991 International Symposium on Information Theory*, Budapest, Hungary. June 24-28, 1991.

Bims, H. and Cioffi, J. "Trellis Coding with M-ary MSK Constraints", *GLOBECOM '89*, Dallas TX. Nov. 1989.

### Professional Associations and Achievements

- Jan 2009 – Present Vice-Chair and Board of Directors, Menlo Park Chamber of Commerce
- Nov 2007 – Sep 2010 Vice-Chair and Secretary, IEEE 802.16h License Exempt Group
- Feb 2002 – Jan 2011 Member, City of Menlo Park Planning Commission  
 (2006 Chairperson, 2005 Vice-Chairperson)
- Feb 2012 – Present Senior Member, IEEE
- Jan 2000 – Dec 2000 Chair, IEEE Engineering Management Society – Silicon Valley Chapter
- Jun 1985 - Jun 1991 AT&T Bell Laboratories Cooperative Research Fellow





US006732147B1

(12) **United States Patent**  
Holt et al.

(10) Patent No.: **US 6,732,147 B1**

(45) Date of Patent: **May 4, 2004**

(54) LEAVING A BROADCAST CHANNEL

## OTHER PUBLICATIONS

(75) Inventors: Fred B. Holt, Seattle, WA (US); Virgil E. Bourassa, Bellevue, WA (US)

(73) Assignee: The Boeing Company, Seattle, WA (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 719 days.

(21) Appl. No.: 09/629,577

(22) Filed: Jul. 31, 2000

(51) Int. Cl.<sup>7</sup> ..... G06F 15/16

(52) U.S. Cl. .... 709/204; 709/227

(58) Field of Search ..... 709/204, 227, 709/217

(56) References Cited

## U.S. PATENT DOCUMENTS

4,912,656	A	3/1990	Cain et al.
5,056,085	A	10/1991	Vu
5,309,437	A	5/1994	Perlman et al.
5,426,637	A	6/1995	Derby et al.
5,535,199	A	7/1996	Amri et al.
5,568,487	A	10/1996	Sitbon et al.
5,636,371	A	6/1997	Yu
5,673,265	A	9/1997	Gupta et al.
5,696,903	A	12/1997	Mahany
5,732,074	A	3/1998	Spaur et al.
5,732,219	A	3/1998	Blumer et al.
5,734,865	A	3/1998	Yu
5,737,526	A	4/1998	Periasamy et al.
5,754,830	A	5/1998	Bults et al.
5,761,425	A	6/1998	Miller
5,764,756	A	6/1998	Onweller
5,790,548	A	8/1998	Sistanizadeh et al.
5,790,553	A	8/1998	Deaton, Jr. et al.
5,799,016	A	8/1998	Onweller
5,802,285	A	9/1998	Hirviniemi
5,864,711	A	1/1999	Mairs et al.

(List continued on next page.)

Bondy et al. "Graph Theory With Applications" American Elsevier Publishing Co. Inc. pp. 47-50 Section 3.3.\*

Yavatkar et al. "A Reliable Dissemination Protocol for Interactive Collaborative Applications" Proc. ACM Multimedia, 1995 p.333-344 <http://citeseer.nj.nec.com/article/yavatkar95reliable.html>.\*

Alagar, S. and Venkatesan, S., "Reliable Broadcast in Mobile Wireless Networks," Department of Computer Science, University of Texas at Dallas, Military Communications Conference, 1995, MILCOM '95 Conference Record, IEEE San Diego, California; Nov. 5-8, 1995 (pp. 236-240).

International Search Report for The Boeing Company, International Patent Application No. PCT/US01/24240, Jun. 5, 2002 (7 pages).

U.S. patent application Ser. No. 09/629,570, Bourassa et al., filed Jul. 31, 2000.

U.S. patent application Ser. No. 09/629,576, Bourassa et al., filed Jul. 31, 2000.

U.S. patent application Ser. No. 09/629,575, Bourassa et al., filed Jul. 31, 2000.

U.S. patent application Ser. No. 09/629,572, Bourassa et al., filed Jul. 31, 2000.

(List continued on next page.)

Primary Examiner—Patrice Winder

Assistant Examiner—David Lazaro

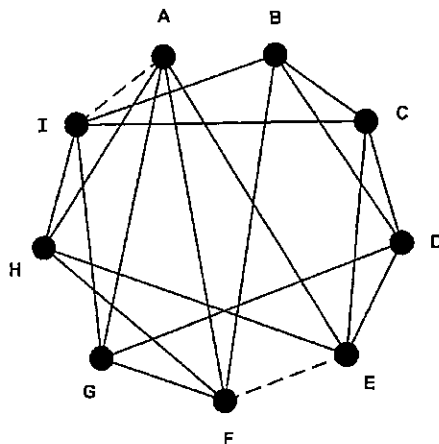
(74) Attorney, Agent, or Firm—Perkins Coie LLP

(57)

## ABSTRACT

A method for leaving a multicast computer network is disclosed. The method allows for the disconnection of a first computer from a second computer. When the first computer decides to disconnect from the second computer, the first computer sends a disconnect message to the second computer. Then, when the second computer receives the disconnect message from the first computer, the second computer broadcasts a connection port search message to find a third computer to which it can connect.

16 Claims, 39 Drawing Sheets



EXHIBIT

4

Bims

2/7/2017 C.A.R.

**EXHIBIT**

**Ex. 1001**

ACTIVISION, EA, TAKE-TWO,  
2K, ROCKSTAR  
Ex. 1001, p. 1 of 58

US 6,732,147 B1

Page 2

## U.S. PATENT DOCUMENTS

5,867,660 A	2/1999	Schmidt et al.	
5,867,667 A	2/1999	Butman et al.	
5,870,605 A	2/1999	Bracho et al.	
5,874,960 A	2/1999	Mairs et al.	
5,899,980 A	5/1999	Wilf et al.	
5,907,610 A	5/1999	Onweller	
5,928,335 A	7/1999	Morita	
5,935,215 A	8/1999	Bell et al.	
5,946,316 A *	8/1999	Chen et al.	370/408
5,948,054 A	9/1999	Nielsen	
5,949,975 A	9/1999	Batty et al.	
5,956,484 A	9/1999	Rosenberg et al.	
5,974,043 A	10/1999	Solomon	
5,987,506 A	11/1999	Carter et al.	
6,003,088 A	12/1999	Houston et al.	
6,013,107 A	1/2000	Blackshear et al.	
6,023,734 A	2/2000	Ratcliff et al.	
6,029,171 A	2/2000	Smiga et al.	
6,032,188 A	2/2000	Mairs et al.	
6,038,602 A	3/2000	Ishikawa	
6,047,289 A	4/2000	Thorne et al.	
6,073,177 A *	6/2000	Hebel et al.	709/228
6,094,676 A	7/2000	Gray et al.	
6,199,116 B1	3/2001	May et al.	
6,216,177 B1	4/2001	Mairs et al.	
6,223,212 B1	4/2001	Batty et al.	
6,243,691 B1	6/2001	Fisher et al.	
6,252,884 B1 *	6/2001	Hunter	370/443
6,268,855 B1	7/2001	Mairs et al.	
6,271,839 B1	8/2001	Mairs et al.	
6,285,363 B1	9/2001	Mairs et al.	
6,304,928 B1	10/2001	Mairs et al.	
6,353,599 B1 *	3/2002	Bi et al.	370/328
6,618,752 B1 *	9/2003	Moore et al.	709/217

## OTHER PUBLICATIONS

U.S. patent application Ser. No. 09/629,023, Bourassa et al., filed Jul. 31, 2000.  
 U.S. patent application Ser. No. 09/629,043, Bourassa et al., filed Jul. 31, 2000.  
 U.S. patent application Ser. No. 09/629,024, Bourassa et al., filed Jul. 31, 2000.  
 U.S. patent application Ser. No. 09/629,042, Bourassa et al., filed Jul. 31, 2000.  
 Murphy, Patricia, A., "The Next Generation Networking Paradigm: Producer/Consumer Model," Dedicated Systems Magazine—2000 (pp. 26–28).

The Gamer's Guide, "First-Person Shooters," Oct. 20, 1998 (4 pages).

The O'Reilly Network, "Gnutella: Alive, Well, and Changing Fast," Jan. 25, 2001 (5 pages) <http://www.open2p.com/lpt/> . . . [Accessed Jan. 29, 2002].

Oram, Andy, "Gnutella and Freenet Represents True Technological Innovation," May 12, 2000 (7 pages) The O'Reilly Network <http://www.oreillynet.com/lpt/> . . . [Accessed Jan. 29, 2002].

Internetworking Technologies Handbook, Chapter 43 (pp. 43–1 –43–16).

Oram, Andy, "Peer-to-Peer Makes the Internet Interesting Again," Sep. 22, 2000 (7 pages) The O'Reilly Network <http://linux.oreillynet.com/lpt/> . . . [Accessed Jan. 29, 2002].

Monte, Richard, "The Random Walk for Dummies," MIT Undergraduate Journal of Mathematics (pp. 143–148).

Srinivasan, R., "XDR: External Data Representation Standard," Sun Microsystems, Aug. 1995 (20 pages) Internet RFC/STD/FYI/BCP Archives <http://www.faqs.org/rfcs/rfc1832.html> [Accessed Jan. 29, 2002].

A Database Corporate White Paper, "A Primer on the T.120 Series Standards," Copyright 1995 (pp. 1–16).

Kessler, Gary, C., "An Overview of TCP/IP Protocols and the Internet," Apr. 23, 1999 (23 pages) Hill Associates, Inc. <http://www.hill.com/library/publications/t> . . . [Accessed Jan. 29, 2002].

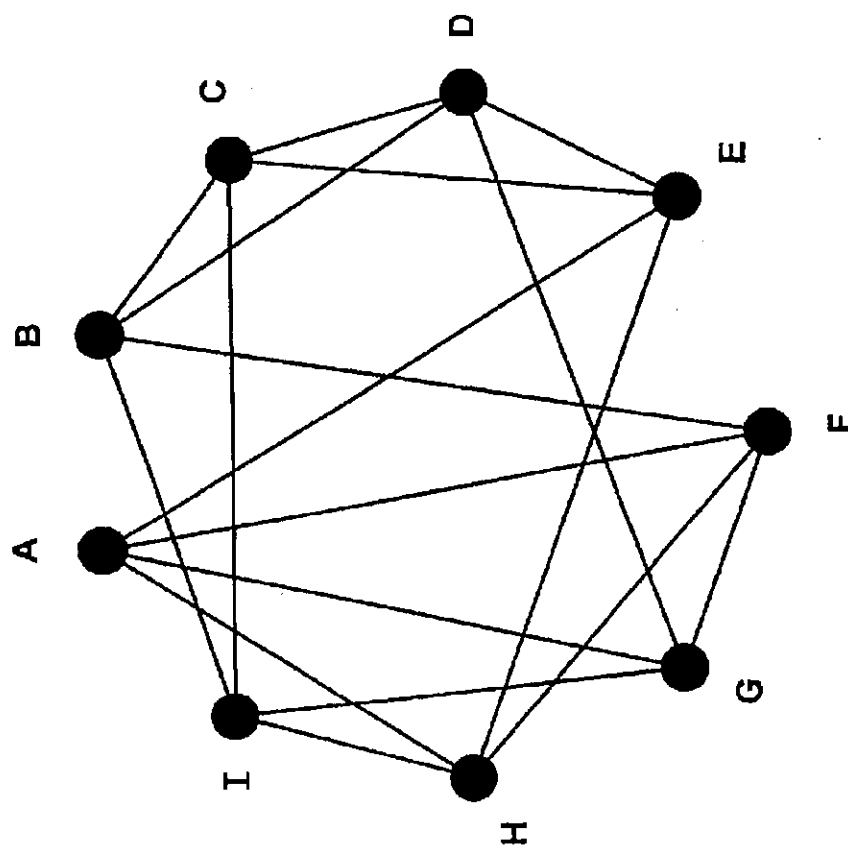
Bondy, J.A., and Murty, U.S.R., "Graph Theory with Applications," Chapters 1–3 (pp. 1–47), 1976 American Elsevier Publishing Co., Inc., New York, New York.

Cormen, Thomas H. et al., Introduction to Algorithms, Chapter 5.3 (pp. 84–91), Chapter 12 (pp. 218–243), Chapter 13 (p. 245), 1990, The MIT Press, Cambridge, Massachusetts, McGraw-Hill Book Company, New York.

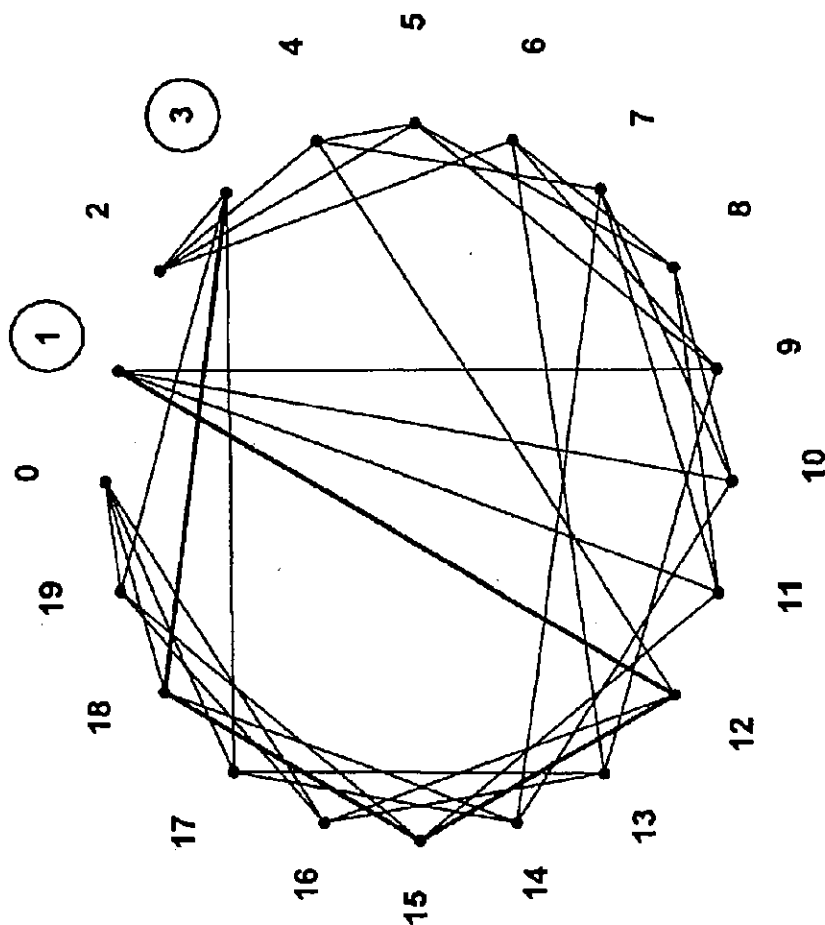
The Common Object Request Broker: Architecture and Specification, Revision 2.6, Dec. 2001, Chapter 12 (pp. 12–1–12–10), Chapter 13 (pp. 13–1–13–56) Chapter 16 (pp. 16–1 –16–26), Chapter 18 (pp. 18–1 –18–52), Chapter 20 (pp. 20–1–20–22).

The University of Warwick, Computer Science Open Days, "Demonstration on the Problems of Distributed Systems," <http://www.dcs.warwick.ac.uk> . . . [Accessed Jan. 29, 2002].

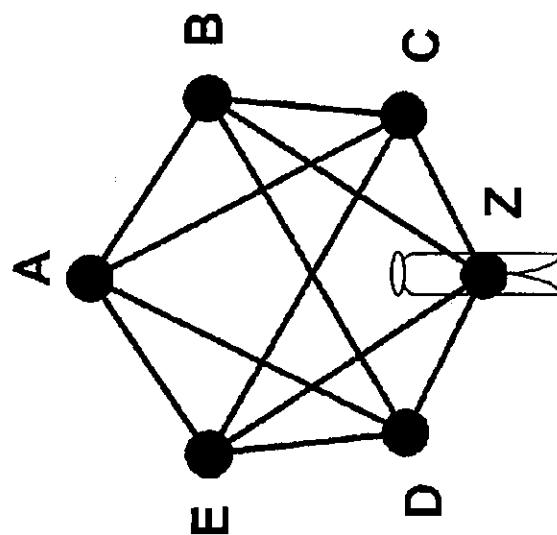
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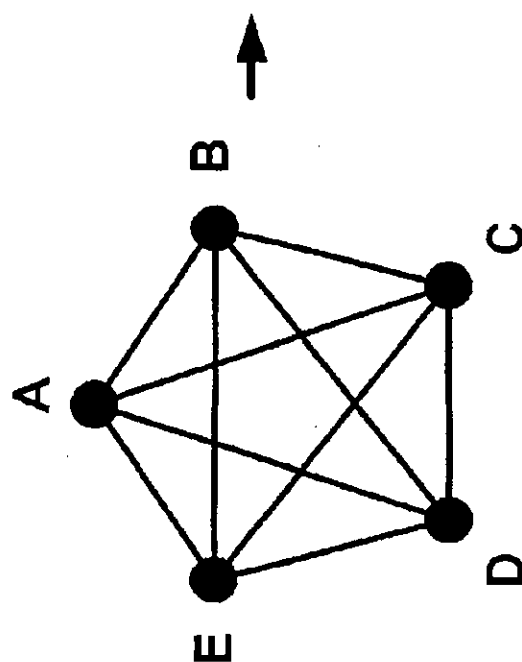
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*Fig. 2*

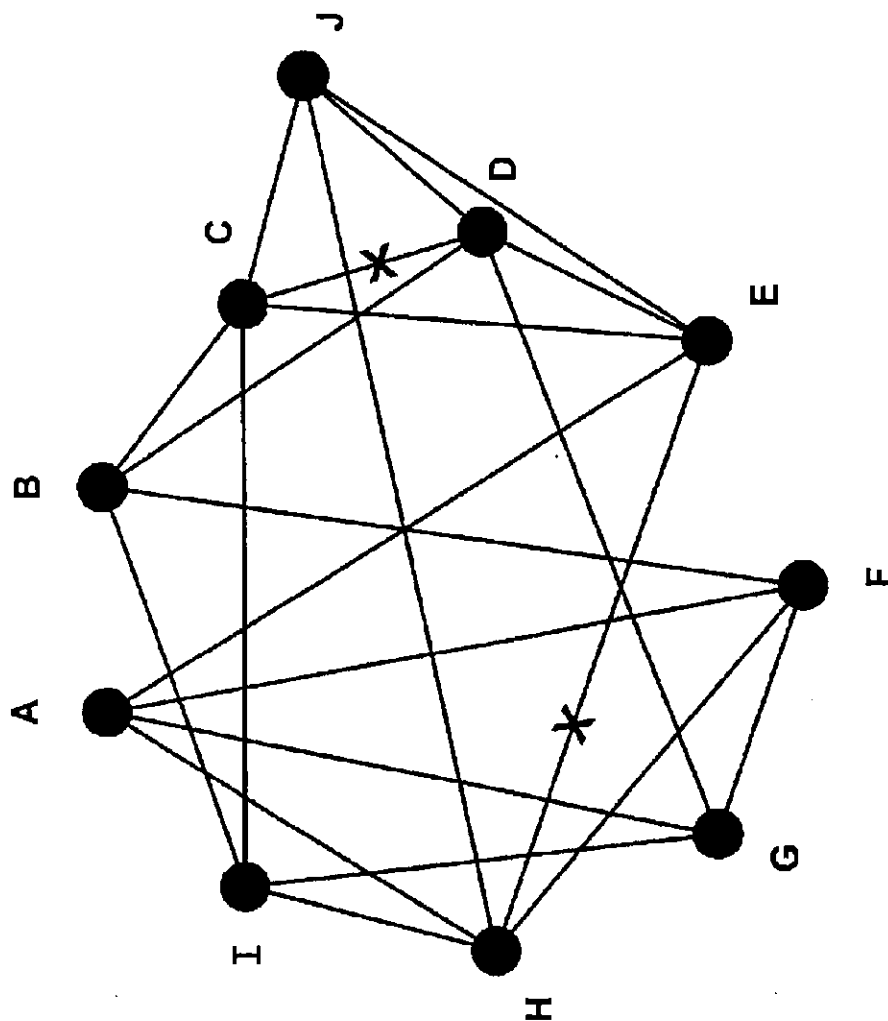


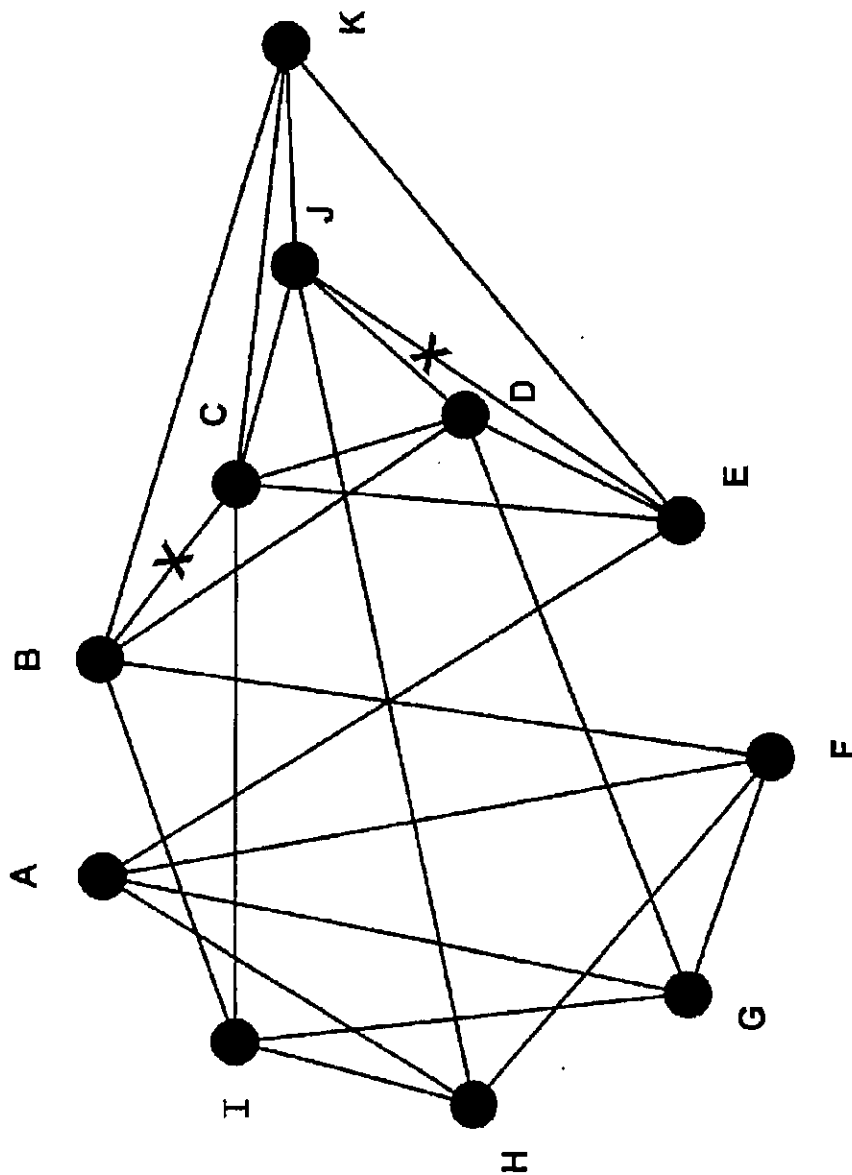


*Fig. 3B*

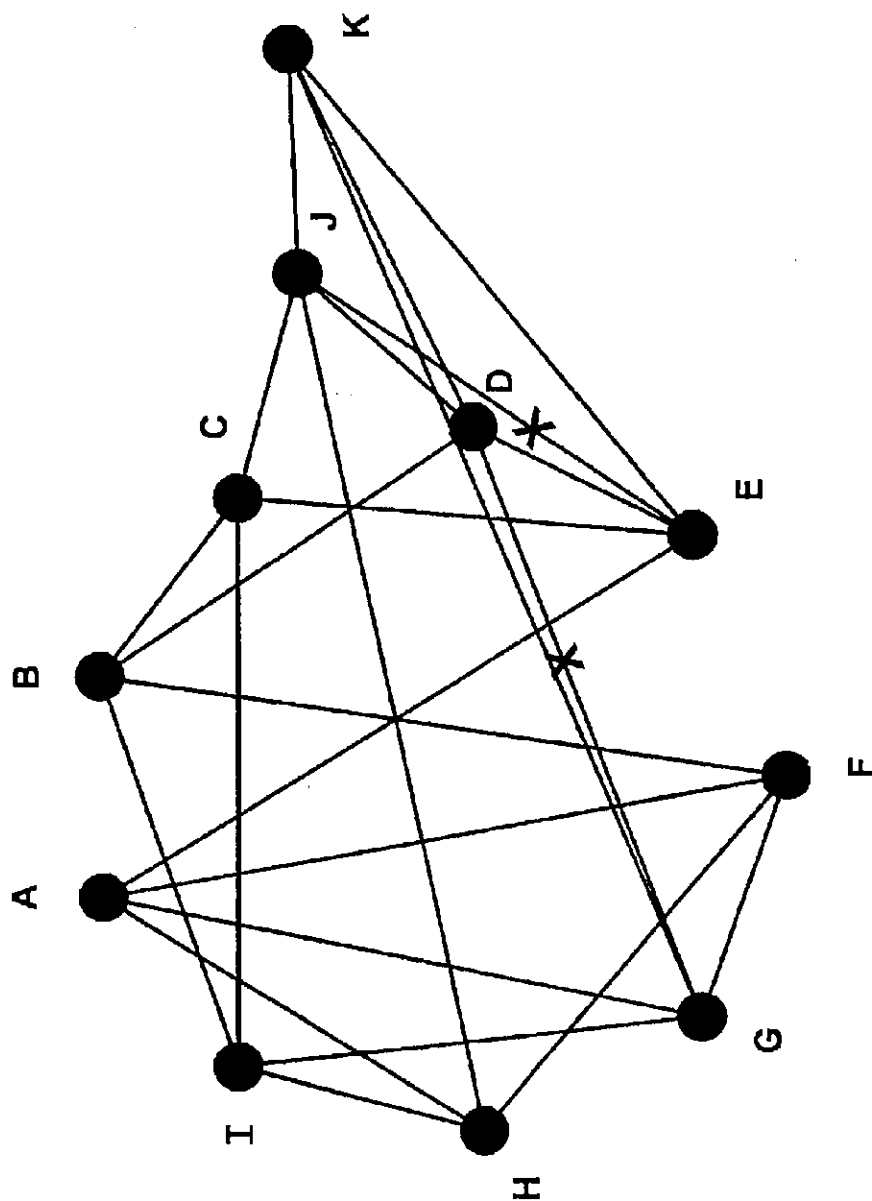


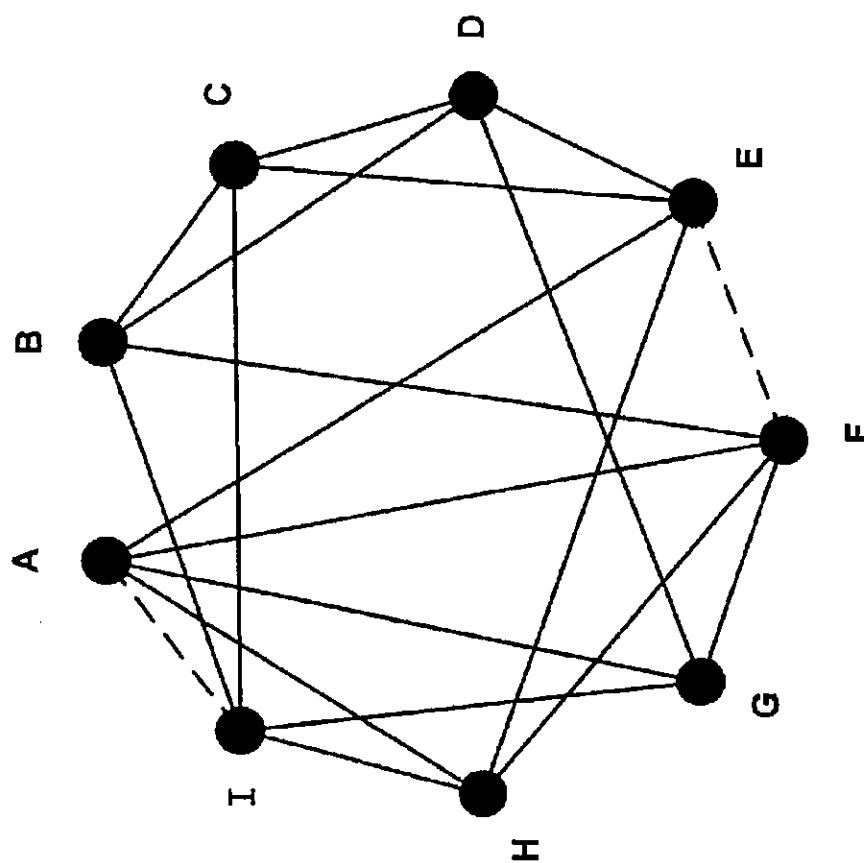
*Fig. 3A*

*Fig. 4A*

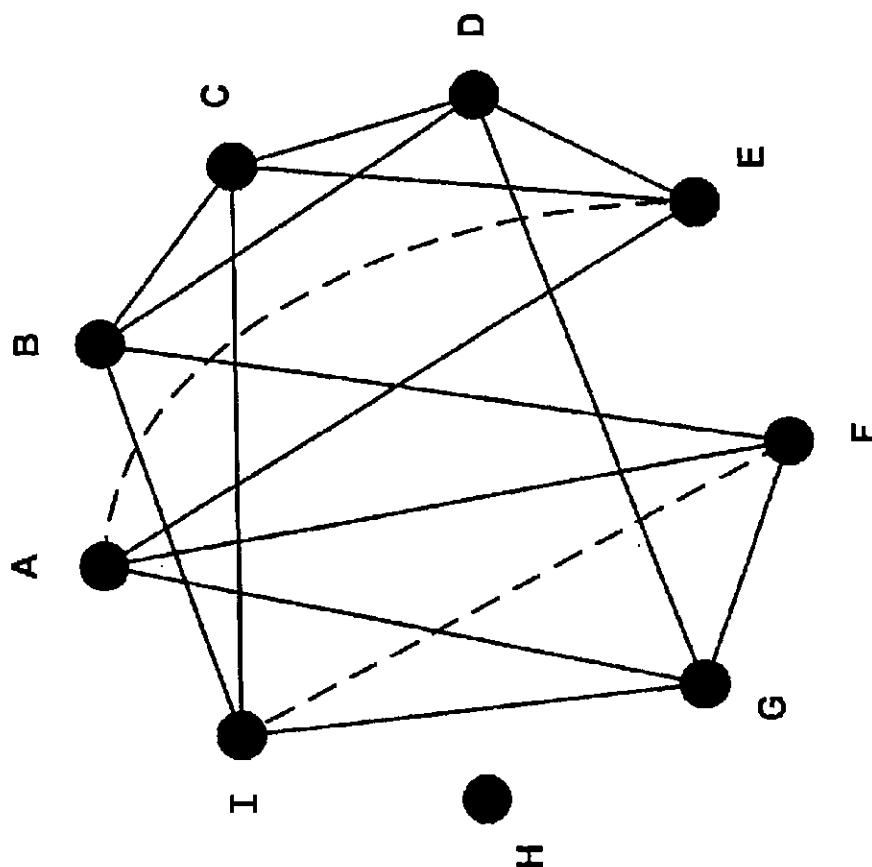


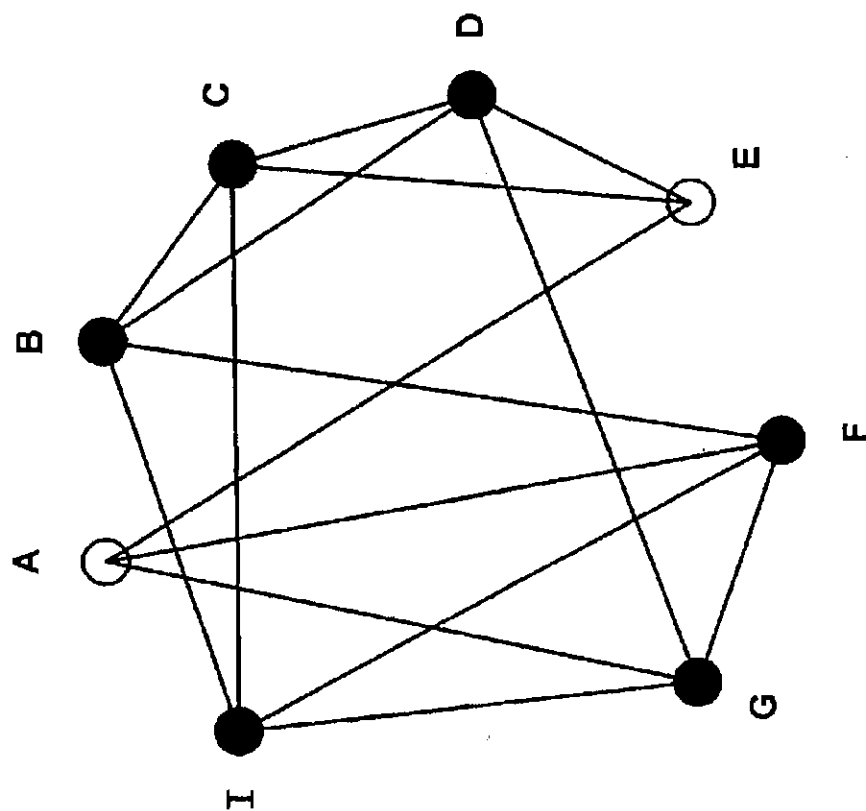
*Fig. 4B*

*Fig. 4C*

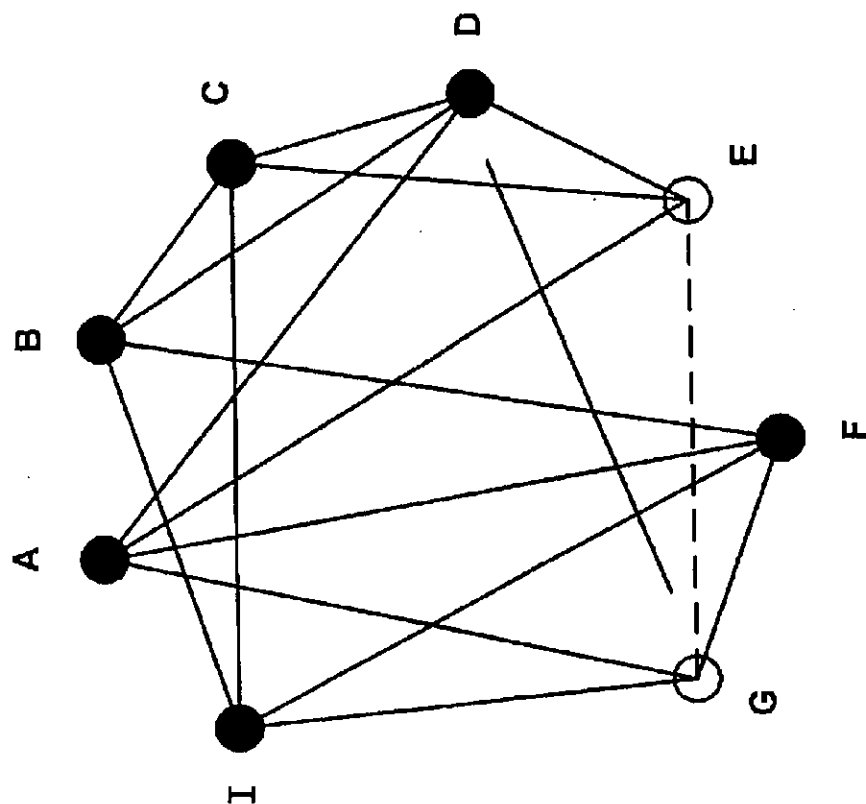


*Fig. 5A*

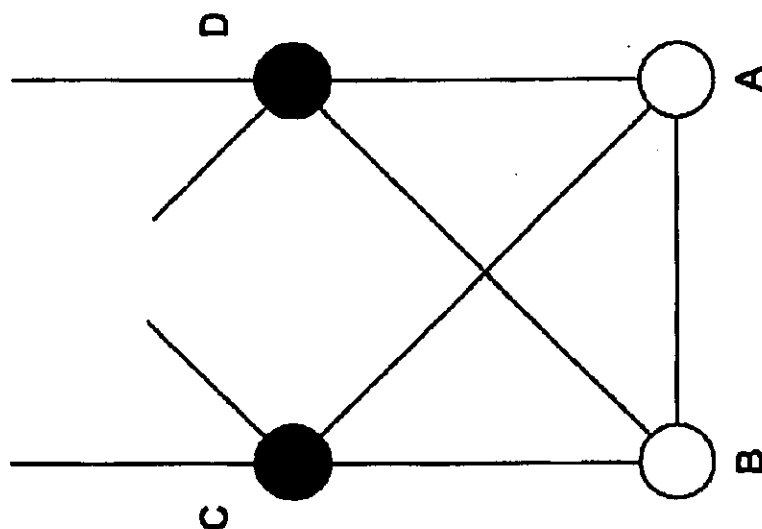
*Fig. 5B*



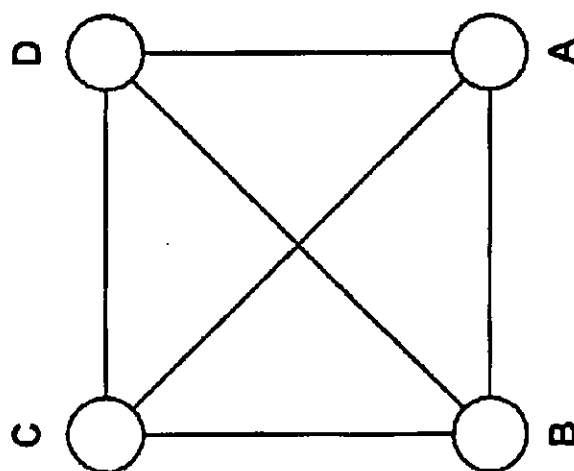
*Fig. 5C*

*Fig. 5D*





*Fig. 5F*



*Fig. 5E*

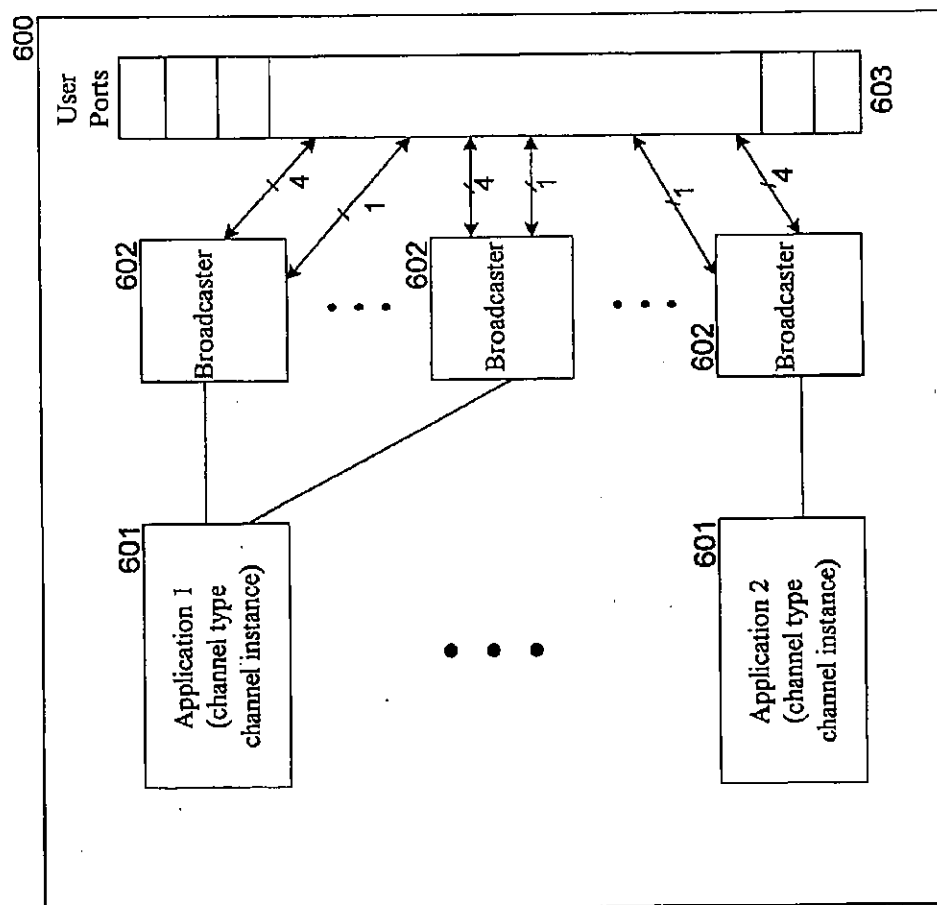


Fig. 6

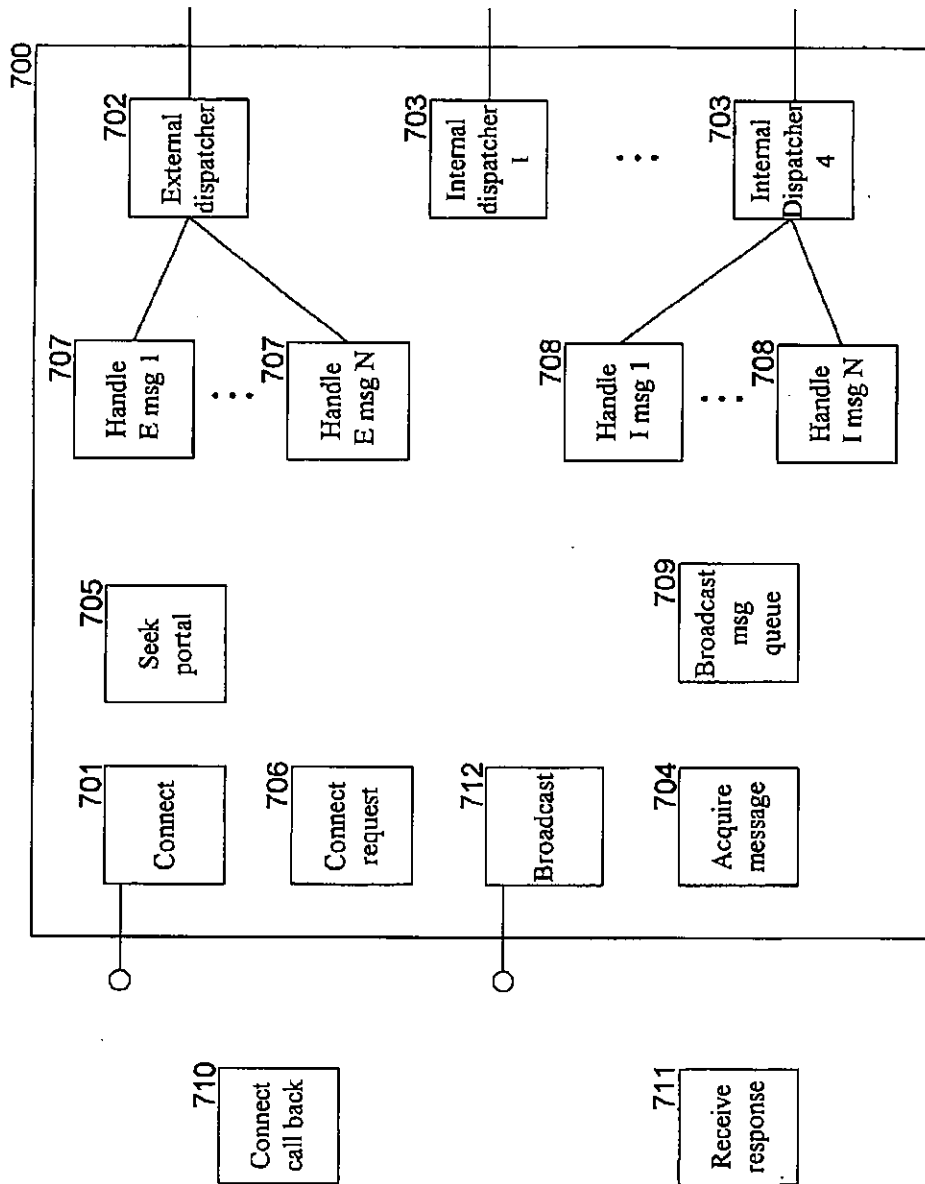
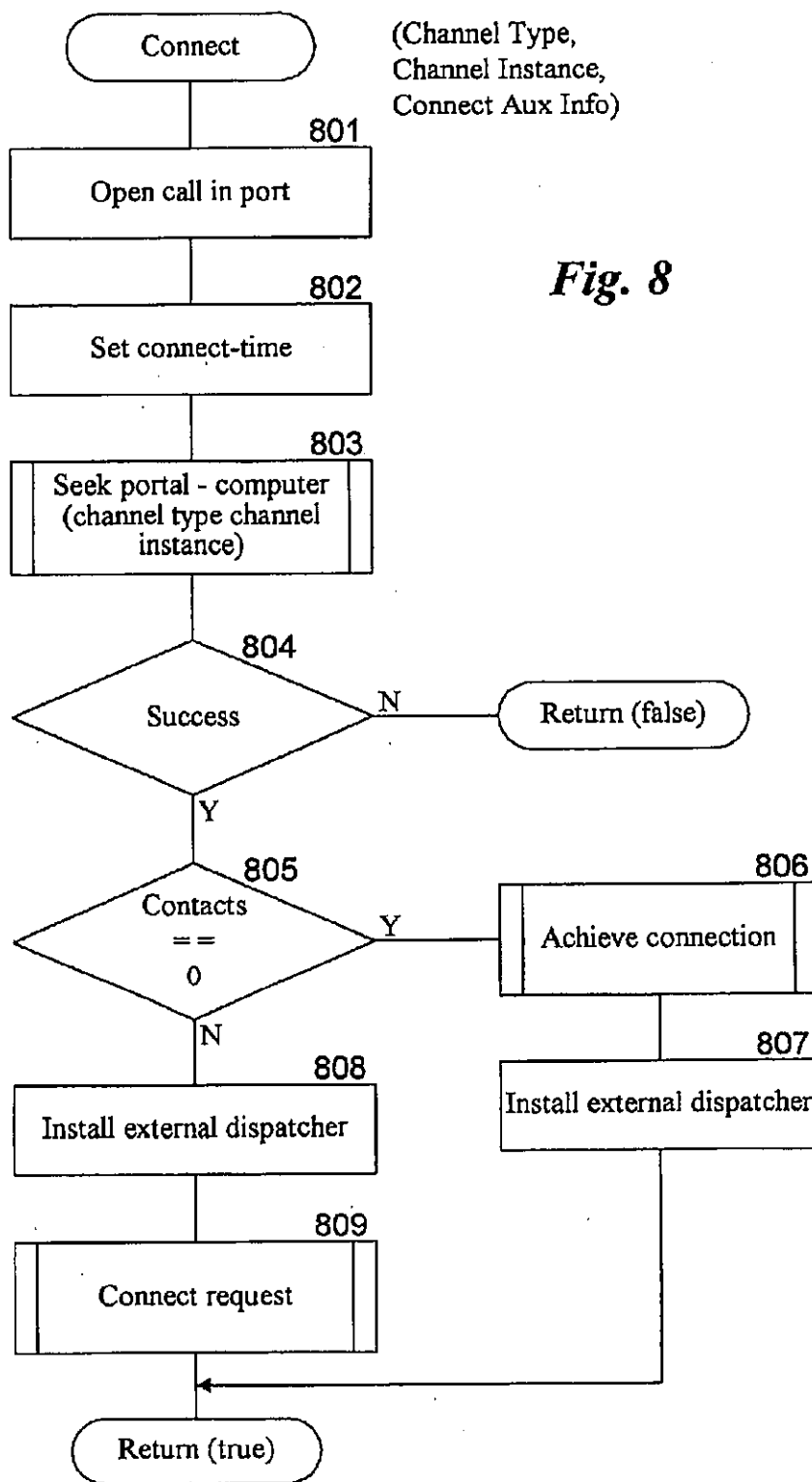
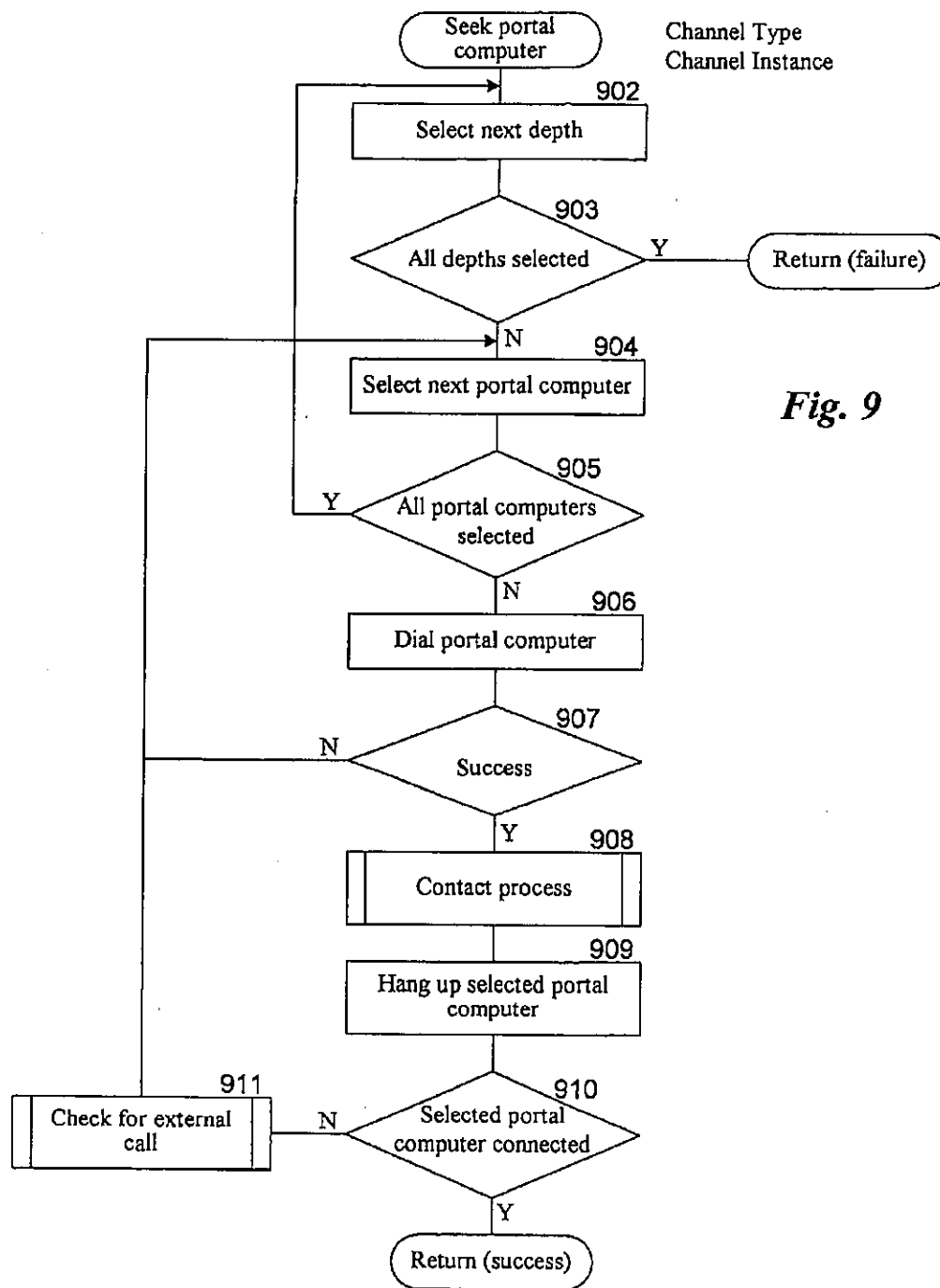
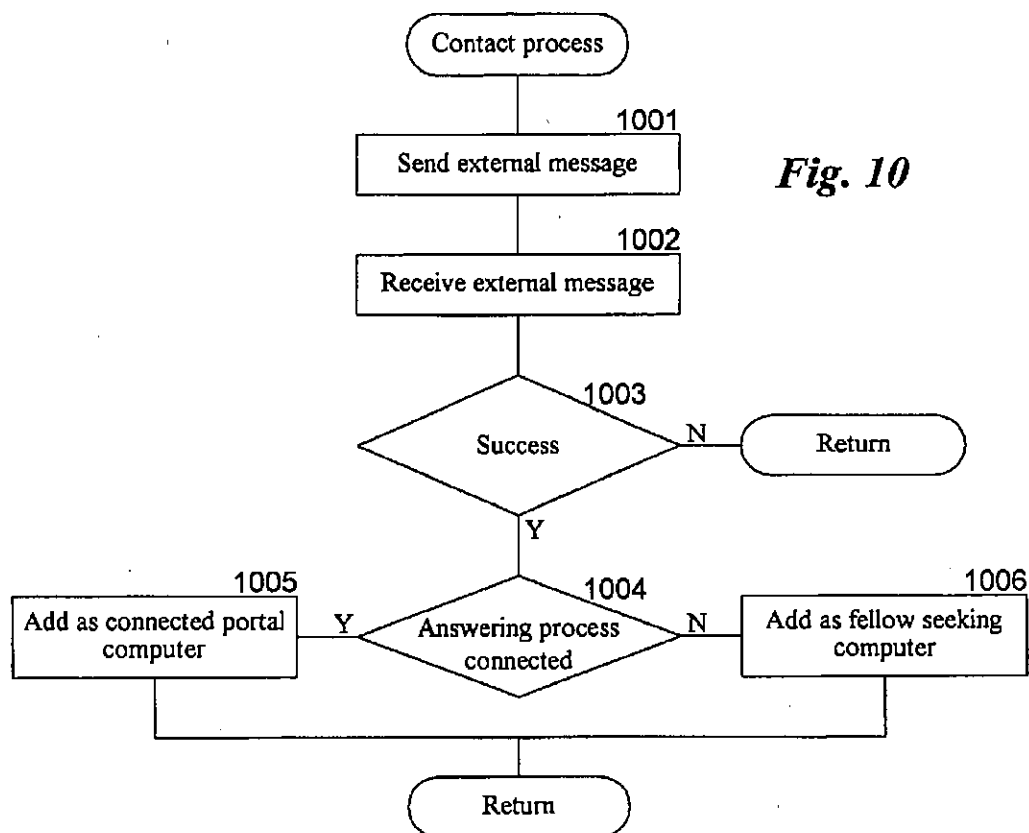
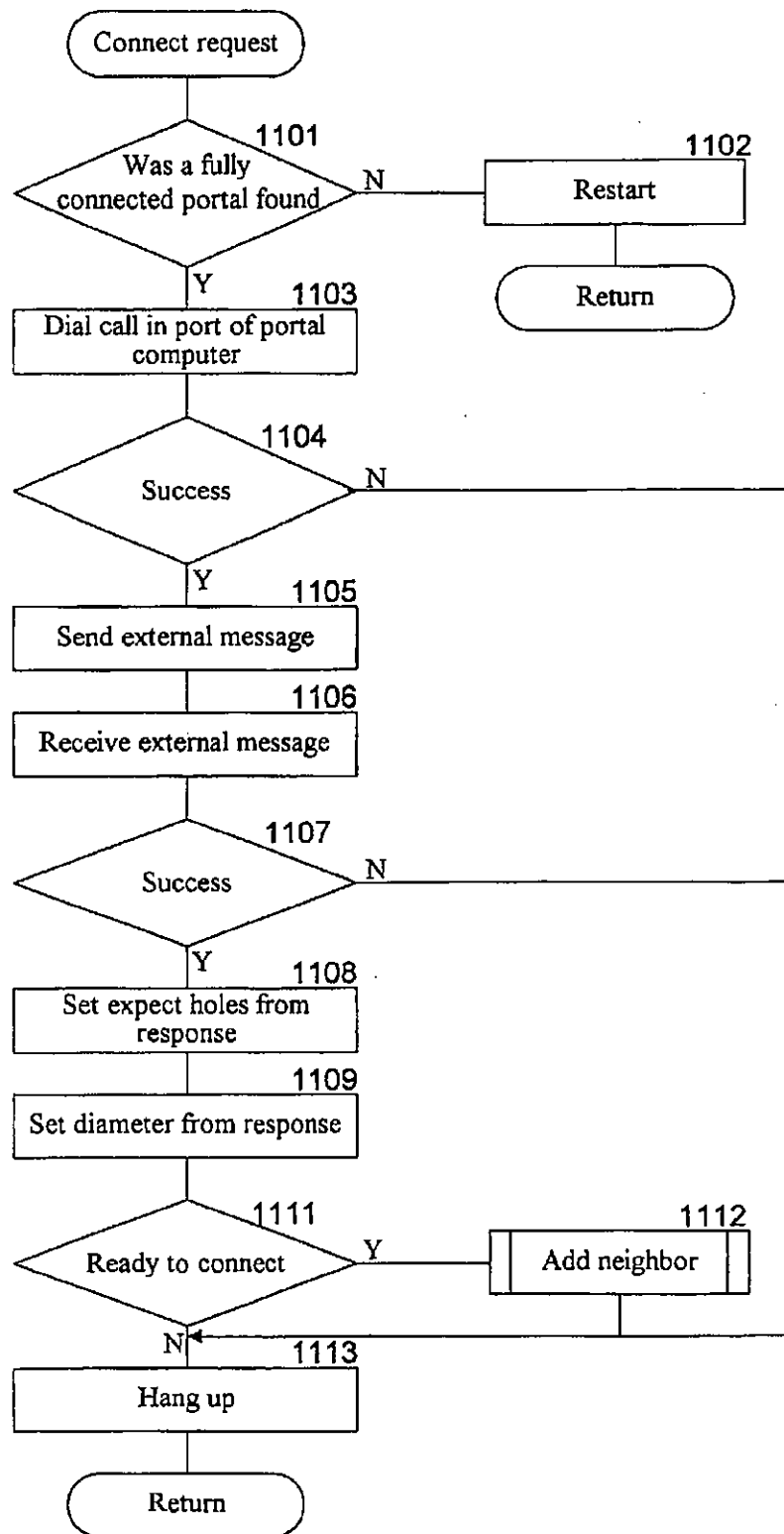


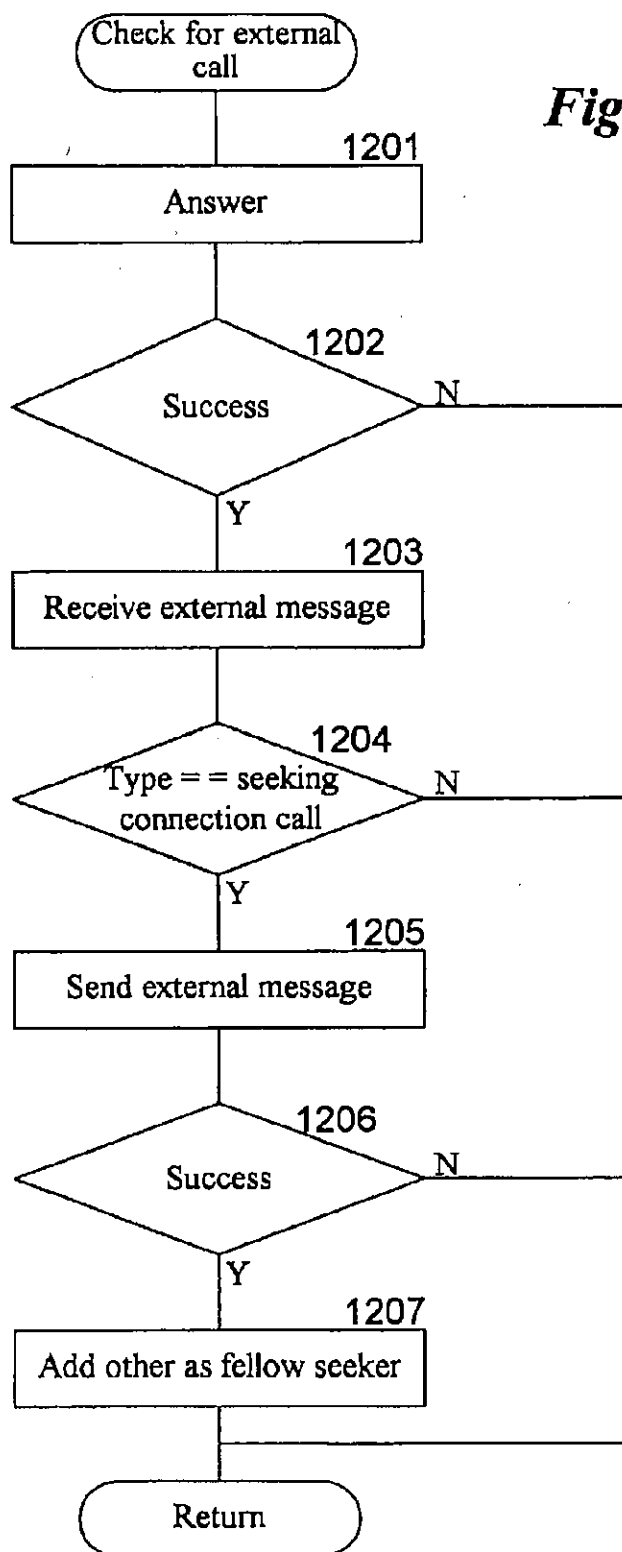
Fig. 7



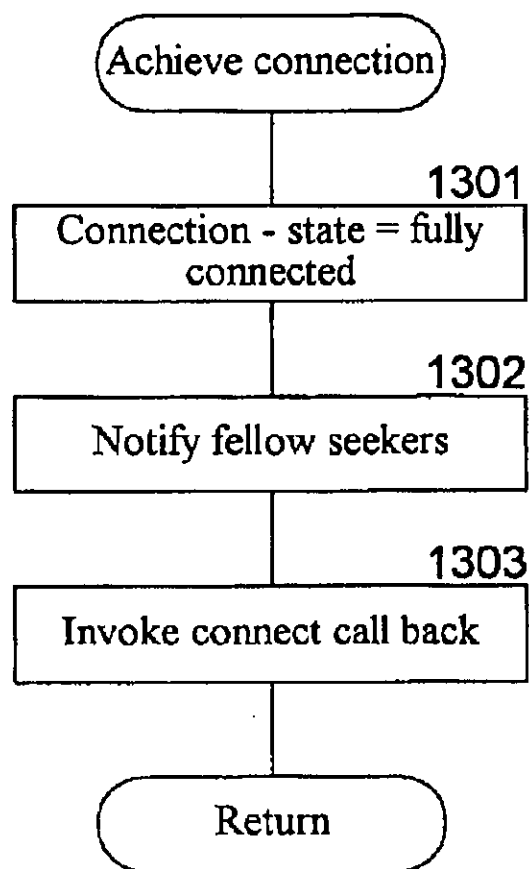


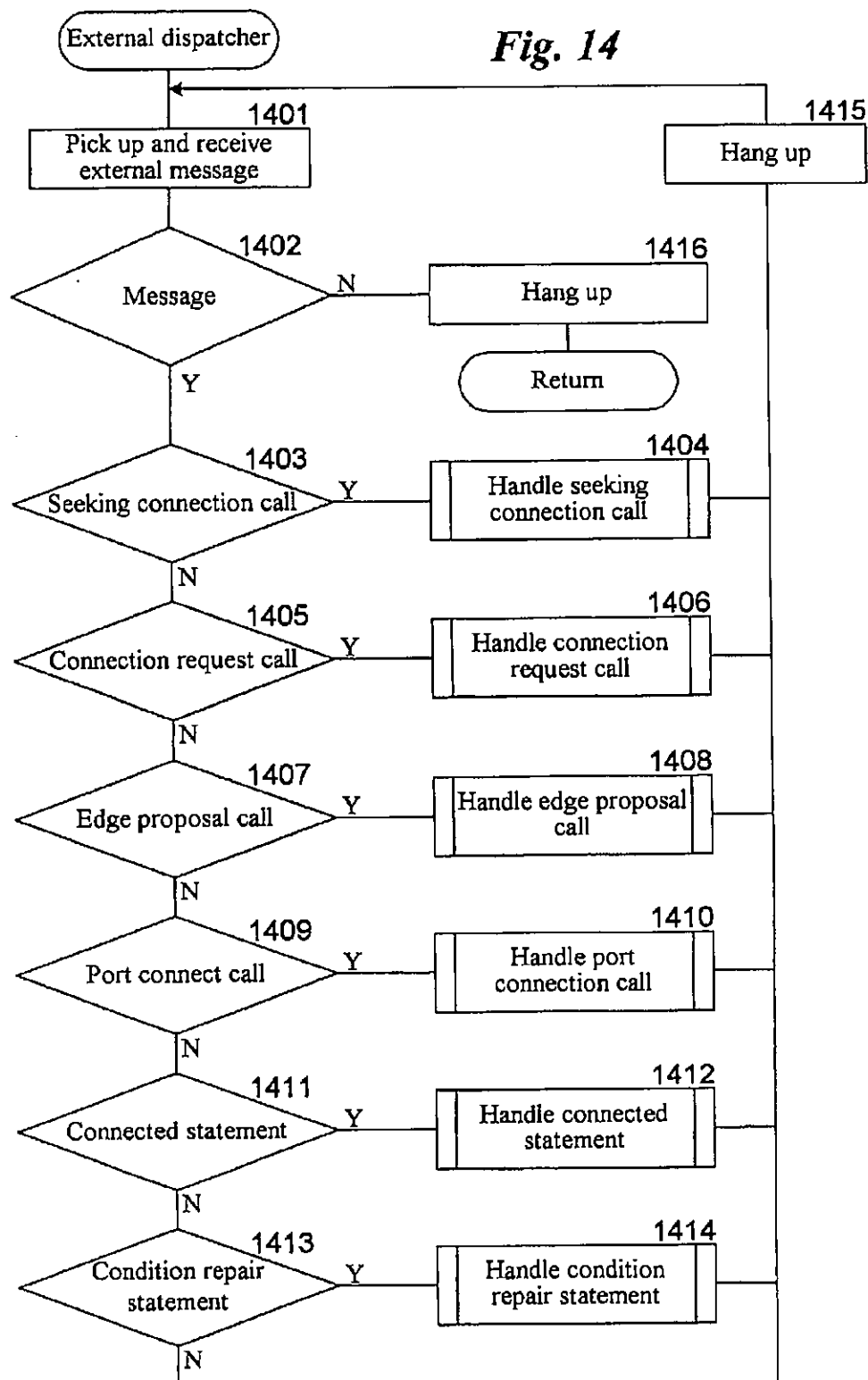


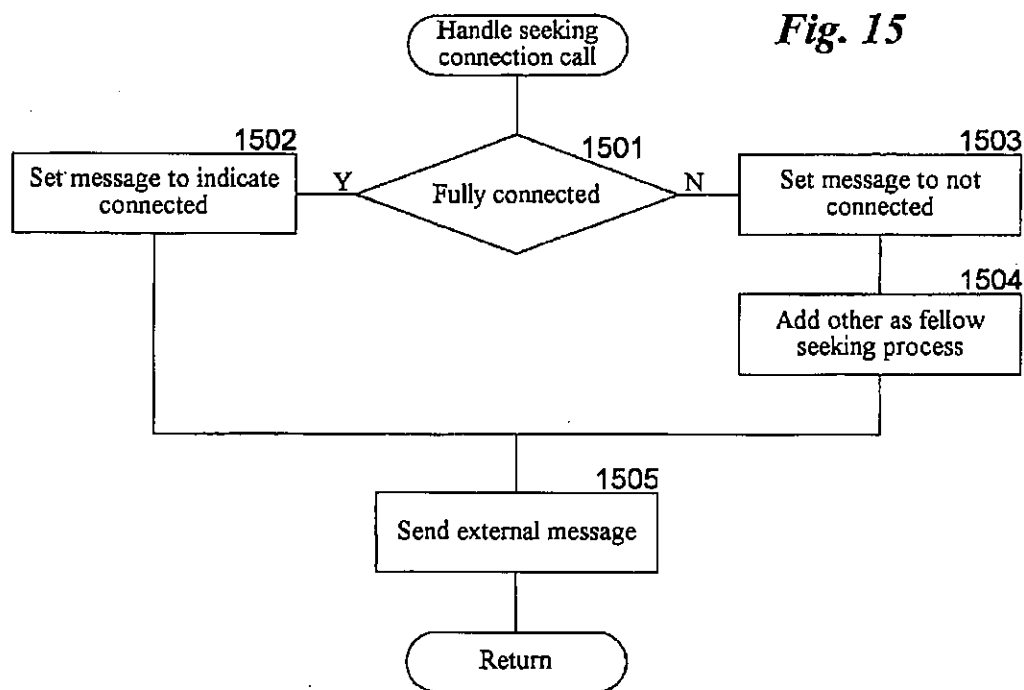
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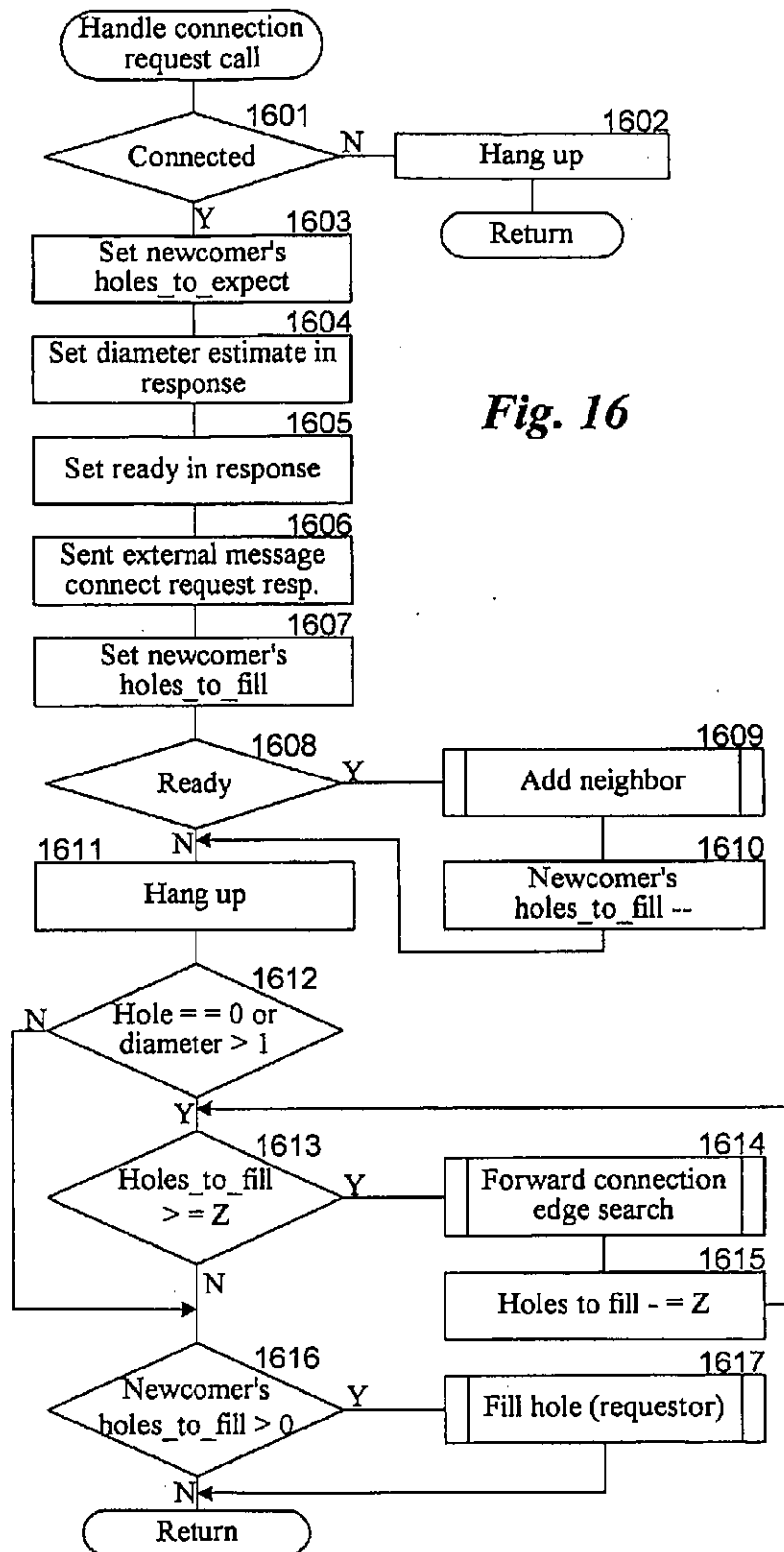
*Fig. 12*

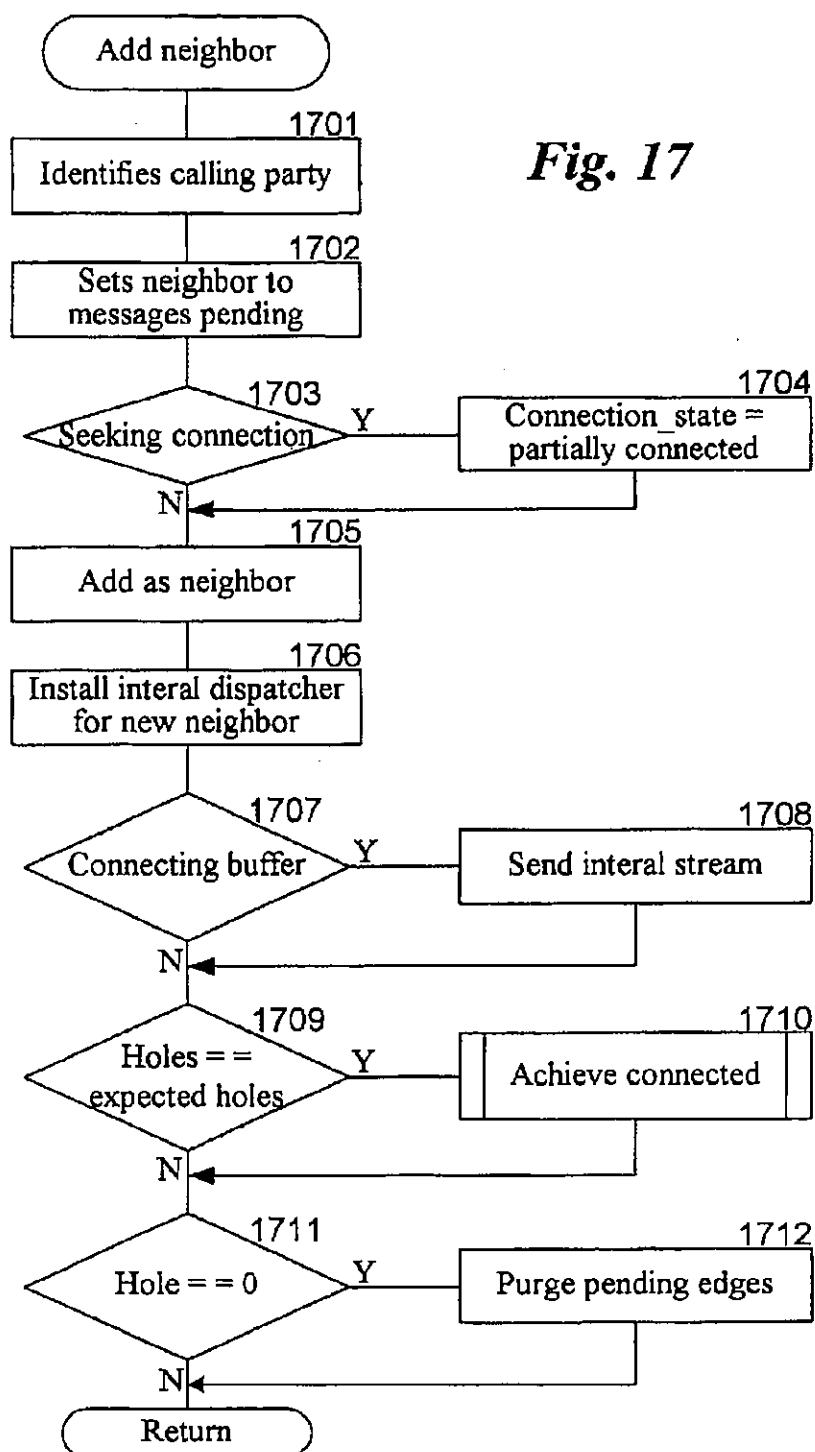


*Fig. 13*

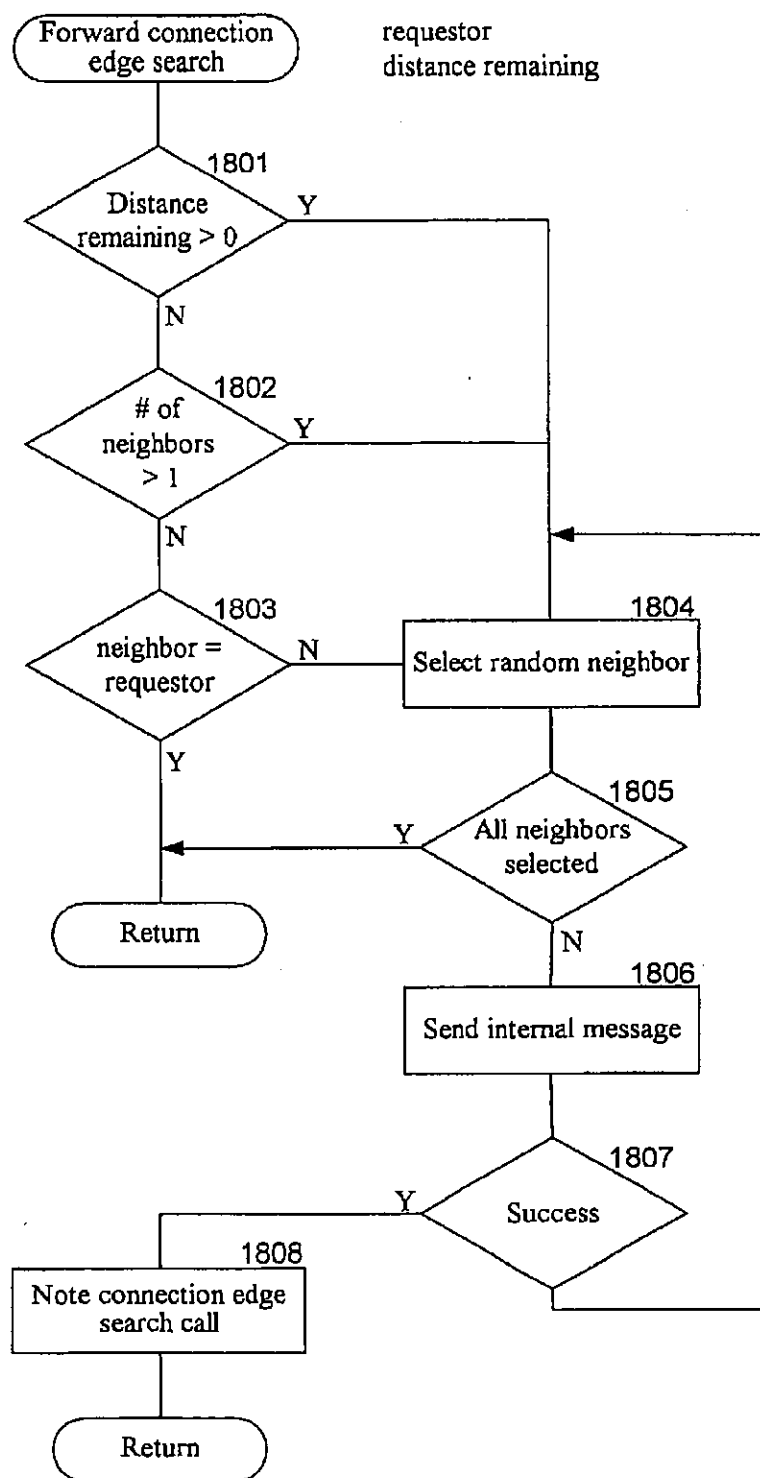


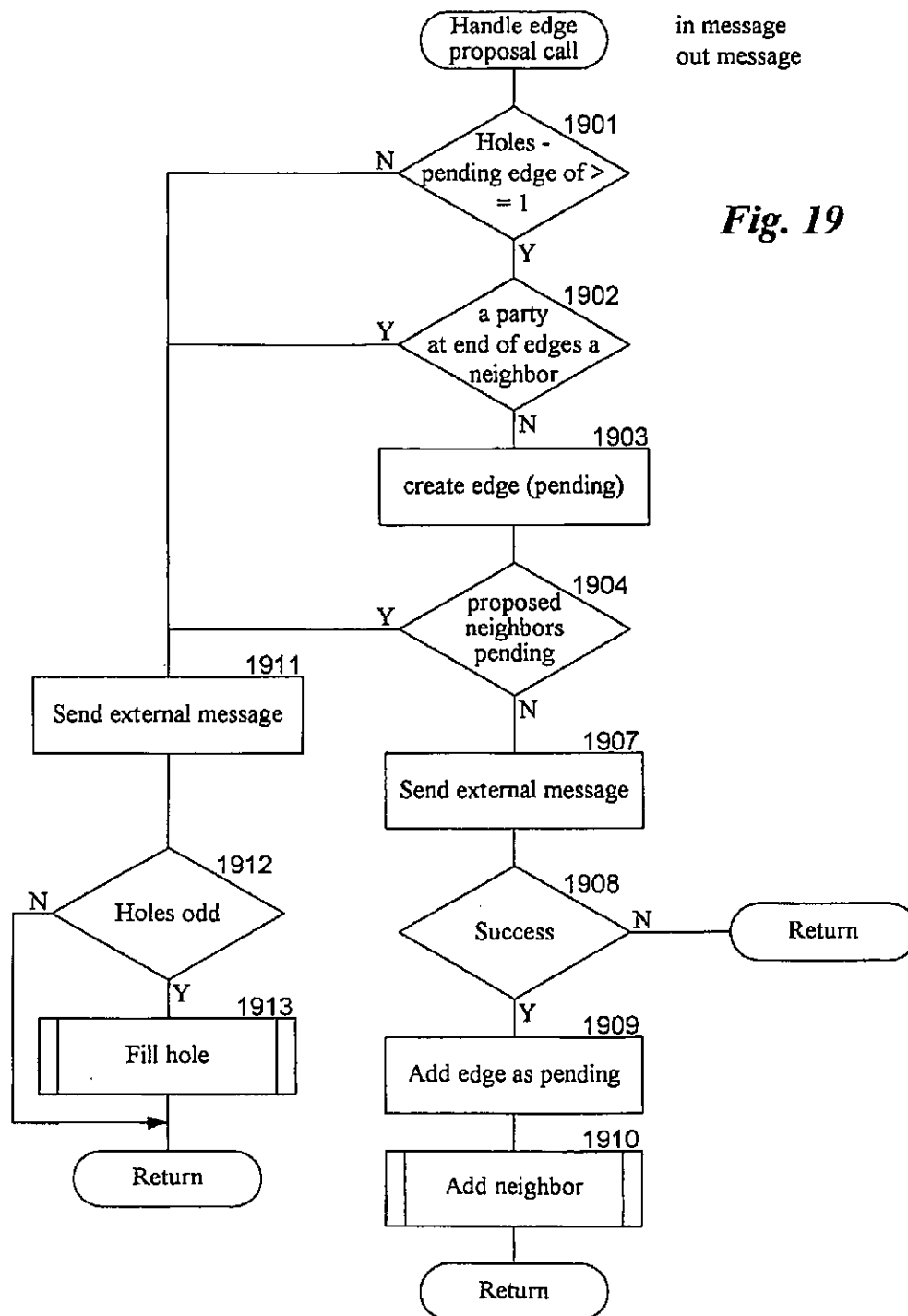




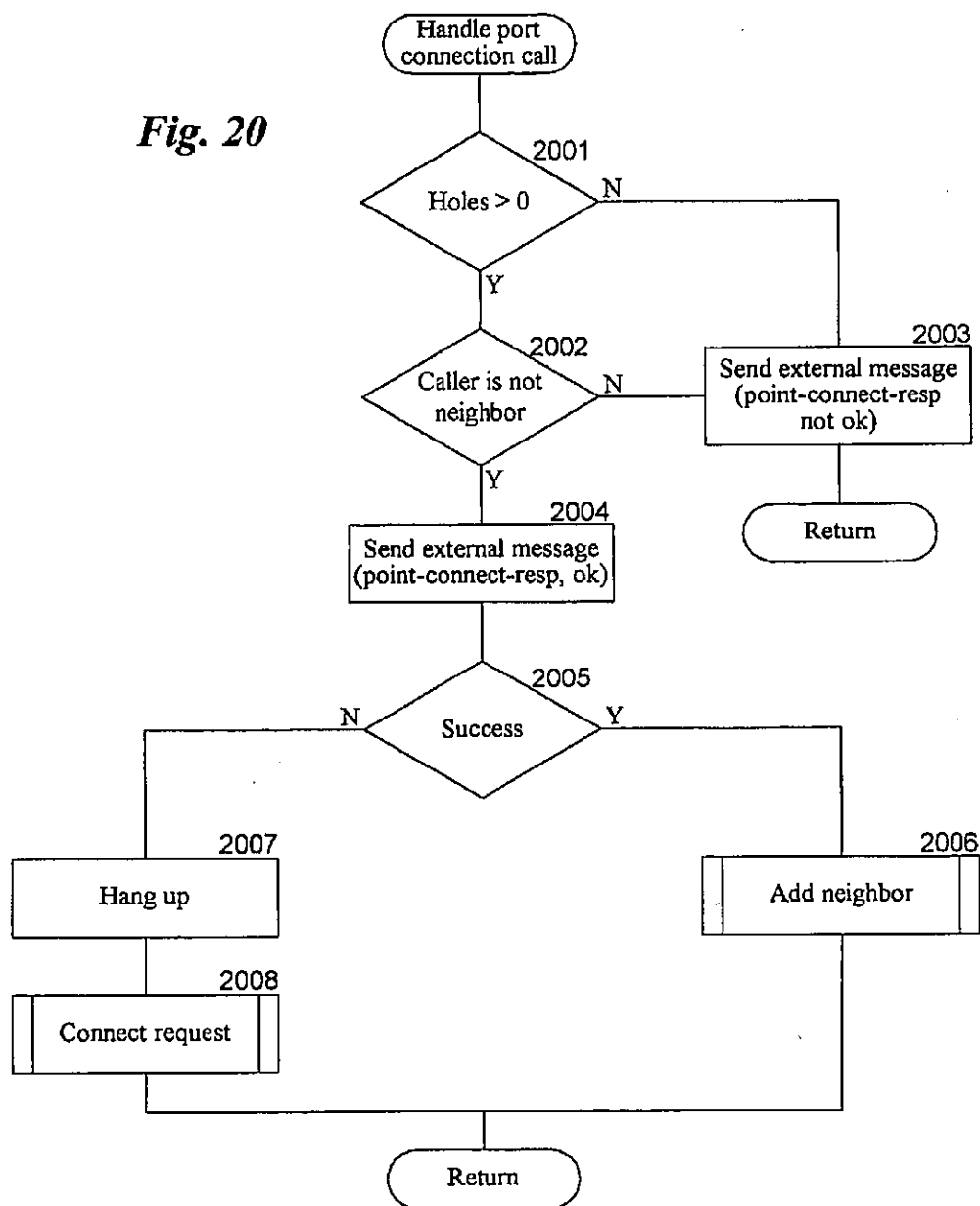


**Fig. 18**

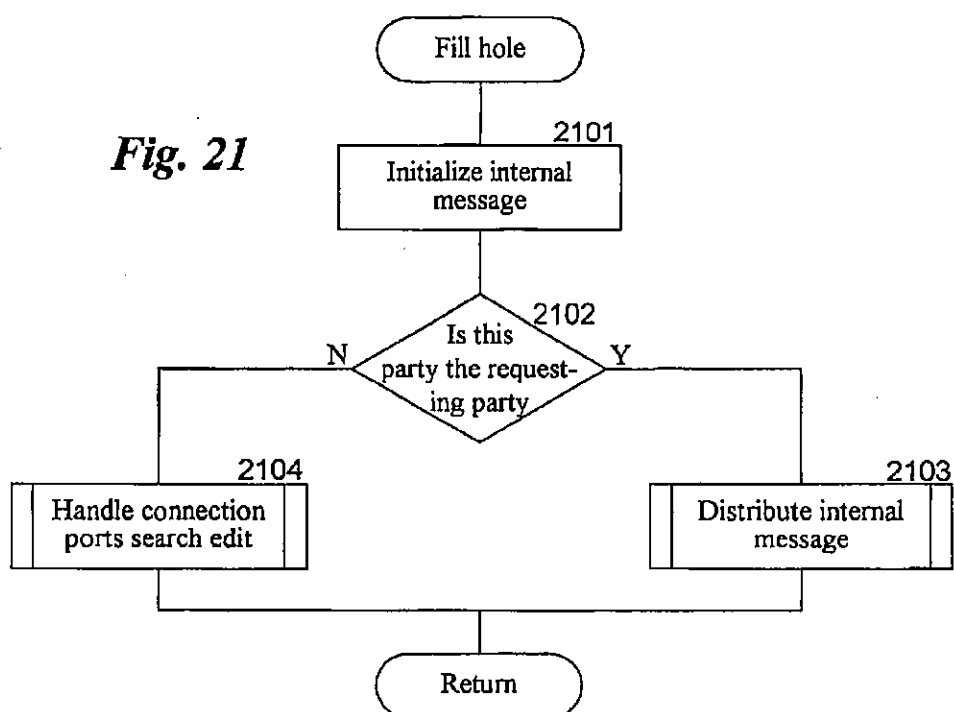




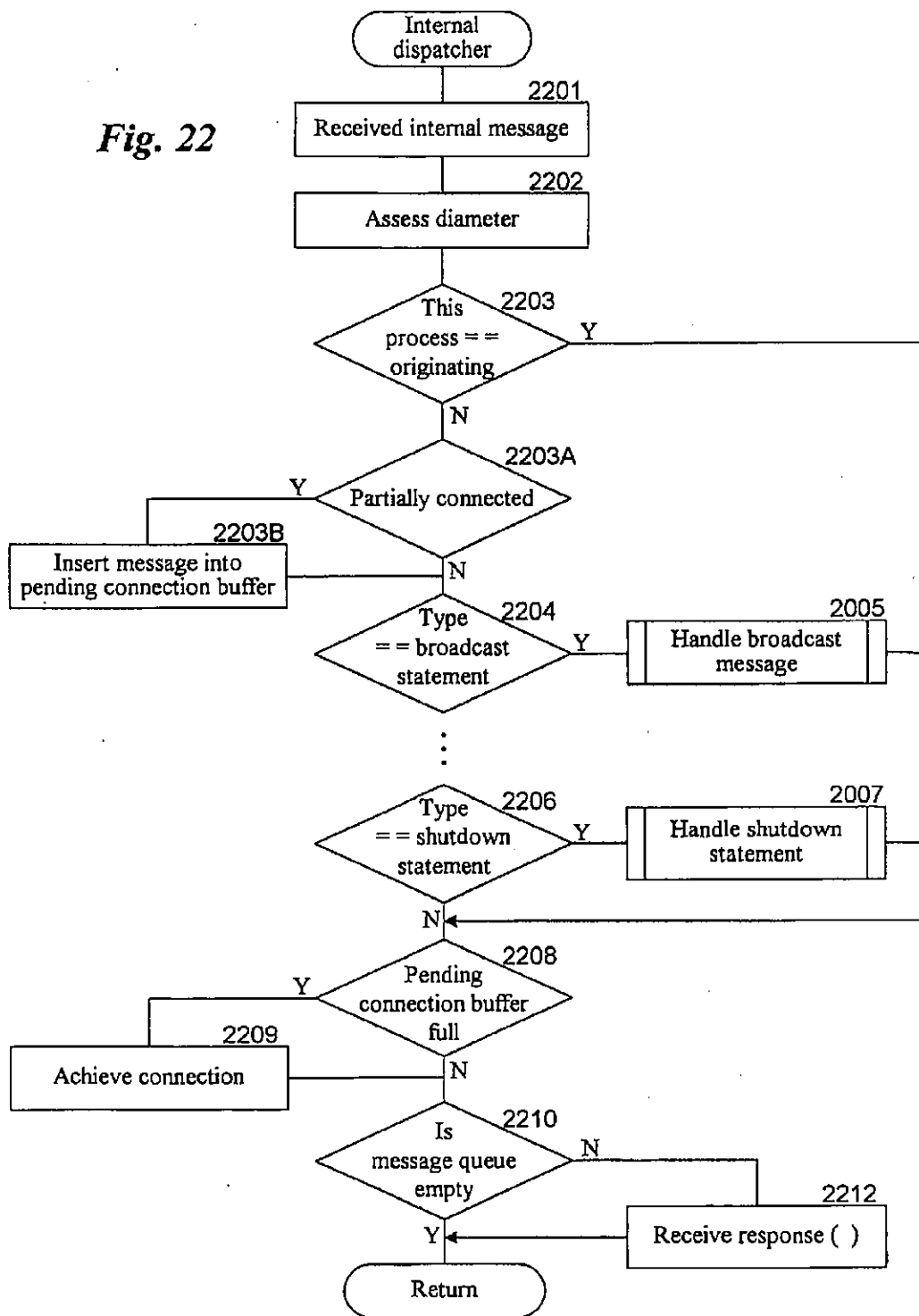
**Fig. 20**



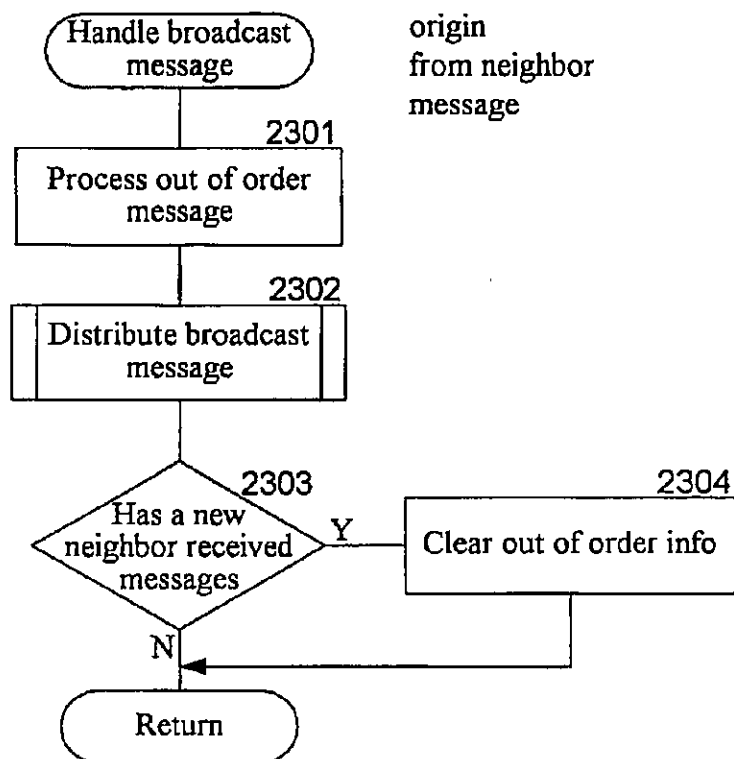


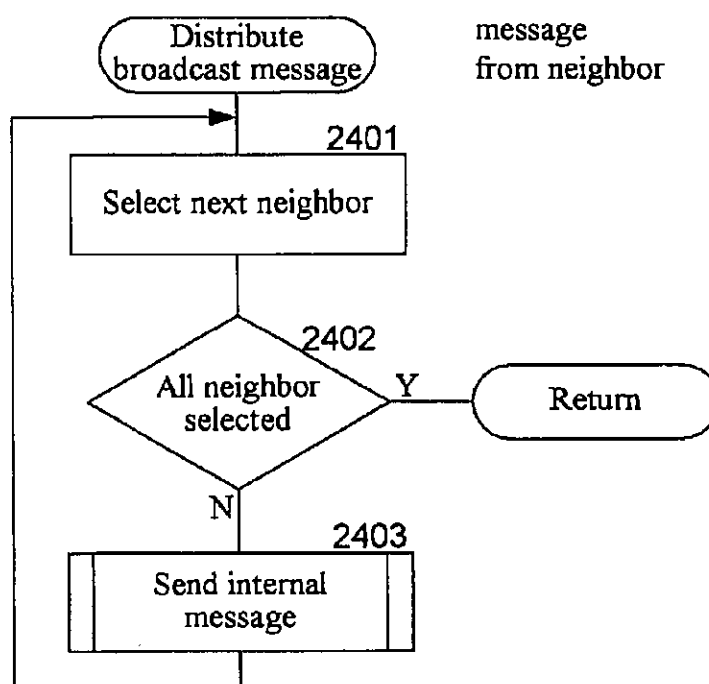
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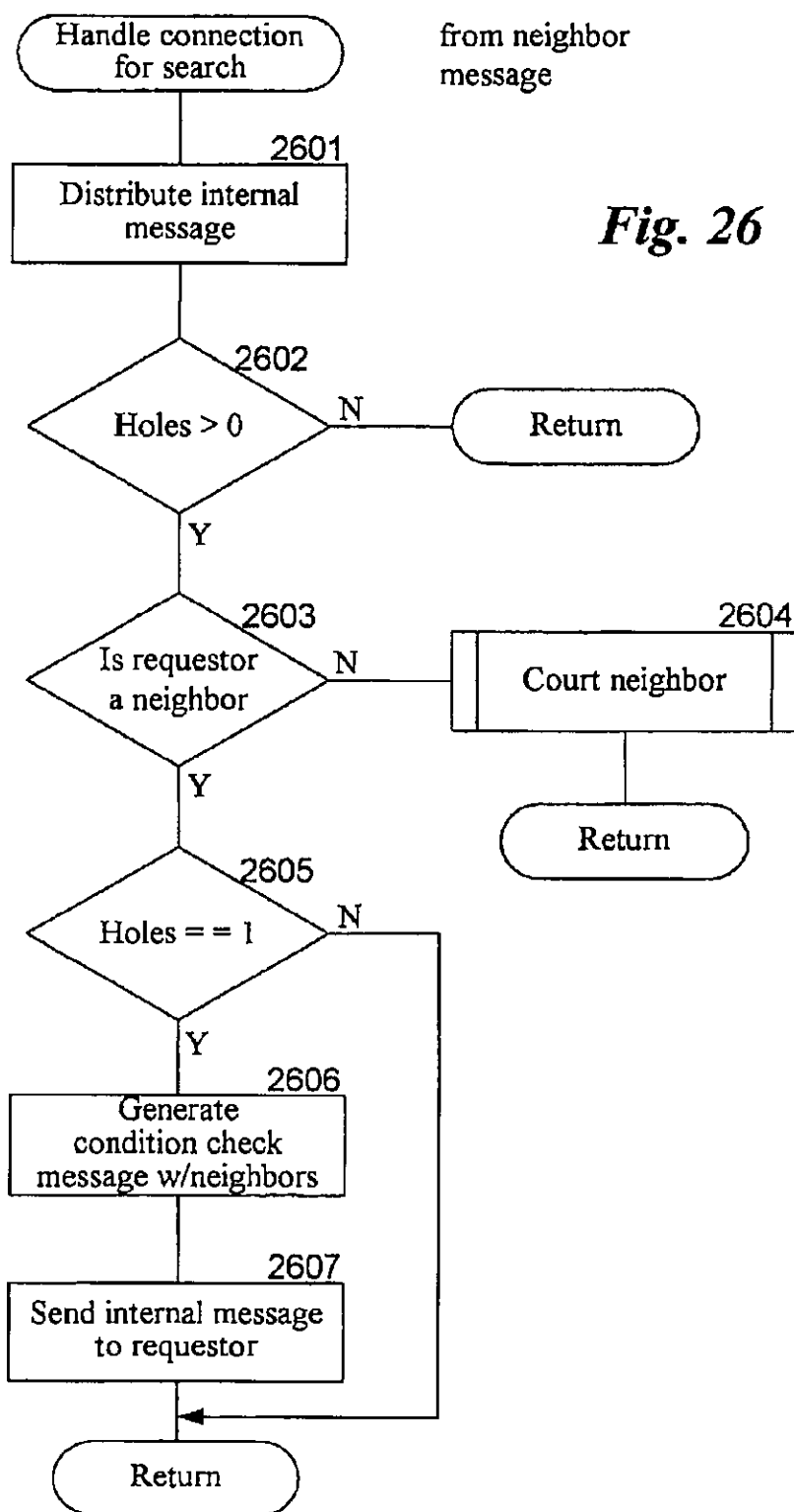
**Fig. 22**



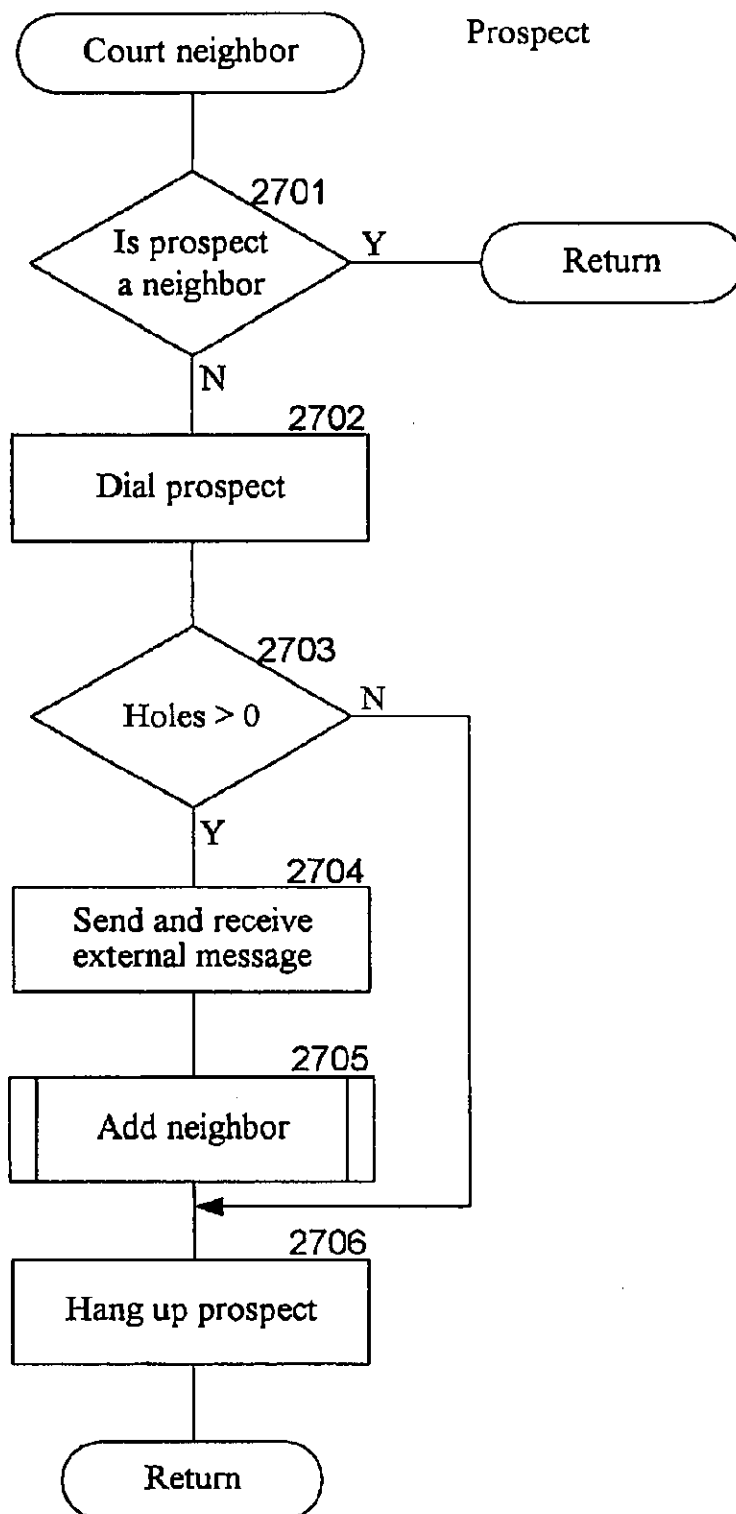
**Fig. 23**



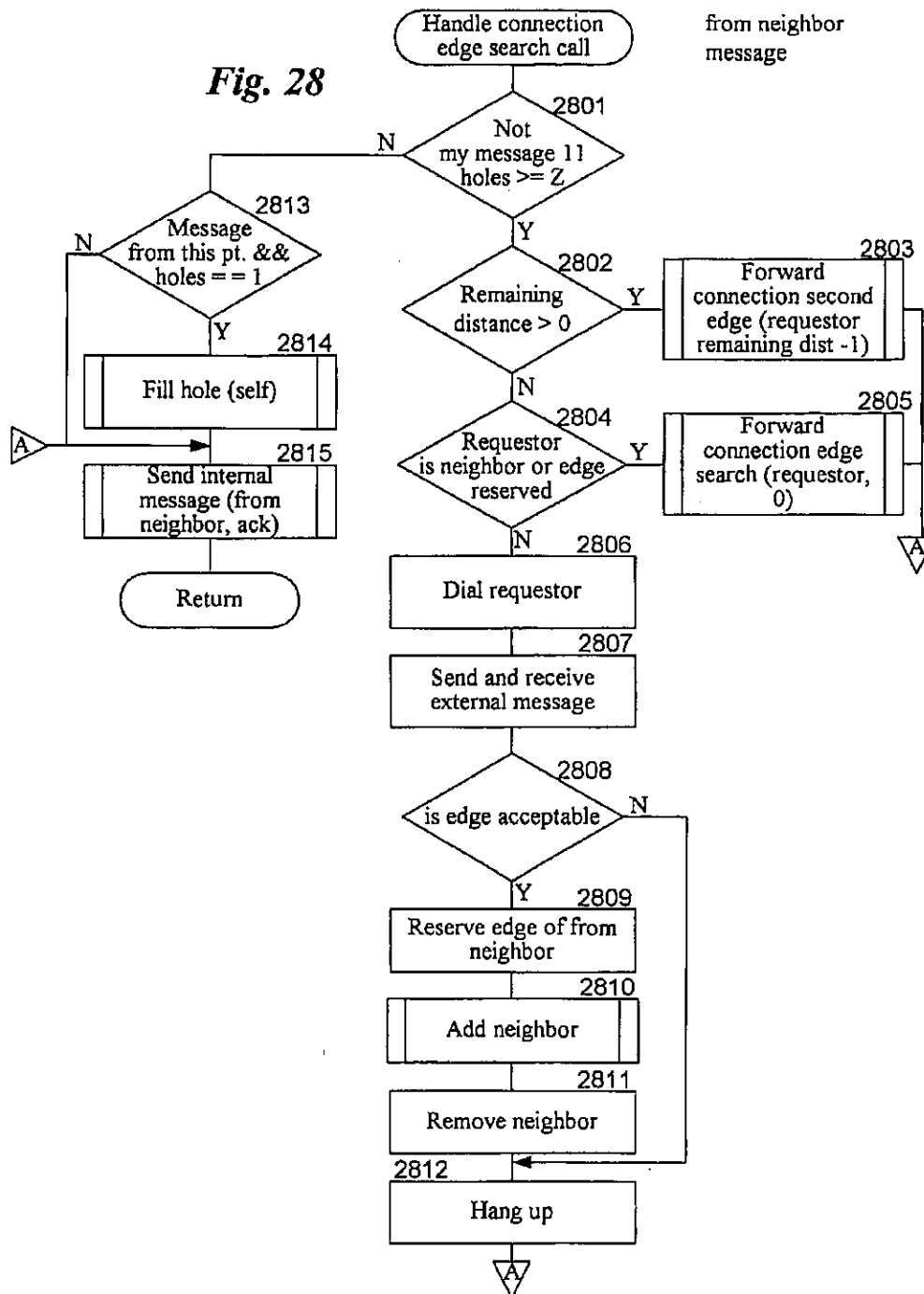
**Fig. 24**

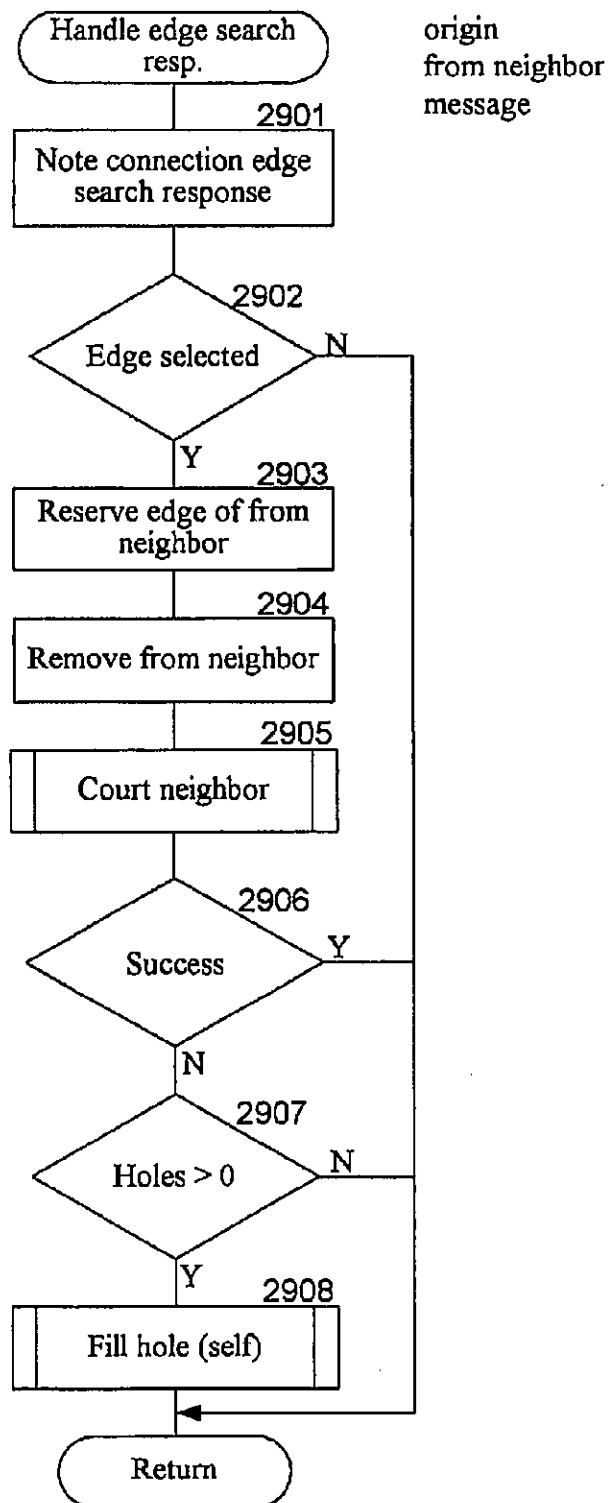


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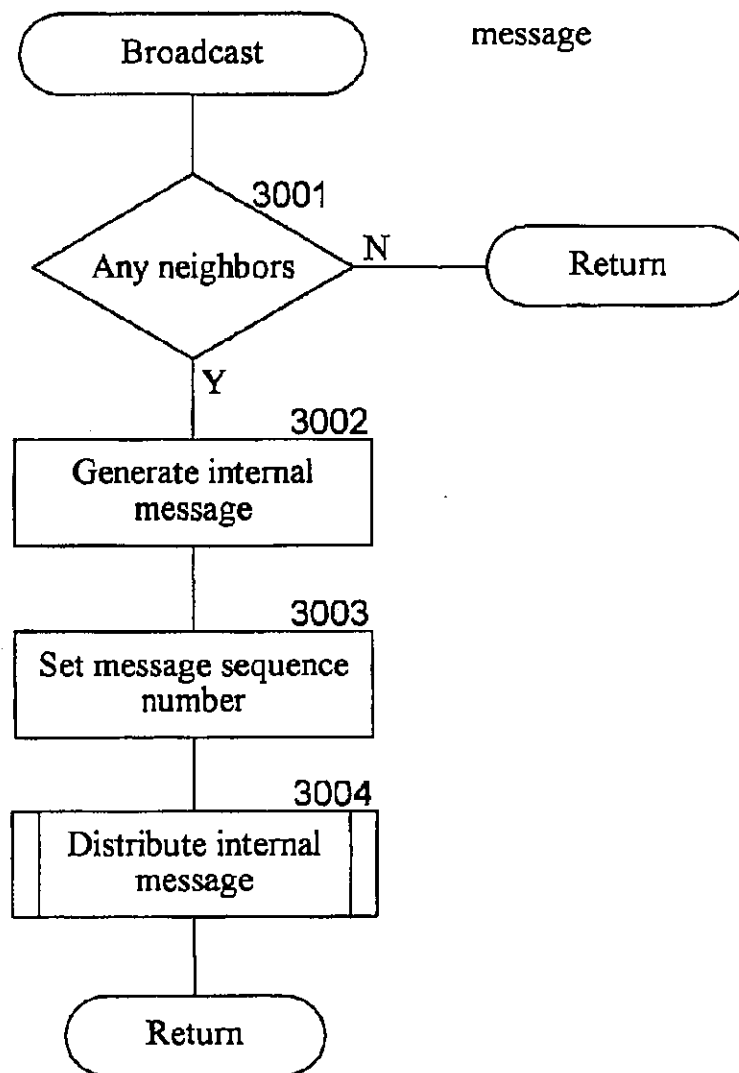
ACTIVISION, EA, TAKE-TWO,  
2K, ROCKSTAR  
Ex. 1001, p. 34 of 58

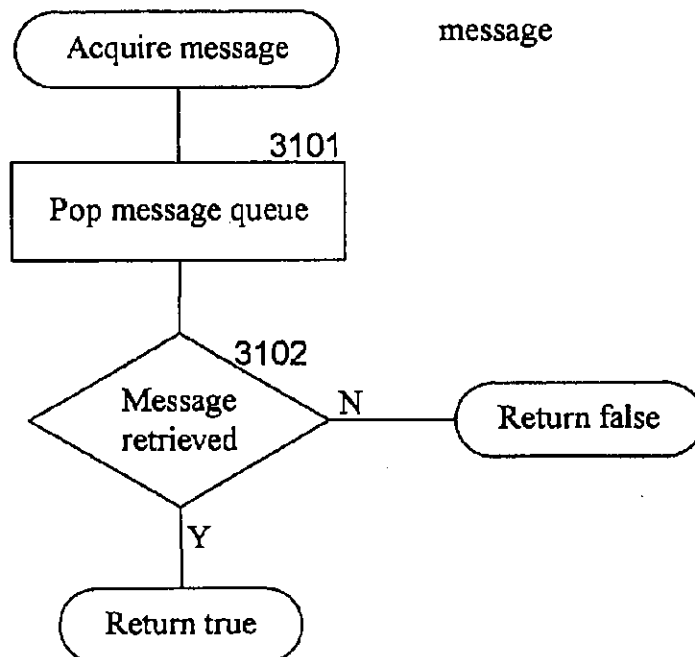
**Fig. 28**

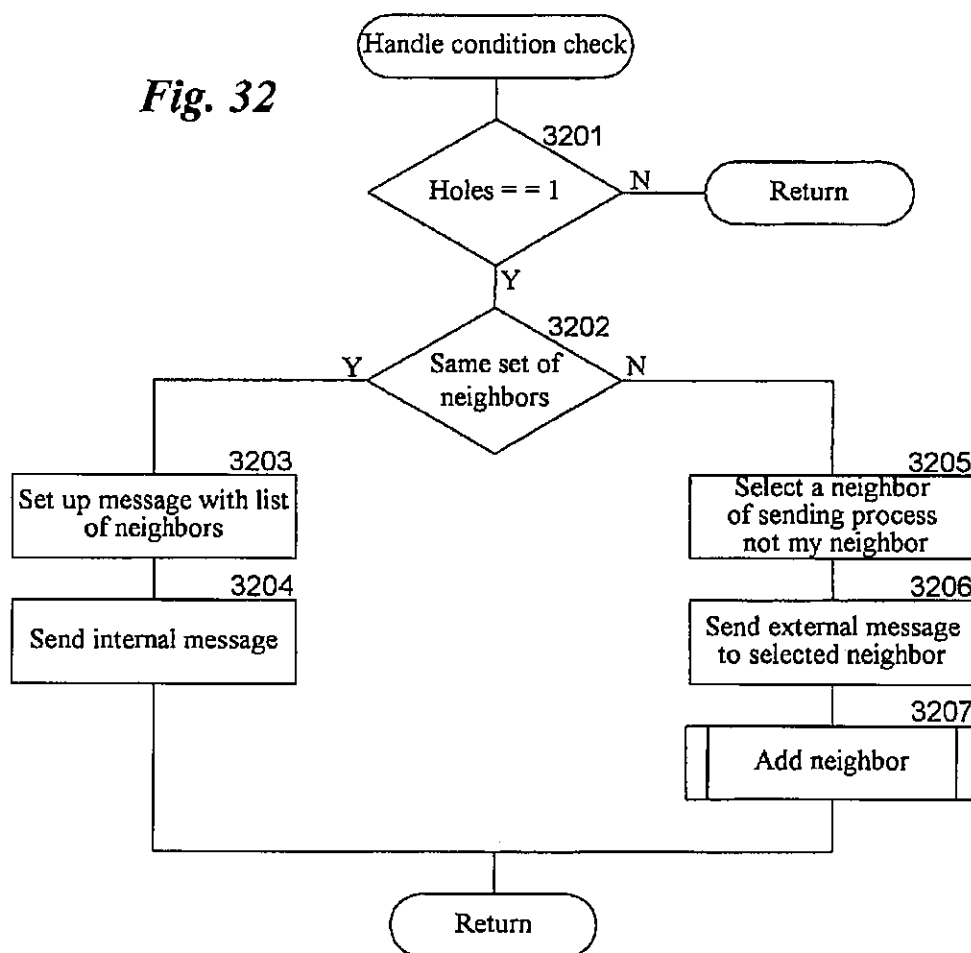
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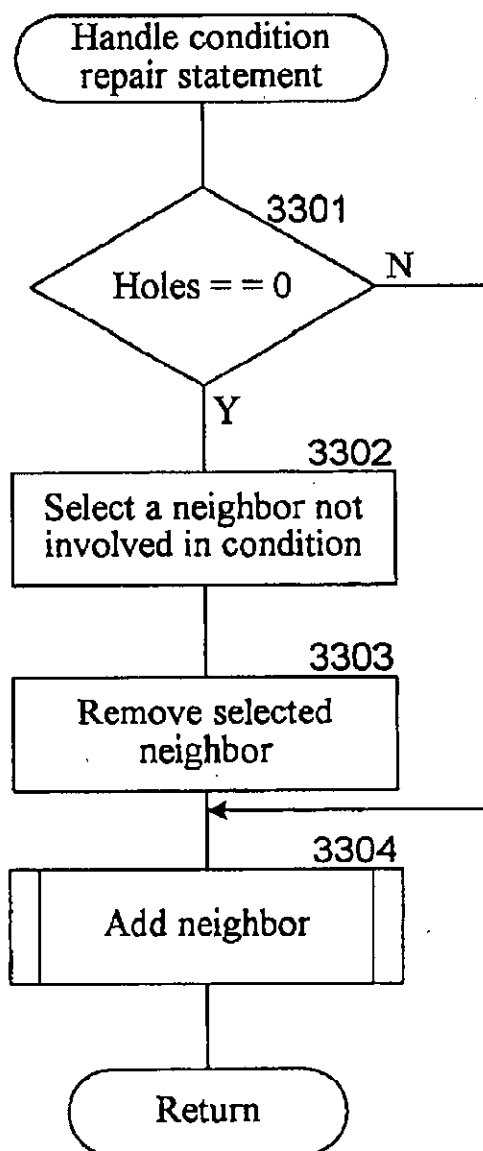


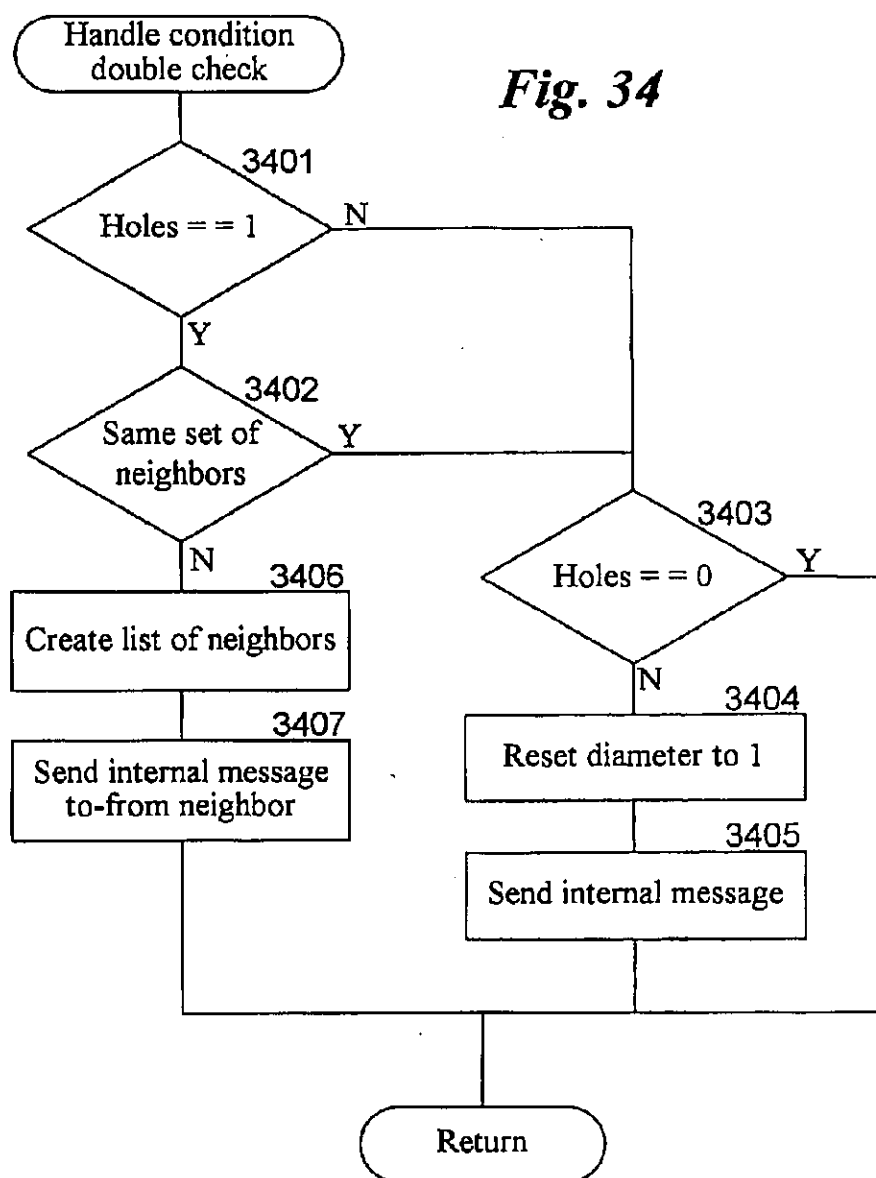
**Fig. 30**



**Fig. 31**

*Fig. 32*

**Fig. 33**

*Fig. 34*

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1

## LEAVING A BROADCAST CHANNEL

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to U.S. patent application Ser. No. 09/629,576, entitled "BROADCASTING NETWORK," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,570, entitled "JOINING A BROADCAST CHANNEL," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,577, "LEAVING A BROADCAST CHANNEL," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,575, entitled "BROADCASTING ON A BROADCAST CHANNEL," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,572, entitled "CONTACTING A BROADCAST CHANNEL," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,023, entitled "DISTRIBUTED AUCTION SYSTEM," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,043, entitled "AN INFORMATION DELIVERY SERVICE," filed on Jul. 31, 2000; U.S. patent application Ser. No. 09/629,024, entitled "DISTRIBUTED CONFERENCING SYSTEM," filed on Jul. 31, 2000; and U.S. patent application Ser. No. 09/629,042, entitled "DISTRIBUTED GAME ENVIRONMENT," filed on Jul. 31, 2000, the disclosures of which are incorporated herein by reference.

## TECHNICAL FIELD

The described technology relates generally to a computer network and more particularly, to a broadcast channel for a subset of a computers of an underlying network.

## BACKGROUND

There are a wide variety of computer network communications techniques such as point-to-point network protocols, client/server middleware, multicasting network protocols, and peer-to-peer middleware. Each of these communications techniques have their advantages and disadvantages, but none is particularly well suited to the simultaneous sharing of information among computers that are widely distributed. For example, collaborative processing applications, such as a network meeting programs, have a need to distribute information in a timely manner to all participants who may be geographically distributed.

The point-to-point network protocols, such as UNIX pipes, TCP/IP, and UDP, allow processes on different computers to communicate via point-to-point connections. The interconnection of all participants using point-to-point connections, while theoretically possible, does not scale well as a number of participants grows. For example, each participating process would need to manage its direct connections to all other participating processes. Programmers, however, find it very difficult to manage single connections, and management of multiple connections is much more complex. In addition, participating processes may be limited to the number of direct connections that they can support. This limits the number of possible participants in the sharing of information.

The client/server middleware systems provide a server that coordinates the communications between the various clients who are sharing the information. The server functions as a central authority for controlling access to shared resources. Examples of client/server middleware systems include remote procedure calls ("RPC"), database servers, and the common object request broker architecture ("CORBA"). Client/server middleware systems are not par-

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ticularly well suited to sharing of information among many participants. In particular, when a client stores information to be shared at the server, each other client would need to poll the server to determine that new information is being shared. Such polling places a very high overhead on the communications network. Alternatively, each client may register a callback with the server, which the server then invokes when new information is available to be shared. Such a callback technique presents a performance bottleneck because a single server needs to call back to each client whenever new information is to be shared. In addition, the reliability of the entire sharing of information depends upon the reliability of the single server. Thus, a failure at a single computer (i.e., the server) would prevent communications between any of the clients.

The multicasting network protocols allow the sending of broadcast messages to multiple recipients of a network. The current implementations of such multicasting network protocols tend to place an unacceptable overhead on the underlying network. For example, UDP multicasting would swamp the Internet when trying to locate all possible participants. IP multicasting has other problems that include needing special-purpose infrastructure (e.g., routers) to support the sharing of information efficiently.

The peer-to-peer middleware communications systems rely on a multicasting network protocol or a graph of point-to-point network protocols. Such peer-to-peer middleware is provided by the T.120 Internet standard, which is used in such products as Data Connection's D.C.-share and Microsoft's NetMeeting. These peer-to-peer middleware systems rely upon a user to assemble a point-to-point graph of the connections used for sharing the information. Thus, it is neither suitable nor desirable to use peer-to-peer middleware systems when more than a small number of participants is desired. In addition, the underlying architecture of the T.120 Internet standard is a tree structure, which relies on the root node of the tree for reliability of the entire network. That is, each message must pass through the root node in order to be received by all participants.

It would be desirable to have a reliable communications network that is suitable for the simultaneous sharing of information among a large number of the processes that are widely distributed.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a graph that is 4-regular and 4-connected which represents a broadcast channel.

FIG. 2 illustrates a graph representing 20 computers connected to a broadcast channel.

FIGS. 3A and 3B illustrate the process of connecting a new computer Z to the broadcast channel.

FIG. 4A illustrates the broadcast channel of FIG. 1 with an added computer.

FIG. 4B illustrates the broadcast channel of FIG. 4A with an added computer.

FIG. 4C also illustrates the broadcast channel of FIG. 4A with an added computer.

FIG. 5A illustrates the disconnecting of a computer from the broadcast channel in a planned manner.

FIG. 5B illustrates the disconnecting of a computer from the broadcast channel in an unplanned manner.

FIG. 5C illustrates the neighbors with empty ports condition.

FIG. 5D illustrates two computers that are not neighbors who now have empty ports.

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FIG. 5E illustrates the neighbors with empty ports condition in the small regime.

FIG. 5F illustrates the situation of FIG. 5E when in the large regime.

FIG. 6 is a block diagram illustrating components of a computer that is connected to a broadcast channel.

FIG. 7 is a block diagram illustrating the sub-components of the broadcaster component in one embodiment.

FIG. 8 is a flow diagram illustrating the processing of the connect routine in one embodiment.

FIG. 9 is a flow diagram illustrating the processing of the seek portal computer routine in one embodiment.

FIG. 10 is a flow diagram illustrating the processing of the contact process routine in one embodiment.

FIG. 11 is a flow diagram illustrating the processing of the connect request routine in one embodiment.

FIG. 12 is a flow diagram of the processing of the check for external call routine in one embodiment.

FIG. 13 is a flow diagram of the processing of the achieve connection routine in one embodiment.

FIG. 14 is a flow diagram illustrating the processing of the external dispatcher routine in one embodiment.

FIG. 15 is a flow diagram illustrating the processing of the handle seeking connection call routine in one embodiment.

FIG. 16 is a flow diagram illustrating processing of the handle connection request call routine in one embodiment.

FIG. 17 is a flow diagram illustrating the processing of the add neighbor routine in one embodiment.

FIG. 18 is a flow diagram illustrating the processing of the forward connection edge search routine in one embodiment.

FIG. 19 is a flow diagram illustrating the processing of the handle edge proposal call routine.

FIG. 20 is a flow diagram illustrating the processing of the handle port connection call routine in one embodiment.

FIG. 21 is a flow diagram illustrating the processing of the fill hole routine in one embodiment.

FIG. 22 is a flow diagram illustrating the processing of the internal dispatcher routine in one embodiment.

FIG. 23 is a flow diagram illustrating the processing of the handle broadcast message routine in one embodiment.

FIG. 24 is a flow diagram illustrating the processing of the distribute broadcast message routine in one embodiment.

FIG. 26 is a flow diagram illustrating the processing of the handle connection port search statement routine in one embodiment.

FIG. 27 is a flow diagram illustrating the processing of the court neighbor routine in one embodiment.

FIG. 28 is a flow diagram illustrating the processing of the handle connection edge search call routine in one embodiment.

FIG. 29 is a flow diagram illustrating the processing of the handle connection edge search response routine in one embodiment.

FIG. 30 is a flow diagram illustrating the processing of the broadcast routine in one embodiment.

FIG. 31 is a flow diagram illustrating the processing of the acquire message routine in one embodiment.

FIG. 32 is a flow diagram illustrating processing of the handle condition check message in one embodiment.

FIG. 33 is a flow diagram illustrating processing of the handle condition repair statement routine in one embodiment.

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FIG. 34 is a flow diagram illustrating the processing of the handle condition double check routine.

#### DETAILED DESCRIPTION

A broadcast technique in which a broadcast channel overlays a point-to-point communications network is provided. The broadcasting of a message over the broadcast channel is effectively a multicast to those computers of the network that are currently connected to the broadcast channel. In one embodiment, the broadcast technique provides a logical broadcast channel to which host computers through their executing processes can be connected. Each computer that is connected to the broadcast channel can broadcast messages onto and receive messages off of the broadcast channel. Each computer that is connected to the broadcast channel receives all messages that are broadcast while it is connected. The logical broadcast channel is implemented using an underlying network system (e.g., the Internet) that allows each computer connected to the underlying network system to send messages to each other connected computer using each computer's address. Thus, the broadcast technique effectively provides a broadcast channel using an underlying network system that sends messages on a point-to-point basis.

The broadcast technique overlays the underlying network system with a graph of point-to-point connections (i.e., edges) between host computers (i.e., nodes) through which the broadcast channel is implemented. In one embodiment, each computer is connected to four other computers, referred to as neighbors. (Actually, a process executing on a computer is connected to four other processes executing on this or four other computers.) To broadcast a message, the originating computer sends the message to each of its neighbors using its point-to-point connections. Each computer that receives the message then sends the message to its three other neighbors using the point-to-point connections. In this way, the message is propagated to each computer using the underlying network to effect the broadcasting of the message to each computer over a logical broadcast channel. A graph in which each node is connected to four other nodes is referred to as a 4-regular graph. The use of a 4-regular graph means that a computer would become disconnected from the broadcast channel only if all four of the connections to its neighbors fail. The graph used by the broadcast technique also has the property that it would take a failure of four computers to divide the graph into disjoint sub-graphs, that is two separate broadcast channels. This property is referred to as being 4-connected. Thus, the graph is both 4-regular and 4-connected.

FIG. 1 illustrates a graph that is 4-regular and 4-connected which represents the broadcast channel. Each of the nine nodes A-I represents a computer that is connected to the broadcast channel, and each of the edges represents an "edge" connection between two computers of the broadcast channel. The time it takes to broadcast a message to each computer on the broadcast channel depends on the speed of the connections between the computers and the number of connections between the originating computer and each other computer on the broadcast channel. The minimum number of connections that a message would need to traverse between each pair of computers is the "distance" between the computers (i.e., the shortest path between the two nodes of the graph). For example, the distance between computers A and F is one because computer A is directly connected to computer F. The distance between computers A and B is two because there is no direct connection between computers A and B, but computer F is directly connected to

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computer B. Thus, a message originating at computer A would be sent directly to computer F, and then sent from computer F to computer B. The maximum of the distances between the computers is the "diameter" of broadcast channel. The diameter of the broadcast channel represented by FIG. 1 is two. That is, a message sent by any computer would traverse no more than two connections to reach every other computer. FIG. 2 illustrates a graph representing 20 computers connected to a broadcast channel. The diameter of this broadcast channel is 4. In particular, the shortest path between computers 1 and 3 contains four connections (1-12, 12-15, 15-18, and 18-3).

The broadcast technique includes (1) the connecting of computers to the broadcast channel (i.e., composing the graph), (2) the broadcasting of messages over the broadcast channel (i.e., broadcasting through the graph), and (3) the disconnecting of computers from the broadcast channel (i.e., decomposing the graph) composing the graph.

#### Composing the Graph

To connect to the broadcast channel, the computer seeking the connection first locates a computer that is currently fully connected to the broadcast channel and then establishes a connection with four of the computers that are already connected to the broadcast channel. (This assumes that there are at least four computers already connected to the broadcast channel. When there are fewer than five computers connected, the broadcast channel cannot be a 4-regular graph. In such a case, the broadcast channel is considered to be in a "small regime." The broadcast technique for the small regime is described below in detail. When five or more computers are connected, the broadcast channel is considered to be in the "large regime." This description assumes that the broadcast channel is in the large regime, unless specified otherwise.) Thus, the process of connecting to the broadcast channel includes locating the broadcast channel, identifying the neighbors for the connecting computer, and then connecting to each identified neighbor. Each computer is aware of one or more "portal computers" through which that computer may locate the broadcast channel. A seeking computer locates the broadcast channel by contacting the portal computers until it finds one that is currently fully connected to the broadcast channel. The found portal computer then directs the identifying of four computers (i.e., to be the seeking computer's neighbors) to which the seeking computer is to connect. Each of these four computers then cooperates with the seeking computer to effect the connecting of the seeking computer to the broadcast channel. A computer that has started the process of locating a portal computer, but does not yet have a neighbor, is in the "seeking connection state." A computer that is connected to at least one neighbor, but not yet four neighbors, is in the "partially connected state." A computer that is currently, or has been, previously connected to four neighbors is in the "fully connected state."

Since the broadcast channel is a 4-regular graph, each of the identified computers is already connected to four computers. Thus, some connections between computers need to be broken so that the seeking computer can connect to four computers. In one embodiment, the broadcast technique identifies two pairs of computers that are currently connected to each other. Each of these pairs of computers breaks the connection between them, and then each of the four computers (two from each pair) connects to the seeking computer. FIGS. 3A and 3B illustrate the process of a new computer Z connecting to the broadcast channel. FIG. 3A illustrates the broadcast channel before computer Z is connected. The pairs of computers B and E and computers C and

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D are the two pairs that are identified as the neighbors for the new computer Z. The connections between each of these pairs is broken, and a connection between computer Z and each of computers B, C, D, and E is established as indicated by FIG. 3B. The process of breaking the connection between two neighbors and reconnecting each of the former neighbors to another computer is referred to as "edge pinning" as the edge between two nodes may be considered to be stretched and pinned to a new node.

Each computer connected to the broadcast channel allocates five communications ports for communicating with other computers. Four of the ports are referred to as "internal" ports because they are the ports through which the messages of the broadcast channels are sent. The connections between internal ports of neighbors are referred to as "internal" connections. Thus, the internal connections of the broadcast channel form the 4-regular and 4-connected graph. The fifth port is referred to as an "external" port because it is used for sending non-broadcast messages between two computers. Neighbors can send non-broadcast messages either through their internal ports of their connection or through their external ports. A seeking computer uses external ports when locating a portal computer.

In one embodiment, the broadcast technique establishes the computer connections using the TCP/IP communications protocol, which is a point-to-point protocol, as the underlying network. The TCP/IP protocol provides for reliable and ordered delivery of messages between computers. The TCP/IP protocol provides each computer with a "port space" that is shared among all the processes that may execute on that computer. The ports are identified by numbers from 0 to 65,535. The first 2056 ports are reserved for specific applications (e.g., port 80 for HTTP messages). The remainder of the ports are user ports that are available to any process. In one embodiment, a set of port numbers can be reserved for use by the computer connected to the broadcast channel. In an alternative embodiment, the port numbers used are dynamically identified by each computer. Each computer dynamically identifies an available port to be used as its call-in port. This call-in port is used to establish connections with the external port and the internal ports. Each computer that is connected to the broadcast channel can receive non-broadcast messages through its external port. A seeking computer tries "dialing" the port numbers of the portal computers until a portal computer "answers," a call on its call-in port. A portal computer answers when it is connected to or attempting to connect to the broadcast channel and its call-in port is dialed. (In this description, a telephone metaphor is used to describe the connections.) When a computer receives a call on its call-in port, it transfers the call to another port. Thus, the seeking computer actually communicates through that transfer-to port, which is the external port. The call is transferred so that other computers can place calls to that computer via the call-in port. The seeking computer then communicates via that external port to request the portal computer to assist in connecting the seeking computer to the broadcast channel. The seeking computer could identify the call-in port number of a portal computer by successively dialing each port in port number order. As discussed below in detail, the broadcast technique uses a hashing algorithm to select the port number order, which may result in improved performance.

A seeking computer could connect to the broadcast channel by connecting to computers either directly connected to the found portal computer or directly connected to one of its neighbors. A possible problem with such a scheme for identifying the neighbors for the seeking computer is that the

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diameter of the broadcast channel may increase when each seeking computer uses the same found portal computer and establishes a connection to the broadcast channel directly through that found portal computer. Conceptually, the graph becomes elongated in the direction of where the new nodes are added. FIGS. 4A-4C illustrate that possible problem. FIG. 4A illustrates the broadcast channel of FIG. 1 with an added computer. Computer J was connected to the broadcast channel by edge pinning edges C-D and E-H to computer J. The diameter of this broadcast channel is still two. FIG. 4B illustrates the broadcast channel of FIG. 4A with an added computer. Computer K was connected to the broadcast channel by edge pinning edges E-J and B-C to computer K. The diameter of this broadcast channel is three, because the shortest path from computer G to computer K is through edges G-A, A-E, and E-K. FIG. 4C also illustrates the broadcast channel of FIG. 4A with an added computer. Computer K was connected to the broadcast channel by edge pinning edges D-G and E-J to computer K. The diameter of this broadcast channel is, however, still two. Thus, the selection of neighbors impacts the diameter of the broadcast channel. To help minimize the diameter, the broadcast technique uses a random selection technique to identify the four neighbors of a computer in the seeking connection state. The random selection technique tends to distribute the connections to new seeking computers throughout the computers of the broadcast channel which may result in smaller overall diameters.

#### Broadcasting Through the Graph

As described above, each computer that is connected to the broadcast channel can broadcast messages onto the broadcast channel and does receive all messages that are broadcast on the broadcast channel. The computer that originates a message to be broadcast sends that message to each of its four neighbors using the internal connections. When a computer receives a broadcast message from a neighbor, it sends the message to its three other neighbors. Each computer on the broadcast channel, except the originating computer, will thus receive a copy of each broadcast message from each of its four neighbors. Each computer, however, only sends the first copy of the message that it receives to its neighbors and disregards subsequently received copies. Thus, the total number of copies of a message that is sent between the computers is  $3N+1$ , where  $N$  is the number of computers connected to the broadcast channel. Each computer sends three copies of the message, except for the originating computer, which sends four copies of the message.

The redundancy of the message sending helps to ensure the overall reliability of the broadcast channel. Since each computer has four connections to the broadcast channel, if one computer fails during the broadcast of a message, its neighbors have three other connections through which they will receive copies of the broadcast message. Also, if the internal connection between two computers is slow, each computer has three other connections through which it may receive a copy of each message sooner.

Each computer that originates a message numbers its own messages sequentially. Because of the dynamic nature of the broadcast channel and because there are many possible connection paths between computers, the messages may be received out of order. For example, the distance between an originating computer and a certain receiving computer may be four. After sending the first message, the originating computer and receiving computer may become neighbors and thus the distance between them changes to one. The first message may have to travel a distance of four to reach the

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receiving computer. The second message only has to travel a distance of one. Thus, it is possible for the second message to reach the receiving computer before the first message.

When the broadcast channel is in a steady state (i.e., no computers connecting or disconnecting from the broadcast channel), out-of-order messages are not a problem because each computer will eventually receive both messages and can queue messages until all earlier ordered messages are received. If, however, the broadcast channel is not in a steady state, then problems can occur. In particular, a computer may connect to the broadcast channel after the second message has already been received and forwarded on by its new neighbors. When a new neighbor eventually receives the first message, it sends the message to the newly connected computer. Thus, the newly connected computer will receive the first message, but will not receive the second message. If the newly connected computer needs to process the messages in order, it would wait indefinitely for the second message.

One solution to this problem is to have each computer queue all the messages that it receives until it can send them in their proper order to its neighbors. This solution, however, may tend to slow down the propagation of messages through the computers of the broadcast channel. Another solution that may have less impact on the propagation speed is to queue messages only at computers who are neighbors of the newly, connected computers. Each already connected neighbor would forward messages as it receives them to its other neighbors who are not newly connected, but not to the newly connected neighbor. The already connected neighbor would only forward messages from each originating computer to the newly connected computer when it can ensure that no gaps in the messages from that originating computer will occur. In one embodiment, the already connected neighbor may track the highest sequence number of the messages already received and forwarded on from each originating computer. The already connected computer will send only higher numbered messages from the originating computers to the newly connected computer. Once all lower numbered messages have been received from all originating computers, then the already connected computer can treat the newly connected computer as its other neighbors and simply forward each message as it is received. In another embodiment, each computer may queue messages and only forwards to the newly connected computer those messages as the gaps are filled in. For example, a computer might receive messages 4 and 5 and then receive message 3. In such a case, the already connected computer would forward queue messages 4 and 5. When message 3 is finally received, the already connected computer will send messages 3, 4, and 5 to the newly connected computer. If messages 4 and 5 were sent to the newly connected computer before message 3, then the newly connected computer would process messages 4 and 5 and disregard message 3. Because the already connected computer queues messages 4 and 5, the newly connected computer will be able to process message 3. It is possible that a newly connected computer will receive a set of messages from an originating computer through one neighbor and then receive another set of message from the same originating computer through another neighbor. If the second set of messages contains a message that is ordered earlier than the messages of the first set received, then the newly connected computer may ignore that earlier ordered message if the computer already processed those later ordered messages.

#### Decomposing the Graph

A connected computer disconnects from the broadcast channel either in a planned or unplanned manner. When a

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computer disconnects in a planned manner, it sends a disconnect message to each of its four neighbors. The disconnect message includes a list that identifies the four neighbors of the disconnecting computer. When a neighbor receives the disconnect message, it tries to connect to one of the computers on the list. In one embodiment, the first computer in the list will try to connect to the second computer in the list, and the third computer in the list will try to connect to the fourth computer in the list. If a computer cannot connect (e.g., the first and second computers are already connected), then the computers may try connecting in various other combinations. If connections cannot be established, each computer broadcasts a message that it needs to establish a connection with another computer. When a computer with an available internal port receives the message, it can then establish a connection with the computer that broadcast the message. FIGS. 5A-5D illustrate the disconnecting of a computer from the broadcast channel. FIG. 5A illustrates the disconnecting of a computer from the broadcast channel in a planned manner. When computer H decides to disconnect, it sends its list of neighbors to each of its neighbors (computers A, E, F and I) and then disconnects from each of its neighbors. When computers A and I receive the message they establish a connection between them as indicated by the dashed line, and similarly for computers E and F.

When a computer disconnects in an unplanned manner, such as resulting from a power failure, the neighbors connected to the disconnected computer recognize the disconnection when each attempts to send its next message to the now disconnected computer. Each former neighbor of the disconnected computer recognizes that it is short one connection (i.e., it has a hole or empty port). When a connected computer detects that one of its neighbors is now disconnected, it broadcasts a port connection request on the broadcast channel, which indicates that it has one internal port that needs a connection. The port connection request identifies the call-in port of the requesting computer. When a connected computer that is also short a connection receives the connection request, it communicates with the requesting computer through its external port to establish a connection between the two computers. FIG. 5B illustrates the disconnecting of a computer from the broadcast channel in an unplanned manner. In this illustration, computer H has disconnected in an unplanned manner. When each of its neighbors, computers A, E, F, and I, recognizes the disconnection, each neighbor broadcasts a port connection request indicating that it needs to fill an empty port. As shown by the dashed lines, computers F and I and computers A and E respond to each other's requests and establish a connection.

It is possible that a planned or unplanned disconnection may result in two neighbors each having an empty internal port. In such a case, since they are neighbors, they are already connected and cannot fill their empty ports by connecting to each other. Such a condition is referred to as the "neighbors with empty ports" condition. Each neighbor broadcasts a port connection request when it detects that it has an empty port as described above. When a neighbor receives the port connection request from the other neighbor, it will recognize the condition that its neighbor also has an empty port. Such a condition may also occur when the broadcast channel is in the small regime. The condition can only be corrected when in the large regime. When in the small regime, each computer will have less than four neighbors. To detect this condition in the large regime, which would be a problem if not repaired, the first neighbor to

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receive the port connection request recognizes the condition and sends a condition check message to the other neighbor. The condition check message includes a list of the neighbors of the sending computer. When the receiving computer receives the list, it compares the list to its own list of neighbors. If the lists are different, then this condition has occurred in the large regime and repair is needed. To repair this condition, the receiving computer will send a condition repair request to one of the neighbors of the sending computer which is not already a neighbor of the receiving computer. When the computer receives the condition repair request, it disconnects from one of its neighbors (other than the neighbor that is involved with the condition) and connects to the computer that sent the condition repair request. Thus, one of the original neighbors involved in the condition will have had a port filled. However, two computers are still in need of a connection, the other original neighbor and the computer that is now disconnected from the computer that received the condition repair request. Those two computers send out port connection requests. If those two computers are not neighbors, then they will connect to each other when they receive the requests. If, however, the two computers are neighbors, then they repeat the condition repair process until two non-neighbors are in need of connections.

It is possible that the two original neighbors with the condition may have the same set of neighbors. When the neighbor that receives the condition check message determines that the sets of neighbors are the same, it sends a condition double check message to one of its neighbors other than the neighbor who also has the condition. When the computer receives the condition double check message, it determines whether it has the same set of neighbors as the sending computer. If so, the broadcast channel is in the small regime and the condition is not a problem. If the set of neighbors are different, then the computer that received the condition double check message sends a condition check message to the original neighbors with the condition. The computer that receives that condition check message directs one of its neighbors to connect to one of the original neighbors with the condition by sending a condition repair message. Thus, one of the original neighbors with the condition will have its port filled.

FIG. 5C illustrates the neighbors with empty ports condition. In this illustration, computer H disconnected in an unplanned manner, but computers F and I responded to the port connection request of the other and are now connected together. The other former neighbors of computer H, computers A and E, are already neighbors, which gives rise to the neighbors with empty ports condition. In this example, computer E received the port connection request from computer A, recognized the possible condition, and sent (since they are neighbors via the internal connection) a condition check message with a list of its neighbors to computer A. When computer A received the list, it recognized that computer E has a different set of neighbor (i.e., the broadcast channel is in the large regime). Computer A selected computer D, which is a neighbor of computer E and sent it a condition repair request. When computer D received the condition repair request, it disconnected from one of its neighbors (other than computer E), which is computer G in this example. Computer D then connected to computer A. FIG. 5D illustrates two computers that are not neighbors who now have empty ports. Computers E and G now have empty ports and are not currently neighbors. Therefore, computers E and G can connect to each other.

FIGS. 5E and 5F further illustrate the neighbors with empty ports condition. FIG. 5E illustrates the neighbors with

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empty ports condition in the small regime. In this example, if computer E disconnected in an unplanned manner, then each computer broadcasts a port connection request when it detects the disconnect. When computer A receives the port connection request from computer B, it detects the neighbors with empty ports condition and sends a condition check message to computer B. Computer B recognizes that it has the same set of neighbors (computer C and D) as computer A and then sends a condition double check message to computer C. Computer C recognizes that the broadcast channel is in the small regime because it also has the same set of neighbors as computers A and B, computer C may then broadcast a message indicating that the broadcast channel is in the small regime.

FIG. 5F illustrates the situation of FIG. 5E when in the large regime. As discussed above, computer C receives the condition double check message from computer B. In this case, computer C recognizes that the broadcast channel is in the large regime because it has a set of neighbors that is different from computer B. The edges extending up from computer C and D indicate connections to other computers. Computer C then sends a condition check message to computer B. When computer B receives the condition check message, it sends a condition repair message to one of the neighbors of computer C. The computer that receives the condition repair message disconnects from one of its neighbors, other than computer C, and tries to connect to computer B and the neighbor from which it disconnected tries to connect to computer A.

#### Port Selection

As described above, the TCP/IP protocol designates ports above number 2056 as user ports. The broadcast technique uses five user port numbers on each computer: one external port and four internal ports. Generally, user ports cannot be statically allocated to an application program because other applications programs executing on the same computer may use conflicting port numbers. As a result, in one embodiment, the computers connected to the broadcast channel dynamically allocate their port numbers. Each computer could simply try to locate the lowest number unused port on that computer and use that port as the call-in port. A seeking computer, however, does not know in advance the call-in port number of the portal computers when the port numbers are dynamically allocated. Thus, a seeking computer needs to dial ports of a portal computer starting with the lowest port number when locating the call-in port of a portal computer. If the portal computer is connected to (or attempting to connect to) the broadcast channel, then the seeking computer would eventually find the call-in port. If the portal computer is not connected, then the seeking computer would eventually dial every user port. In addition, if each application program on a computer tried to allocate low-ordered port numbers, then a portal computer may end up with a high-numbered port for its call-in port because many of the low-ordered port numbers would be used by other application programs. Since the dialing of a port is a relatively slow process, it would take the seeking computer a long time to locate the call-in port of a portal computer. To minimize this time, the broadcast technique uses a port ordering algorithm to identify the port-number order that a portal computer should use when finding an available port for its call-in port. In one embodiment, the broadcast technique uses a hashing algorithm to identify the port-order. The algorithm preferably distributes the ordering of the port numbers randomly through out the user port number space and only selects each port number once. In addition, every time the algorithm is executed on any computer for a given

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channel type and channel instance, it generates the same port ordering. As described below, it is possible for a computer to be connected to multiple broadcast channels that are uniquely identified by channel type and channel instance. The algorithm may be "seeded" with channel type and channel instance in order to generate a unique ordering of port numbers for each broadcast channel. Thus, a seeking computer will dial the ports of a portal computer in the same order as the portal computer used when allocating its call-in port.

If many computers are at the same time seeking connection to a broadcast channel through a single portal computer, then the ports of the portal computer may be busy when called by seeking computers. The seeking computers would typically need to keep on redialing a busy port. The process of locating a call-in port may be significantly slowed by such redialing. In one embodiment, each seeking computer may each reorder the first few port numbers generated by the hashing algorithm. For example, each seeking computer could randomly reorder the first eight port numbers generated by the hashing algorithm. The random ordering could also be weighted where the first port number generated by the hashing algorithm would have a 50% chance of being first in the reordering, the second port number would have a 25% chance of being first in the reordering, and so on. Because the seeking computers would use different orderings, the likelihood of finding a busy port is reduced. For example, if the first eight port numbers are randomly selected, then it is possible that eight seeking computers could be simultaneously dialing ports in different sequences which would reduce the chances of dialing a busy port.

#### Locating a Portal Computer

Each computer that can connect to the broadcast channel has a list of one or more portal computers through which it can connect to the broadcast channel. In one embodiment, each computer has the same set of portal computers. A seeking computer locates a portal computer that is connected to the broadcast channel by successively dialing the ports of each portal computer in the order specified by an algorithm. A seeking computer could select the first portal computer and then dial all its ports until a call-in port of a computer that is fully connected to the broadcast channel is found. If no call-in port is found, then the seeking computer would select the next portal computer and repeat the process until a portal computer with such a call-in port is found. A problem with such a seeking technique is that all user ports of each portal computer are dialed until a portal computer fully connected to the broadcast channel is found. In an alternate embodiment, the seeking computer selects a port number according to the algorithm and then dials each portal computer at that port number. If no acceptable call-in port to the broadcast channel is found, then the seeking computer selects the next port number and repeats the process. Since the call-in ports are likely allocated at lower-ordered port numbers, the seeking computer first dials the port numbers that are most likely to be call-in ports of the broadcast channel. The seeking computers may have a maximum search depth, that is the number of ports that it will dial when seeking a portal computer that is fully connected. If the seeking computer exhausts its search depth, then either the broadcast channel has not yet been established or, if the seeking computer is also a portal computer, it can then establish the broadcast channel with itself as the first fully connected computer.

When a seeking computer locates a portal computer that is itself not fully connected, the two computers do not connect when they first locate each other because the

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broadcast channel may already be established and accessible through a higher-ordered port number on another portal computer. If the two seeking computers were to connect to each other, then two disjoint broadcast channels would be formed. Each seeking computer can share its experience in trying to locate a portal computer with the other seeking computer. In particular, if one seeking computer has searched all the portal computers to a depth of eight, then the one seeking computer can share that it has searched to a depth of eight with another seeking computer. If that other seeking computer has searched to a depth of, for example, only four, it can skip searching through depths five through eight and that other seeking computer can advance its searching to a depth of nine.

In one embodiment, each computer may have a different set of portal computers and a different maximum search depth. In such a situation, it may be possible that two disjoint broadcast channels are formed because a seeking computer cannot locate a fully connected port computer at a higher depth. Similarly, if the set of portal computers are disjoint, then two separate broadcast channels would be formed.

#### Identifying Neighbors for a Seeking Computer

As described above, the neighbors of a newly connecting computer are preferably selected randomly from the set of currently connected computers. One advantage of the broadcast channel, however, is that no computer has global knowledge of the broadcast channel. Rather, each computer has local knowledge of itself and its neighbors. This limited local knowledge has the advantage that all the connected computers are peers (as far as the broadcasting is concerned) and the failure of any one computer (actually any three computers when in the 4-regular and 4-connect form) will not cause the broadcast channel to fail. This local knowledge makes it difficult for a portal computer to randomly select four neighbors for a seeking computer.

To select the four computers, a portal computer sends an edge connection request message through one of its internal connections that is randomly selected. The receiving computer again sends the edge connection request message through one of its internal connections that is randomly selected. This sending of the message corresponds to a random walk through the graph that represents the broadcast channel. Eventually, a receiving computer will decide that the message has traveled far enough to represent a randomly selected computer. That receiving computer will offer the internal connection upon which it received the edge connection request message to the seeking computer for edge pinning. Of course, if either of the computers at the end of the offered internal connection are already neighbors of the seeking computer, then the seeking computer cannot connect through that internal connection. The computer that decided that the message has traveled far enough will detect this condition of already being a neighbor and send the message to a randomly selected neighbor.

In one embodiment, the distance that the edge connection request message travels is established by the portal computer to be approximately twice the estimated diameter of the broadcast channel. The message includes an indication of the distance that it is to travel. Each receiving computer decrements that distance to travel before sending the message on. The computer that receives a message with a distance to travel that is zero is considered to be the randomly selected computer. If that randomly selected computer cannot connect to the seeking computer (e.g., because it is already connected to it), then that randomly selected computer forwards the edge connection request to one of its neighbors with a new distance to travel. In one embodiment,

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the forwarding computer toggles the new distance to travel between zero and one to help prevent two computers from sending the message back and forth between each other.

Because of the local nature of the information maintained by each computer connected to the broadcast channel, the computers need not generally be aware of the diameter of the broadcast channel. In one embodiment, each message sent through the broadcast channel has a distance traveled field. Each computer that forwards a message increments the distance traveled field. Each computer also maintains an estimated diameter of the broadcast channel. When a computer receives a message that has traveled a distance that indicates that the estimated diameter is too small, it updates its estimated diameter and broadcasts an estimated diameter message. When a computer receives an estimated diameter message that indicates a diameter that is larger than its own estimated diameter, it updates its own estimated diameter. This estimated diameter is used to establish the distance that an edge connection request message should travel.

#### External Data Representation

The computers connected to the broadcast channel may internally store their data in different formats. For example, one computer may use 32-bit integers, and another computer may use 64-bit integers. As another example, one computer may use ASCII to represent text and another computer may use Unicode. To allow communications between heterogeneous computers, the messages sent over the broadcast channel may use the XDR ("eXternal Data Representation") format.

The underlying peer-to-peer communications protocol may send multiple messages in a single message stream. The traditional technique for retrieving messages from a stream has been to repeatedly invoke an operating system routine to retrieve the next message in the stream. The retrieval of each message may require two calls to the operating system: one to retrieve the size of the next message and the other to retrieve the number of bytes indicated by the retrieved size. Such calls to the operating system can, however, be very slow in comparison to the invocations of local routines. To overcome the inefficiencies of such repeated calls, the broadcast technique in one embodiment, uses XDR to identify the message boundaries in a stream of messages. The broadcast technique may request the operating system to provide the next, for example, 1,024 bytes from the stream. The broadcast technique can then repeatedly invoke the XDR routines to retrieve the messages and use the success or failure of each invocation to determine whether another block of 1,024 bytes needs to be retrieved from the operating system. The invocation of XDR routines do not involve system calls and are thus more efficient than repeated system calls.

#### M-Regular.

In the embodiment described above, each fully connected computer has four internal connections. The broadcast technique can be used with other numbers of internal connections. For example, each computer could have 6, 8, or any even number of internal connections. As the number of internal connections increase, the diameter of the broadcast channel tends to decrease, and thus propagation time for a message tends to decrease. The time that it takes to connect a seeking computer to the broadcast channel may, however, increase as the number of internal connections increases. When the number of internal connectors is even, then the broadcast channel can be maintained as m-regular and m-connected (in the steady state). If the number of internal connections is odd, then when the broadcast channel has an odd number of computers connected, one of the computers will have less than that odd number of internal connections.

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In such a situation, the broadcast network is neither m-regular nor m-connected. When the next computer connects to the broadcast channel, it can again become m-regular and m-connected. Thus, with an odd number of internal connections, the broadcast channel toggles between being and not being m-regular and m-connected.

Components

FIG. 6 is a block diagram illustrating components of a computer that is connected to a broadcast channel. The above description generally assumed that there was only one broadcast channel and that each computer had only one connection to that broadcast channel. More generally, a network of computers may have multiple broadcast channels, each computer may be connected to more than one broadcast channel, and each computer can have multiple connections to the same broadcast channel. The broadcast channel is well suited for computer processes (e.g., application programs) that execute collaboratively, such as network meeting programs. Each computer process can connect to one or more broadcast channels. The broadcast channels can be identified by channel type (e.g., application program name) and channel instance that represents separate broadcast channels for that channel type. When a process attempts to connect to a broadcast channel, it seeks a process currently connected to that broadcast channel that is executing on a portal computer. The seeking process identifies the broadcast channel by channel type and channel instance.

Computer 600 includes multiple application programs 601 executing as separate processes. Each application program interfaces with a broadcaster component 602 for each broadcast channel to which it is connected. The broadcaster component may be implemented as an object that is instantiated within the process space of the application program. Alternatively, the broadcaster component may execute as a separate process or thread from the application program. In one embodiment, the broadcaster component provides functions (e.g., methods of class) that can be invoked by the application programs. The primary functions provided may include a connect function that an application program invokes passing an indication of the broadcast channel to which the application program wants to connect. The application program may provide a callback routine that the broadcaster component invokes to notify the application program that the connection has been completed, that is the process enters the fully connected state. The broadcaster component may also provide an acquire message function that the application program can invoke to retrieve the next message that is broadcast on the broadcast channel. Alternatively, the application program may provide a callback routine (which may be a virtual function provided by the application program) that the broadcaster component invokes to notify the application program that a broadcast message has been received. Each broadcaster component allocates a call-in port using the hashing algorithm. When calls are answered at the call-in port, they are transferred to other ports that serve as the external and internal ports.

The computers connecting to the broadcast channel may include a central processing unit, memory, input devices (e.g., keyboard and pointing device), output devices (e.g., display devices), and storage devices (e.g., disk drives). The memory and storage devices are computer-readable medium that may contain computer instructions that implement the broadcaster component. In addition, the data structures and message structures may be stored or transmitted via a signal transmitted on a computer-readable media, such as a communications link.

FIG. 7 is a block diagram illustrating the sub-components of the broadcaster component in one embodiment. The

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broadcaster component includes a connect component 701, an external dispatcher 702, an internal dispatcher 703 for each internal connection, an acquire message component 704 and a broadcast component 712. The application program may provide a connect callback component 710 and a receive response component 711 that are invoked by the broadcaster component. The application program invokes the connect component to establish a connection to a designated broadcast channel. The connect component identifies the external port and installs the external dispatcher for handling messages that are received on the external port. The connect component invokes the seek portal computer component 705 to identify a portal computer that is connected to the broadcast channel and invokes the connect request component 706 to ask the portal computer (if fully connected) to select neighbor processes for the newly connecting process. The external dispatcher receives external messages, identifies the type of message, and invokes the appropriate handling routine 707. The internal dispatcher receives the internal messages, identifies the type of message, and invokes the appropriate handling routine 708. The received broadcast messages are stored in the broadcast message queue 709. The acquire message component is invoked to retrieve messages from the broadcast queue. The broadcast component is invoked by the application program to broadcast messages in the broadcast channel.

The following tables list messages sent by the broadcaster components.

#### EXTERNAL MESSAGES

Message Type	Description
seeking_connection_call	Indicates that a seeking process would like to know whether the receiving process is fully connected to the broadcast channel
connection_request_call	Indicates that the sending process would like the receiving process to initiate a connection of the sending process to the broadcast channel
edge_proposal_call	Indicates that the sending process is proposing an edge through which the receiving process can connect to the broadcast channel (i.e., edge pinning)
port_connection_call	Indicates that the sending process is proposing a port through which the receiving process can connect to the broadcast channel
connected_stmt	Indicates that the sending process is connected to the broadcast channel
condition_repair_stmt	Indicates that the receiving process should disconnect from one of its neighbors and connect to one of the processes involved in the neighbors with empty port condition

#### INTERNAL MESSAGES

Message Type	Description
broadcast_stmt	Indicates a message that is being broadcast through the broadcast channel for the application programs
connection_port_search_stmt	Indicates that the designated process is looking for a port through which it can connect to the broadcast channel
connection_edge_search_call	Indicates that the requesting process is looking for an edge through which it can connect to the broadcast channel

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INTERNAL MESSAGES

Message Type	Description
connection_edge_search_resp	Indicates whether the edge between this process and the sending neighbor has been accepted by the requesting party
diameter_estimate_stmt	Indicates an estimated diameter of the broadcast channel
diameter_reset_stmt	Indicates to reset the estimated diameter to indicated diameter
disconnect_stmt	Indicates that the sending neighbor is disconnecting from the broadcast channel
condition_check_stmt	Indicates that neighbors with empty port condition have been detected
condition_double_check_stmt	Indicates that the neighbors with empty ports have the same set of neighbors
shutdown_stmt	Indicates that the broadcast channel is being shutdown

## Flow Diagrams

FIGS. 8-34 are flow diagrams illustrating the processing of the broadcaster component in one embodiment. FIG. 8 is a flow diagram illustrating the processing of the connect routine in one embodiment. This routine is passed a channel type (e.g., application name) and channel instance (e.g., session identifier), that identifies the broadcast channel to which this process wants to connect. The routine is also passed auxiliary information that includes the list of portal computers and a connection callback routine. When the connection is established, the connection callback routine is invoked to notify the application program. When this process invokes this routine, it is in the seeking connection state. When a portal computer is located that is connected and this routine connects to at least one neighbor, this process enters the partially connected state, and when the process eventually connects to four neighbors, it enters the fully connected state. When in the small regime, a fully connected process may have less than four neighbors. In block 801, the routine opens the call-in port through which the process is to communicate with other processes when establishing external and internal connections. The port is selected as the first available port using the hashing algorithm described above. In block 802, the routine sets the connect time to the current time. The connect time is used to identify the instance of the process that is connected through this external port. One process may connect to a broadcast channel of a certain channel type and channel instance using one call-in port and then disconnects, and another process may then connect to that same broadcast channel using the same call-in port. Before the other process becomes fully connected, another process may try to communicate with it thinking it is the fully connected old process. In such a case, the connect time can be used to identify this situation. In block 803, the routine invokes the seek portal computer routine passing the channel type and channel instance. The seek portal computer routine attempts to locate a portal computer through which this process can connect to the broadcast channel for the passed type and instance. In decision block 804, if the seek portal computer routine is successful in locating a fully connected process on that portal computer, then the routine continues at block 805, else the routine returns an unsuccessful indication. In decision block 805, if no portal computer other than the portal computer on which the process is executing was located, then this is the first process to fully connect to broadcast channel and the routine continues at block 806, else the

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routine continues at block 808. In block 806, the routine invokes the achieve connection routine to change the state of this process to fully connected. In block 807, the routine installs the external dispatcher for processing messages received through this process' external port for the passed channel type and channel instance. When a message is received through that external port, the external dispatcher is invoked. The routine then returns. In block 808, the routine installs an external dispatcher. In block 809, the routine invokes the connect request routine to initiate the process of identifying neighbors for the seeking computer. The routine then returns.

FIG. 9 is a flow diagram illustrating the processing of the seek portal computer routine in one embodiment. This routine is passed the channel type and channel instance of the broadcast channel to which this process wishes to connect. This routine, for each search depth (e.g., port number), checks the portal computers at that search depth. If a portal computer is located at that search depth with a process that is fully connected to the broadcast channel, then the routine returns an indication of success. In blocks 902-911, the routine loops selecting each search depth until a process is located. In block 902, the routine selects the next search depth using a port number ordering algorithm. In decision block 903, if all the search depths have already been selected during this execution of the loop, that is for the currently selected depth, then the routine returns a failure indication, else the routine continues at block 904. In blocks 904-911, the routine loops selecting each portal computer and determining whether a process of that portal computer is connected to (or attempting to connect to) the broadcast channel with the passed channel type and channel instance. In block 904, the routine selects the next portal computer. In decision block 905, if all the portal computers have already been selected, then the routine loops to block 902 to select the next search depth, else the routine continues at block 906. In block 906, the routine dials the selected portal computer through the port represented by the search depth. In decision block 907, if the dialing was successful, then the routine continues at block 908, else the routine loops to block 904 to select the next portal computer. The dialing will be successful if the dialed port is the call-in port of the broadcast channel of the passed channel type and channel instance of a process executing on that portal computer. In block 908, the routine invokes a contact process routine, which contacts the answering process of the portal computer through the dialed port and determines whether that process is fully connected to the broadcast channel. In block 909, the routine hangs up on the selected portal computer. In decision block 910, if the answering process is fully connected to the broadcast channel, then the routine returns a success indicator, else the routine continues at block 911. In block 911, the routine invokes the check for external call routine to determine whether an external call has been made to this process as a portal computer and processes that call. The routine then loops to block 904 to select the next portal computer.

FIG. 10 is a flow diagram illustrating the processing of the contact process routine in one embodiment. This routine determines whether the process of the selected portal computer that answered the call-in to the selected port is fully connected to the broadcast channel. In block 1001, the routine sends an external message (i.e., seeking\_connection\_call) to the answering process indicating that a seeking process wants to know whether the answering process is fully connected to the broadcast channel. In block 1002, the routine receives the external response message

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from the answering process. In decision block 1003, if the external response message is successfully received (i.e., seeking\_connection\_resp), then the routine continues at block 1004, else the routine returns. Wherever the broadcast component requests to receive an external message, it sets a time out period. If the external message is not received within that time out period, the broadcaster component checks its own call-in port to see if another process is calling it. In particular, the dialed process may be calling the dialing process, which may result in a deadlock situation. The broadcaster component may repeat the receive request several times. If the expected message is not received, then the broadcaster component handles the error as appropriate. In decision block 1004, if the answering process indicates in its response message that it is fully connected to the broadcast channel, then the routine continues at block 1005, else the routine continues at block 1006. In block 1005, the routine adds the selected portal computer to a list of connected portal computers and then returns. In block 1006, the routine adds the answering process to a list of fellow seeking processes and then returns.

FIG. 11 is a flow diagram illustrating the processing of the connect request routine in one embodiment. This routine requests a process of a portal computer that was identified as being fully connected to the broadcast channel to initiate the connection of this process to the broadcast channel. In decision block 1101, if at least one process of a portal computer was located that is fully connected to the broadcast channel, then the routine continues at block 1103, else the routine continues at block 1102. A process of the portal computer may no longer be in the list if it recently disconnected from the broadcast channel. In one embodiment, a seeking computer may always search its entire search depth and find multiple portal computers through which it can connect to the broadcast channel. In block 1102, the routine restarts the process of connecting to the broadcast channel and returns. In block 1103, the routine dials the process of one of the found portal computers through the call-in port. In decision block 1104, if the dialing is successful, then the routine continues at block 1105, else the routine continues at block 1113. The dialing may be unsuccessful if, for example, the dialed process recently disconnected from the broadcast channel. In block 1105, the routine sends an external message to the dialed process requesting a connection to the broadcast channel (i.e., connection\_request\_call). In block 1106, the routine receives the response message (i.e., connection\_request\_resp). In decision block 1107, if the response message is successfully received, then the routine continues at block 1108, else the routine continues at block 1113. In block 1108, the routine sets the expected number of holes (i.e., empty internal connections) for this process based on the received response. When in the large regime, the expected number of holes is zero. When in the small regime, the expected number of holes varies from one to three. In block 1109, the routine sets the estimated diameter of the broadcast channel based on the received response. In decision block 1111, if the dialed process is ready to connect to this process as indicated by the response message, then the routine continues at block 1112, else the routine continues at block 1113. In block 1112, the routine invokes the add neighbor routine to add the answering process as a neighbor to this process. This adding of the answering process typically occurs when the broadcast channel is in the small regime. When in the large regime, the random walk search for a neighbor is performed. In block 1113, the routine hangs up the external connection with the answering process computer and then returns.

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FIG. 12 is a flow diagram of the processing of the check for external call routine in one embodiment. This routine is invoked to identify whether a fellow seeking process is attempting to establish a connection to the broadcast channel through this process. In block 1201, the routine attempts to answer a call on the call-in port. In decision block 1202, if the answer is successful, then the routine continues at block 1203, else the routine returns. In block 1203, the routine receives the external message from the external port. In decision block 1204, if the type of the message indicates that a seeking process is calling (i.e., seeking\_connection\_call), then the routine continues at block 1205, else the routine returns. In block 1205, the routine sends an external message (i.e., seeking\_connection\_resp) to the other seeking process indicating that this process is also seeking a connection. In decision block 1206, if the sending of the external message is successful, then the routine continues at block 1207, else the routine returns. In block 1207, the routine adds the other seeking process to a list of fellow seeking processes and then returns. This list may be used if this process can find no process that is fully connected to the broadcast channel. In which case, this process may check to see if any fellow seeking process were successful in connecting to the broadcast channel. For example, a fellow seeking process may become the first process fully connected to the broadcast channel.

FIG. 13 is a flow diagram of the processing of the achieve connection routine in one embodiment. This routine sets the state of this process to fully connected to the broadcast channel and invokes a callback routine to notify the application program that the process is now fully connected to the requested broadcast channel. In block 1301, the routine sets the connection state of this process to fully connected. In block 1302, the routine notifies fellow seeking processes that it is fully connected by sending a connected external message to them (i.e., connected\_stmt). In block 1303, the routine invokes the connect callback routine to notify the application program and then returns.

FIG. 14 is a flow diagram illustrating the processing of the external dispatcher routine in one embodiment. This routine is invoked when the external port receives a message. This routine retrieves the message, identifies the external message type, and invokes the appropriate routine to handle that message. This routine loops processing each message until all the received messages have been handled. In block 1401, the routine answers (e.g., picks up) the external port and retrieves an external message. In decision block 1402, if a message was retrieved, then the routine continues at block 1403, else the routine hangs up on the external port in block 1415 and returns. In decision block 1403, if the message type is for a process seeking a connection (i.e., seeking\_connection\_call), then the routine invokes the handle seeking connection call routine in block 1404, else the routine continues at block 1405. In decision block 1405, if the message type is for a connection request call (i.e., connection\_request\_call), then the routine invokes the handle connection request call routine in block 1406, else the routine continues at block 1407. In decision block 1407, if the message type is edge proposal call (i.e., edge\_proposal\_call), then the routine invokes the handle edge proposal call routine in block 1408, else the routine continues at block 1409. In decision block 1409, if the message type is port connect call (i.e., port\_connect\_call), then the routine invokes the handle port connection call routine in block 1410, else the routine continues at block 1411. In decision block 1411, if the message type is a connected statement (i.e., connected\_stmt), the routine invokes the

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handle connected statement in block 1112, else the routine continues at block 1212. In decision block 1412, if the message type is a condition repair statement (i.e., condition\_repair\_stmt), then the routine invokes the handle condition repair routine in block 1413, else the routine loops to block 1414 to process the next message. After each handling routine is invoked, the routine loops to block 1414. In block 1414, the routine hangs up on the external port and continues at block 1401 to receive the next message.

FIG. 15 is a flow diagram illustrating the processing of the handle seeking connection call routine in one embodiment. This routine is invoked when a seeking process is calling to identify a portal computer through which it can connect to the broadcast channel. In decision block 1501, if this process is currently fully connected to the broadcast channel identified in the message, then the routine continues at block 1502, else the routine continues at block 1503. In block 1502, the routine sets a message to indicate that this process is fully connected to the broadcast channel and continues at block 1505. In block 1503, the routine sets a message to indicate that this process is not fully connected. In block 1504, the routine adds the identification of the seeking process to a list of fellow seeking processes. If this process is not fully connected, then it is attempting to connect to the broadcast channel. In block 1505, the routine sends the external message response (i.e., seeking\_connection\_resp) to the seeking process and then returns.

FIG. 16 is a flow diagram illustrating processing of the handle connection request call routine in one embodiment. This routine is invoked when the calling process wants this process to initiate the connection of the process to the broadcast channel. This routine either allows the calling process to establish an internal connection with this process (e.g., if in the small regime) or starts the process of identifying a process to which the calling process can connect. In decision block 1601, if this process is currently fully connected to the broadcast channel, then the routine continues at block 1603, else the routine hangs up on the external port in block 1602 and returns. In block 1603, the routine sets the number of holes that the calling process should expect in the response message. In block 1604, the routine sets the estimated diameter in the response message. In block 1605, the routine indicates whether this process is ready to connect to the calling process. This process is ready to connect when the number of its holes is greater than zero and the calling process is not a neighbor of this process. In block 1606, the routine sends to the calling process an external message that is responsive to the connection request call (i.e., connection\_request\_resp). In block 1607, the routine notes the number of holes that the calling process needs to fill as indicated in the request message. In decision block 1608, if this process is ready to connect to the calling process, then the routine continues at block 1609, else the routine continues at block 1611. In block 1609, the routine invokes the add neighbor routine to add the calling process as a neighbor. In block 1610, the routine decrements the number of holes that the calling process needs to fill and continues at block 1611. In block 1611, the routine hangs up on the external port. In decision block 1612, if this process has no holes or the estimated diameter is greater than one (i.e., in the large regime), then the routine continues at block 1613, else the routine continues at block 1616. In blocks 1613-1615, the routine loops forwarding a request for an edge through which to connect to the calling process to the broadcast channel. One request is forwarded for each pair of holes of the calling process that needs to be filled. In decision block 1613, if the number of holes of the calling process to be

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filled is greater than or equal to two, then the routine continues at block 1614, else the routine continues at block 1616. In block 1614, the routine invokes the forward connection edge search routine. The invoked routine is passed to an indication of the calling process and the random walk distance. In one embodiment, the distance is twice in the estimated diameter of the broadcast channel. In block 1614, the routine decrements the holes left to fill by two and loops to block 1613. In decision block 1616, if there is still a hole to fill, then the routine continues at block 1617, else the routine returns. In block 1617, the routine invokes the fill hole routine passing the identification of the calling process. The fill hole routine broadcasts a connection port search statement (i.e., connection\_port\_search\_stmt) for a hole of a connected process through which the calling process can connect to the broadcast channel. The routine then returns.

FIG. 17 is a flow diagram illustrating the processing of the add neighbor routine in one embodiment. This routine adds the process calling on the external port as a neighbor to this process. In block 1701, the routine identifies the calling process on the external port. In block 1702, the routine sets a flag to indicate that the neighbor has not yet received the broadcast messages from this process. This flag is used to ensure that there are no gaps in the messages initially sent to the new neighbor. The external port becomes the internal port for this connection. In decision block 1703, if this process is in the seeking connection state, then this process is connecting to its first neighbor and the routine continues at block 1704, else the routine continues at block 1705. In block 1704, the routine sets the connection state of this process to partially connected. In block 1705, the routine adds the calling process to the list of neighbors of this process. In block 1706, the routine installs an internal dispatcher for the new neighbor. The internal dispatcher is invoked when a message is received from that new neighbor through the internal port of that new neighbor. In decision block 1707, if this process buffered up messages while not fully connected, then the routine continues at block 1708, else the routine continues at block 1709. In one embodiment, a process that is partially connected may buffer the messages that it receives is through an internal connection so that it can send these messages as it connects to new neighbors. In block 1708, the routine sends the buffered messages to the new neighbor through the internal port. In decision block 1709, if the number of holes of this process equals the expected number of holes, then this process is fully connected and the routine continues at block 1710, else the routine continues at block 1711. In block 1710, the routine invokes the achieve connected routine to indicate that this process is fully connected. In decision block 1711, if the number of holes for this process is zero, then the routine continues at block 1712, else the routine returns. In block 1712, the routine deletes any pending edges and then returns. A pending edge is an edge that has been proposed to this process for edge pinning, which in this case is no longer needed.

FIG. 18 is a flow diagram illustrating the processing of the forward connection edge search routine in one embodiment. This routine is responsible for passing along a request to connect a requesting process to a randomly selected neighbor of this process through the internal port of the selected neighbor, that is part of the random walk. In decision block 1801, if the forwarding distance remaining is greater than zero, then the routine continues at block 1804, else the routine continues at block 1802. In decision block 1802, if the number of neighbors of this process is greater than one, then the routine continues at block 1804, else this broadcast

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channel is in the small regime and the routine continues at block 1803. In decision block 1803, if the requesting process is a neighbor of this process, then the routine returns, else the routine continues at block 1804. In blocks 1804–1807, the routine loops attempting to send a connection edge search call internal message (i.e., `connection_edge_search_call`) to a randomly selected neighbor. In block 1804, the routine randomly selects a neighbor of this process. In decision block 1805, if all the neighbors of this process have already been selected, then the routine cannot forward the message and the routine returns, else the routine continues at block 1806. In block 1806, the routine sends a connection edge search call internal message to the selected neighbor. In decision block 1807, if the sending of the message is successful, then the routine continues at block 1808, else the routine loops to block 1804 to select the next neighbor. When the sending of an internal message is unsuccessful, then the neighbor may have disconnected from the broadcast channel in an unplanned manner. Whenever such a situation is detected by the broadcaster component, it attempts to find another neighbor by invoking the fill holes routine to fill a single hole or the forward connecting edge search routine to fill two holes. In block 1808, the routine notes that the recently sent connection edge search call has not yet been acknowledged and indicates that the edge to this neighbor is reserved if the remaining forwarding distance is less than or equal to one. It is reserved because the selected neighbor may offer this edge to the requesting process for edge pinning. The routine then returns.

FIG. 19 is a flow diagram illustrating the processing of the handle edge proposal call routine. This routine is invoked when a message is received from a proposing process that proposes to connect an edge between the proposing process and one of its neighbors to this process for edge pinning. In decision block 1901, if the number of holes of this process minus the number of pending edges is greater than or equal to one, then this process still has holes to be filled and the routine continues at block 1902, else the routine continues at block 1911. In decision block 1902, if the proposing process or its neighbor is a neighbor of this process, then the routine continues at block 1911, else the routine continues at block 1903. In block 1903, the routine indicates that the edge is pending between this process and the proposing process. In decision block 1904, if a proposed neighbor is already pending as a proposed neighbor, then the routine continues at block 1911, else the routine continues at block 1907. In block 1907, the routine sends an edge proposal response as an external message to the proposing process (i.e., `edge_proposal_resp`) indicating that the proposed edge is accepted. In decision block 1908, if the sending of the message was successful, then the routine continues at block 1909, else the routine returns. In block 1909, the routine adds the edge as a pending edge. In block 1910, the routine invokes the add neighbor routine to add the proposing process on the external port as a neighbor. The routine then returns. In block 1911, the routine sends an external message (i.e., `edge_proposal_resp`) indicating that this proposed edge is not accepted. In decision block 1912, if the number of holes is odd, then the routine continues at block 1913, else the routine returns. In block 1913, the routine invokes the fill hole routine and then returns.

FIG. 20 is a flow diagram illustrating the processing of the handle port connection call routine in one embodiment. This routine is invoked when an external message is received then indicates that the sending process wants to connect to one hole of this process. In decision block 2001, if the number of holes of this process is greater than zero, then the

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routine continues at block 2002, else the routine continues at block 2003. In decision block 2002, if the sending process is not a neighbor, then the routine continues at block 2004, else the routine continues to block 2003. In block 2003, the routine sends a port connection response external message (i.e., `port_connection_resp`) to the sending process that indicates that it is not okay to connect to this process. The routine then returns. In block 2004, the routine sends a port connection response external message to the sending process that indicates that it is okay to connect this process. In decision block 2005, if the sending of the message was successful, then the routine continues at block 2006, else the routine continues at block 2007. In block 2006, the routine invokes the add neighbor routine to add the sending process as a neighbor of this process and then returns. In block 2007, the routine hangs up the external connection. In block 2008, the routine invokes the connect request routine to request that a process connect to one of the holes of this process. The routine then returns.

FIG. 21 is a flow diagram illustrating the processing of the fill hole routine in one embodiment. This routine is passed an indication of the requesting process. If this process is requesting to fill a hole, then this routine sends an internal message to other processes. If another process is requesting to fill a hole, then this routine invokes the routine to handle a connection port search request. In block 2101, the routine initializes a connection port search statement internal, message (i.e., `connection_port_search_stmt`). In decision block 2102, if this process is the requesting process, then the routine continues at block 2103, else the routine continues at block 2104. In block 2103, the routine distributes the message to the neighbors of this process through the internal ports and then returns. In block 2104, the routine invokes the handle connection port search routine and then returns.

FIG. 22 is a flow diagram illustrating the processing of the internal dispatcher routine in one embodiment. This routine is passed an indication of the neighbor who sent the internal message. In block 2201, the routine receives the internal message. This routine identifies the message type and invokes the appropriate routine to handle the message. In block 2202, the routine assesses whether to change the estimated diameter of the broadcast channel based on the information in the received message. In decision block 2203, if this process is the originating process of the message or the message has already been received (i.e., a duplicate), then the routine ignores the message and continues at block 2208, else the routine continues at block 2203A. In decision block 2203A, if the process is partially connected, then the routine continues at block 2203B, else the routine continues at block 2204. In block 2203B, the routine adds the message to the pending connection buffer and continues at block 2204. In decision blocks 2204–2207, the routine decodes the message type and invokes the appropriate routine to handle the message. For example, in decision block 2204, if the type of the message is broadcast statement (i.e., `broadcast_stmt`), then the routine invokes the handle broadcast message routine in block 2205. After invoking the appropriate handling routine, the routine continues at block 2208. In decision block 2208, if the partially connected buffer is full, then the routine continues at block 2209, else the routine continues at block 2210. The broadcaster component collects all its internal messages in a buffer while partially connected so that it can forward the messages as it connects to new neighbors. If, however, that buffer becomes full, then the process assumes that it is now fully connected and that the expected number of connections was too high, because the broadcast channel is now in the small regime. In block 2209,

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the routine invokes the achieve connection routine and then continues in block 2210. In decision block 2210, if the application program message queue is empty, then the routine returns, else the routine continues at block 2212. In block 2212, the routine invokes the receive response routine passing the acquired message and then returns. The received response routine is a callback routine of the application program.

FIG. 23 is a flow diagram illustrating the processing of the handle broadcast message routine in one embodiment. This routine is passed an indication of the originating process, an indication of the neighbor who sent the broadcast message, and the broadcast message itself. In block 2301, the routine performs the out of order processing for this message. The broadcaster component queues messages from each originating process until it can send them in sequence number order to the application program. In block 2302, the routine invokes the distribute broadcast message routine to forward the message to the neighbors of this process. In decision block 2303, if a newly connected neighbor is waiting to receive messages, then the routine continues at block 2304, else the routine returns. In block 2304, the routine sends the messages in the correct order if possible for each originating process and then returns.

FIG. 24 is a flow diagram illustrating the processing of the distribute broadcast message routine in one embodiment. This routine sends the broadcast message to each of the neighbors of this process, except for the neighbor who sent the message to this process. In block 2401, the routine selects the next neighbor other than the neighbor who sent the message. In decision block 2402, if all such neighbors have already been selected, then the routine returns. In block 2403, the routine sends the message to the selected neighbor and then loops to block 2401 to select the next neighbor.

FIG. 26 is a flow diagram illustrating the processing of the handle connection port search statement routine in one embodiment. This routine is passed an indication of the neighbor that sent the message and the message itself. In block 2601, the routine invokes the distribute internal message which sends the message to each of its neighbors other than the sending neighbor. In decision block 2602, if the number of holes of this process is greater than zero, then the routine continues at block 2603, else the routine returns. In decision block 2603, if the requesting process is a neighbor, then the routine continues at block 2605 else the routine continues at block 2604. In block 2604, the routine invokes the court neighbor routine and then returns. The court neighbor routine connects this process to the requesting process if possible. In block 2605, if this process has one hole, then the neighbors with empty ports condition exists and the routine continues at block 2606, else the routine returns. In block 2606, the routine generates a condition check message (i.e., condition\_check) that includes a list of this process' neighbors. In block 2607, the routine sends the message to the requesting neighbor.

FIG. 27 is a flow diagram illustrating the processing of the court neighbor routine in one embodiment. This routine is passed an indication of the prospective neighbor for this process. If this process can connect to the prospective neighbor, then it sends a port connection call external message to the prospective neighbor and adds the prospective neighbor as a neighbor. In decision block 2701, if the prospective neighbor is already a neighbor, then the routine returns, else the routine continues at block 2702. In block 2702, the routine dials the prospective neighbor. In decision block 2703, if the number of holes of this process is greater than zero, then the routine continues at block 2704, else the

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routine continues at block 2706. In block 2704, the routine sends a port connection call external message (i.e., port\_connection\_call) to the prospective neighbor and receives its response (i.e., port\_connection\_resp). Assuming the response is successfully received, in block 2705, the routine adds the prospective neighbor as a neighbor of this process by invoking the add neighbor routine. In block 2706, the routine hangs up with the prospect and then returns.

FIG. 28 is a flow diagram illustrating the processing of the handle connection edge search call routine in one embodiment. This routine is passed an indication of the neighbor who sent the message and the message itself. This routine either forwards the message to a neighbor or proposes the edge between this process and the sending neighbor to the requesting process for edge pinning. In decision block 2801, if this process is not the requesting process or the number of holes of the requesting process is still greater than or equal to two, then the routine continues at block 2802, else the routine continues at block 2813. In decision block 2802, if the forwarding distance is greater than zero, then the random walk is not complete and the routine continues at block 2803, else the routine continues at block 2804. In block 2803, the routine invokes the forward connection edge search routine passing the identification of the requesting process and the decremented forwarding distance. The routine then continues at block 2815. In decision block 2804, if the requesting process is a neighbor or the edge between this process and the sending neighbor is reserved because it has already been offered to a process, then the routine continues at block 2805, else the routine continues at block 2806. In block 2805, the routine invokes the forward connection edge search routine passing an indication of the requesting party and a toggle indicator that alternatively indicates to continue the random walk for one or two more computers. The routine then continues at block 2815. In block 2806, the routine dials the requesting process via the call-in port. In block 2807, the routine sends an edge proposal call external message (i.e., edge\_proposal\_call) and receives the response (i.e., edge\_proposal\_resp). Assuming that the response is successfully received, the routine continues at block 2808. In decision block 2808, if the response indicates that the edge is acceptable to the requesting process, then the routine continues at block 2809, else the routine continues at block 2812. In block 2809, the routine reserves the edge between this process and the sending neighbor. In block 2810, the routine adds the requesting process as a neighbor by invoking the add neighbor routine. In block 2811, the routine removes the sending neighbor as a neighbor. In block 2812, the routine hangs up the external port and continues at block 2815. In decision block 2813, if this process is the requesting process and the number of holes of this process equals one, then the routine continues at block 2814, else the routine continues at block 2815. In block 2814, the routine invokes the fill hole routine. In block 2815, the routine sends an connection edge search response message (i.e., connection\_edge\_search\_response) to the sending neighbor indicating acknowledgement and then returns. The graphs are sensitive to parity. That is, all possible paths starting from a node and ending at that node will have an even length unless the graph has a cycle whose length is odd. The broadcaster component uses a toggle indicator to vary the random walk distance between even and odd distances.

FIG. 29 is a flow diagram illustrating the processing of the handle connection edge search response routine in one embodiment. This routine is passed as indication of the requesting process, the sending neighbor, and the message. In block 2901, the routine notes that the connection edge

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search response (i.e., connection\_edge\_search\_resp) has been received and if the forwarding distance is less than or equal to one unreserves the edge between this process and the sending neighbor. In decision block 2902, if the requesting process indicates that the edge is acceptable as indicated in the message, then the routine continues at block 2903, else the routine returns. In block 2903, the routine reserves the edge between this process and the sending neighbor. In block 2904, the routine removes the sending neighbor as a neighbor. In block 2905, the routine invokes the court neighbor routine to connect to the requesting process. In decision block 2906, if the invoked routine was unsuccessful, then the routine continues at block 2907, else the routine returns. In decision block 2907, if the number of holes of this process is greater than zero, then the routine continues at block 2908, else the routine returns. In block 2908, the routine invokes the fill hole routine and then returns.

FIG. 30 is a flow diagram illustrating the processing of the broadcast routine in one embodiment. This routine is invoked by the application program to broadcast a message on the broadcast channel. This routine is passed the message to be broadcast. In decision block 3001, if this process has at least one neighbor, then the routine continues at block 3002, else the routine returns since it is the only process connected to be broadcast channel. In block 3002, the routine generates an internal message of the broadcast statement type (i.e., broadcast\_stmt). In block 3003, the routine sets the sequence number of the message. In block 3004, the routine invokes the distribute internal message routine to broadcast the message on the broadcast channel. The routine returns.

FIG. 31 is a flow diagram illustrating the processing of the acquire message routine in one embodiment. The acquire message routine may be invoked by the application program or by a callback routine provided by the application program. This routine returns a message. In block 3101, the routine pops the message from the message queue of the broadcast channel. In decision block 3102, if a message was retrieved, then the routine returns an indication of success, else the routine returns indication of failure.

FIGS. 32-34 are flow diagrams illustrating the processing of messages associated with the neighbors with empty ports condition. FIG. 32 is a flow diagram illustrating processing of the handle condition check message in one embodiment. This message is sent by a neighbor process that has one hole and has received a request to connect to a hole of this process. In decision block 3201, if the number of holes of this process is equal to one, then the routine continues at block 3202, else the neighbors with empty ports condition does not exist any more and the routine returns. In decision block 3202, if the sending neighbor and this process have the same set of neighbors, the routine continues at block 3203, else the routine continues at block 3205. In block 3203, the routine initializes a condition double check message (i.e., condition\_double\_check) with the list of neighbors of this process. In block 3204, the routine sends the message internally to a neighbor other than sending neighbor. The routine then returns. In block 3205, the routine selects a neighbor of the sending process that is not also a neighbor of this process. In block 3206, the routine sends a condition repair message (i.e., condition\_repair\_stmt) externally to the selected process. In block 3207, the routine invokes the add neighbor routine to add the selected neighbor as a neighbor of this process and then returns.

FIG. 33 is a flow diagram illustrating processing of the handle condition repair statement routine in one embodi-

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ment. This routine removes an existing neighbor and connects to the process that sent the message. In decision block 3301, if this process has no holes, then the routine continues at block 3302, else the routine continues at block 3304. In block 3302, the routine selects a neighbor that is not involved in the neighbors with empty ports condition. In block 3303, the routine removes the selected neighbor as a neighbor of this process. Thus, this process that is executing the routine now has at least one hole. In block 3304, the routine invokes the add neighbor routine to add the process that sent the message as a neighbor of this process. The routine then returns.

FIG. 34 is a flow diagram illustrating the processing of the handle condition double check routine. This routine determines whether the neighbors with empty ports condition really is a problem or whether the broadcast channel is in the small regime. In decision block 3401, if this process has one hole, then the routine continues at block 3402, else the routine continues at block 3403. If this process does not have one hole, then the set of neighbors of this process is not the same as the set of neighbors of the sending process. In decision block 3402, if this process and the sending process have the same set of neighbors, then the broadcast channel is not in the small regime and the routine continues at block 3403, else the routine continues at block 3406. In decision block 3403, if this process has no holes, then the routine returns, else the routine continues at block 3404. In block 3404, the routine sets the estimated diameter for this process to one. In block 3405, the routine broadcasts a diameter reset internal message (i.e., diameter\_reset) indicating that the estimated diameter is one and then returns. In block 3406, the routine creates a list of neighbors of this process. In block 3407, the routine sends the condition check message (i.e., condition\_check\_stmt) with the list of neighbors to the neighbor who sent the condition double check message and then returns.

From the above description, it will be appreciated that although specific embodiments of the technology have been described, various modifications may be made without deviating from the spirit and scope of the invention. For example, the communications on the broadcast channel may be encrypted. Also, the channel instance or session identifier may be a very large number (e.g., 128 bits) to help prevent an unauthorized user to maliciously tap into a broadcast channel. The portal computer may also enforce security and not allow an unauthorized user to connect to the broadcast channel.

Accordingly, the invention is not limited except by the claims.

We claim:

1. A method of disconnecting a first computer from a second computer, the first computer and the second computer being connected to a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3, the method comprising:

when the first computer decides to disconnect from the second computer, the first computer sends a disconnect message to the second computer, said disconnect message including a list of neighbors of the first computer; and

when the second computer receives the disconnect message from the first computer, the second computer broadcasts a connection port search message on the broadcast channel to find a third computer to which it can connect in order to maintain an m-regular graph, said third computer being one of the neighbors on said list of neighbors.

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2. The method of claim 1 wherein the second computer receives a port connection message indicating that the third computer is proposing that the third computer and the second computer connect.

3. The method of claim 1 wherein the first computer disconnects from the second computer after sending the disconnect message.

4. The method of claim 1 wherein the broadcast channel is implemented using the Internet.

5. The method of claim 1 wherein the first computer and second computer are connected via a TCP/IP connection.

6. A method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising:

attempting to send a message from the first computer to the second computer; and

when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection; and

having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph.

7. The method of claim 6 including:

when a third computer receives the connection port search message and the third computer also needs a connection, sending a message from the third computer to the first computer proposing that the first computer and third computer connect.

8. The method of claim 7 including:

when the first computer receives the message proposing that the first computer and third computer connect, sending from the first computer to the third computer a message indicating that the first computer accepts the proposal to connect the first computer to the third computer.

9. The method of claim 6 wherein each computer connected to the broadcast channel is connected to at least three other computers.

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10. The method of claim 6 wherein the broadcasting includes sending the message to each computer to which the first computer is connected.

11. A computer-readable medium containing instructions for controlling disconnecting of a computer from another computer, the computer and the other computer being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, comprising:

a component that, when the computer decides to disconnect from the other computer, the computer sends a disconnect message to the other computer, said disconnect message including a list of neighbors of the computer; and

a component that, when the computer receives a disconnect message from another computer, the computer broadcasts a connection port search message on the broadcast channel to find a computer to which it can connect in order to maintain an m-regular graph, said computer to which it can connect being one of the neighbors on said list of neighbors.

12. The computer-readable medium of claim 11 including:

a component that, when the computer receives a connection port search message and the computer needs to connect to another computer, sends to the computer that sent the connection port search message a port connection message indicating that the computer is proposing that the computer that sent the connection port search message connect to the computer.

13. The computer-readable medium of claim 12 including:

a component that, when the computer receives a port connection message, connecting to the computer that sent the port connection message.

14. The computer-readable medium of claim 11 wherein the computers are connected via a TCP/IP connection.

15. The computer-readable medium of claim 11 wherein the computers that are connected to the broadcast channel are peers.

16. The computer-readable medium of claim 11 wherein the broadcast channel is implemented using the Internet.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,732,147 B1  
DATED : May 4, 2004  
INVENTOR(S) : Fred B. Holt

Page 2 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 25 (cont'd),  
Line 46, delete comma between "2604" and "In";

Signed and Sealed this

Twenty-seventh Day of July, 2004



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JON W. DUDAS

*Acting Director of the United States Patent and Trademark Office*

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UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,732,147 B1  
 DATED : May 4, 2004  
 INVENTOR(S) : Fred B. Holt

Page 1 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5,

Line 9, "a-broadcast" should be -- a broadcast --;

Column 6,

Line 30, "on-that" should be -- on that --;

Column 8,

Line 26, delete comma between "newly";

Column 11,

Line 60, "port-number" should be -- port number --;

Line 63, "port-order" should be -- port order --;

Column 13,

Line 50, "computer-cannot" should be -- computer cannot --;

Column 14,

Line 51, delete period after "Regular";

Column 22,

Line 41, delete "is" between "receives" and "through";

Column 23,

Line 23, delete "is" between "In" and "block";

Column 25,

Line 45, insert comma between "2605" and "else";

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 2K, ROCKSTAR  
 Ex. 1001, p. 57 of 58

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ACTIVISION BLIZZARD, INC.,  
ELECTRONIC ARTS INC.,  
TAKE-TWO INTERACTIVE SOFTWARE, INC.,  
2K SPORTS, INC., and  
ROCKSTAR GAMES, INC.,  
Petitioners,

v.

ACCELERATION BAY, LLC,  
Patent Owner.

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Case No. IPR2016-00747  
Patent 6,732,147

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**DECLARATION OF MICHAEL GOODRICH, Ph.D. IN SUPPORT OF  
PATENT OWNER'S RESPONSE TO PETITION**

**EXHIBIT**

**5**

Bims

2/7/2017 CAR.

Patent Owner Acceleration Bay, LLC - Ex. 2003, p. 1

Declaration of Dr. Michael Goodrich  
IPR2016-00747 (U.S. Patent No. 6,732,147)

I, Michael Goodrich, Ph.D., declare and state as follows:

# **I. QUALIFICATIONS**

1. I make this Declaration based upon my own personal knowledge, information, and belief, and I would and could competently testify to the matters set forth herein if called upon to do so.

2. I received a Bachelor of Arts ("BA") degree in Mathematics and Computer Science from Calvin College in 1983 and a PhD in Computer Sciences from Purdue University in 1987.

3. I am a Chancellor's Professor in the Department of Computer Science at the University of California, Irvine, where I have been a faculty member since 2001. The Chancellor's Professor title at University of California, Irvine is designed for persons who have earned the title of Professor and who have demonstrated unusual academic merit and whose continued promise for scholarly achievement is unusually high. In addition, I am technical director for the Center for Algorithms and Theory of Computation in the Donald Bren School of Information and Computer Sciences at University of California, Irvine. I was a professor in the Department of Computer Science at Johns Hopkins University from 1987-2001.

4. I have authored or coauthored over 300 publications, including several widely adopted books, such as *Introduction to Computer Security* and *Algorithm*



Declaration of Dr. Michael Goodrich  
IPR2016-00747 (U.S. Patent No. 6,732,147)

*Design and Applications.* My research includes contributions to data structures and algorithms, information security and privacy, networking, graph algorithms, computational geometry, distributed and parallel algorithms, and cloud security. My research is supported by grants from the Defense Advanced Research Projects Agency (DARPA) and the National Science Foundation (NSF).

5. In addition, I have consulting experience in matters involving algorithms, cryptography, machine learning, digital rights management, computer security, networking, software, and storage technologies.

6. I am an ACM Distinguished Scientist, a Fellow of the American Association for the Advancement of Science (AAAS), a Fulbright Scholar, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and a Fellow of the Association for Computing Machinery (ACM). I am also a recipient of the IEEE Computer Society Technical Achievement Award and the Pond Award for Excellence in Undergraduate Teaching.

7. Attached hereto as Appendix A is a true and correct copy of my Curriculum Vitae (CV).

8. In developing my opinions below, I have applied my professional experience and I have considered the materials cited herein, including the subject Petition, all the exhibits cited therein and identified on Petitioner's Exhibit List, and the Decision to Institute Trial. In addition, I have reviewed the documents

Declaration of Dr. Michael Goodrich  
IPR2016-00747 (U.S. Patent No. 6,732,147)

cited by Dr. David R. Karger in his declaration to the Petition (Dr. Karger's declaration hereinafter referred to as "Karger Decl"). I have also review Dr. Karger's deposition transcript in this case. (Dr. Karger's transcript hereinafter referred to as "Karger Tr." (Ex. 2010)).

9. To the extent that I am presented with new information concerning the subject matter of this declaration or affecting any assumptions made herein, I reserve the right to supplement this declaration accordingly.

## **II. SCOPE OF ASSIGNMENT AND APPROACH**

10. I have been retained as an expert on behalf of Patent Owner, Acceleration Bay LLC, ("Acceleration Bay"), to provide information and opinions to the Patent Trial and Appeal Board (hereinafter "the Board") to assist in the determination of whether or not the Board should invalidate of one or more claims of Acceleration Bay's U.S. Patent No. 6,732,147 (Ex. 1001, the "'147 Patent"). Specifically, counsel for Acceleration Bay asked me to provide opinions regarding the validity of claims 6-10 of the '147 Patent in view of certain prior art references cited by Activision Blizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., 2K Sports, Inc., and Rockstar Games, Inc. (collectively, "Petitioners"). In my opinion, claims 6-10 of the '147 Patent are valid in light of the prior art and arguments presented in the Petition and the Karger Decl.

Declaration of Dr. Michael Goodrich  
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11. I have been informed by counsel and I understand that the analysis of whether a patent is anticipated or obvious is performed from the perspective of a person of ordinary skill in the art at the time of the patented inventions. The relevant timeframe for the challenged claims of the '147 Patent is at least July 2000.

### **III. APPLICABLE STANDARDS AND CONTROLLING PRINCIPLES**

#### **A. Anticipation**

12. Counsel has informed me, and I understand, that an issued patent claim is invalid as anticipated if each and every element of that claim is disclosed in a single prior art reference that enables a person of ordinary skill in the art to make the allegedly anticipating subject matter. I understand that to be anticipatory, a reference must enable one of skill in the art to practice an embodiment of the claimed invention without undue experimentation.

13. Counsel has informed me, and I understand, that if a prior art reference does not disclose a given element expressly, it may do so inherently. I have been informed by counsel and I further understand that a prior art reference will inherently anticipate a claimed invention if any claim elements or other information missing from the reference would nonetheless be known by the person of ordinary skill in the art to be necessarily present in the subject matter of the reference.

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**B. Obviousness**

14. Counsel has informed me, and I understand, that an issued patent claim is invalid as obvious if it can be shown that the differences between the patented subject matter and the prior art are such that the subject matter as a whole would have been obvious, at the time the invention was made, to a person having ordinary skill in the art. Relevant considerations include the level of ordinary skill in the art; the scope and content of the prior art; differences between the prior art and the claims at issue; and the so-called objective secondary factors of nonobviousness.

15. Counsel has informed me, and I understand, that in order to evaluate the obviousness of any claim of the '147 Patent over a given prior art combination, I should analyze whether the prior art references, included collectively in the combination, disclose each and every element of the allegedly invalid claim as those references are read by the person of ordinary skill in the art at the time of the invention. Then I am to determine whether that combination makes the claims of the '147 Patent obvious to the person of ordinary skill in the art by a preponderance of the evidence, at the time of the inventions. I understand that such preponderance of the evidence is satisfied if the proposition is more likely to be true than not true.

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16. Counsel has informed me, and I understand, that the obviousness inquiry requires that the prior art be considered in its entirety. I am further informed and I understand that an invention cannot be obvious to try where “the breadth of the[] choices and the numerous combinations indicate that the[] disclosures would not have rendered the claimed invention obvious to try.”

17. Counsel has informed me, and I understand, that even where all of the claim limitations are expressly disclosed in the prior art references, there must be some showing that a person of ordinary skill in the art would have been motivated to combine such prior art references and that there would have been a reasonable expectation of successfully achieving the claimed invention from such combination.

18. Counsel has informed me, and I understand, in considering the obviousness of a claimed invention, one should not view the invention and the prior art with the benefit of hindsight. It is for that reason, I am informed and I understand, that obviousness is assessed by the person of ordinary skill in the art at the time the invention was made. In this regard, I am informed and I understand that the invention cannot be used as a guide to selecting and understanding the prior art. I understand that the appropriate standard is to determine whether a person of skill in the art *would* be motivated to combine references, not whether they *could*.

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19. Counsel has informed me, and I understand, that obviousness cannot be predicated on what was unknown at the time of the invention, even if the inherency of a certain feature is later established. Counsel has also informed me, and I understand, that unknown properties of the prior art may not be relied upon to provide the rationale for modifying or combining the prior art to reach the claimed subject matter.

20. Counsel has informed me, and I understand, that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.

21. Counsel has informed me, and I understand, that the “time of invention” applicable to the inventions of claims 6-10 the ‘147 Patent is no later than July 31, 2000, which I understand to be the priority date on the face of the ‘147 Patent.

**C. Person Of Ordinary Skill In The Art**

22. Counsel has informed me, and I understand, that the “person of ordinary skill in the art” (“POSITA”) is a hypothetical person who is presumed to be familiar with the relevant scientific field and its literature at the time of the invention. This hypothetical person is also a person of ordinary creativity capable of understanding the scientific principles applicable to the pertinent field.

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23. I am informed by counsel and I understand that the level of ordinary skill in the art may be determined by reference to certain factors, including (1) the type of problems encountered in the art, (2) prior art solutions to those problems, (3) the rapidity with which innovations are made, (4) the sophistication of the technology, and (5) the educational level of active workers in the field. I further understand that the face of the '147 Patent claims a priority date of July 31, 2000.

24. It is my opinion that the person of ordinary skill in the art in the field of the '147 Patent would have been someone with a bachelor's degree in computer science or related field, and either (1) two or more years of industry experience and/or (2) an advanced degree in computer science or related field.

25. Based on my training and experience, I believe that I am (and was as of July 2000) a person of greater than ordinary skill in the relevant art, which permits me to give an opinion about the qualifications of one of ordinary skill at the time of the invention.

26. I note that Dr. Karger's opinion on a person of ordinary skill in the art in his declaration is:

In my opinion, a POSITA at the time of the alleged inventions claimed by the '147 and '069 patents would have a minimum of: (i) a bachelor's degree in computer science, computer engineering, applied mathematics, or a related field of study; and (ii) four or more years of industry experience relating to networking protocols and network

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topologies. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

Karger Decl. at ¶ 19.

27. My opinions stated in this declaration would be the same if rendered from the perspective of a person of ordinary skill in the art set out by Dr. Karger.

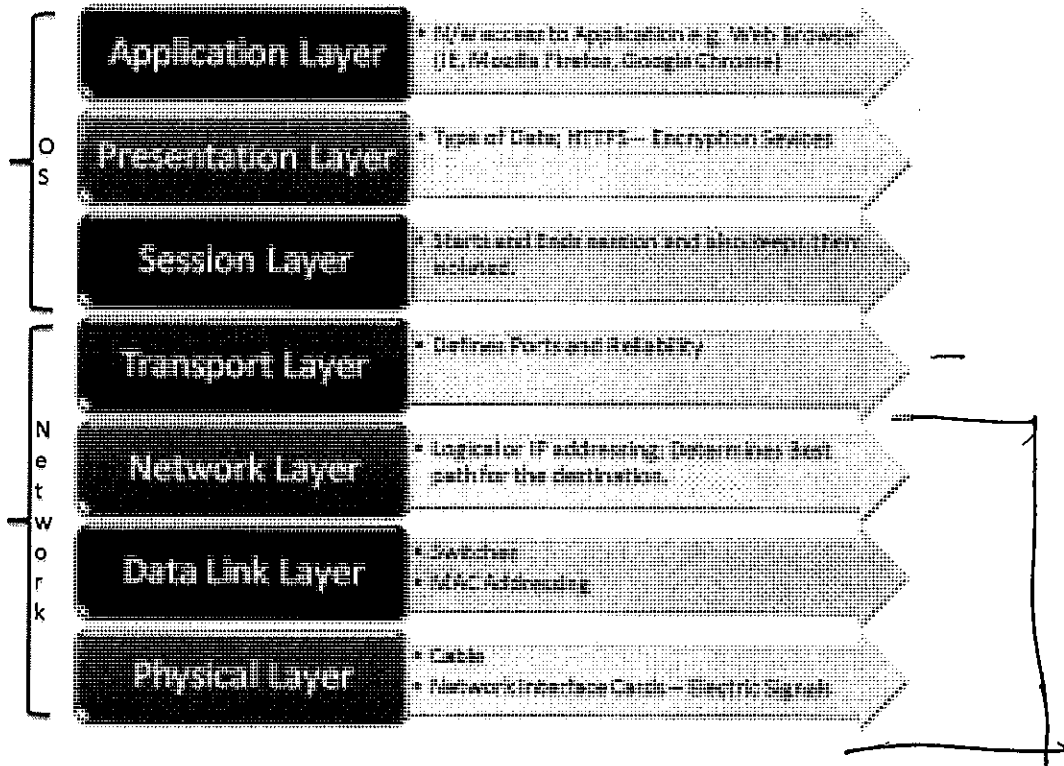
#### **IV. OVERVIEW OF THE TECHNOLOGY**

##### **A. Network Layers**

28. Network protocols are typically modelled conceptually as being partitioned into layers, which collectively are called the network protocol stack. Each layer provides a set of services and functionality guarantees for higher layers and, to the extent possible, each layer does not depend on details or services from higher levels. To reduce complexity, most networks are designed with a small number of layers, from the physical layer, at the bottom, where computer hardware interfaces with copper wire or wireless radio, to the application layer, at the top, where the user interacts with the software. See Ex. 2007 (“Tanenbaum”) at 17. Each layer uses a set of protocols to build on top of the layers below. The well-known Open System Interconnection (OSI) reference model is used to abstract such layers as shown below:



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Ex. 2021; see also Tanenbaum at 28-29.

29. Other protocol stacks also exist, which have overlapping functionality with the OSI Reference Model. The Internet Protocol stack, for example, groups the top three layers as the application layer, while keeping the bottom four layers as in the OSI Reference Model. In the OSI model, the data link layer is used to transfer data between a pair of network nodes or between nodes in a local-area network and to detect errors that occur at the physical layer, dealing with the logical aspects of sending information across network links, such as in the Ethernet protocol. See Tanenbaum at 28-34.

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30. The task of the network layer is to provide for the moving of packets between any two hosts, on a best effort basis. It provides a way of individually addressing each host using a numerical label, such an IP address. This layer is concerned with packet transmission and route searching using routing tables or flooding algorithms. The Internet Protocol (“IP”) is an example of a protocol at the network layer. The task of the transport layer is to support communication based on network (e.g., IP) addresses and ports, which are numerical addresses for higher-level protocols to use. For example, the transport layer in the Internet provides a protocol, the Transmission Control Protocol (TCP), which establishes a virtual connection between a client and server and guarantees delivery of all packets in an ordered fashion, and the Internet also provides a transport protocol, the User Datagram Protocol (UDP), which assumes no prior setup and delivers packets as quickly as possible but with no delivery or ordering guarantees. The role of the session layer is to manage communication sessions, that is, the exchange of information in the form of multiple back-and-forth related transmissions between two nodes, such as in the HTTP protocol, which uses TCP and supports web browsing sessions. See Tanenbaum at 28-34.

31. The presentation layer is dedicated to dealing with the translation of data between a networking service and an application and includes such functions as character encoding, data compression, and encryption and decryption of data, as

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in the HTTPS protocol that is used to encrypt/decrypt private web sessions. The task of the application layer is to provide protocols that support useful functions for users, based on the services provided by the lower layers. Example application-layer functions include web browsers, web-based collaboration systems, and multi-player online games. Typically, the application layer will use application programming interfaces (“APIs”) that will interact with a variety of underlying networks. Designing systems at the application layer is completely different from designing systems at the network layer. An application layer system is typically designed to run on multiple platforms and is usually untethered to the underlying network that may be used to send data to other applications. In contrast, a system at the network layer does not consider the data that is routed through the system or how the application uses the data because its primary job and concern is the getting packets from the source all the way to the destination. See Tanenbaum at 28-34.

#### **B. Token Ring Networks**

32. The token ring topology is a simple network topology where stations are connected one to the next so as to form a physical ring. Each station has a single transmitter and a single receiver, such that the transmitter from one station is directly linked to the receiver of another station. *See, e.g.*, Tanenbaum at 292-293. This convention automatically implies that the connections form a circular ring

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topology, with messages being transmitted around the ring in the order determined by the transmitters.

33. A special small message, called a “token,” is sent around the stations in such a network in order to facilitate the routing of messages between stations. This token message is continuously transmitted around the ring, in a fashion reminiscent of the classic party game, “hot potato.” That is, a station receives the token from its receiver and transmits it to the next station out its transmitter. The following figure (4-28) from Tanenbaum is an illustration of the topology of a token ring (in part (a) on the left) and the token-passing hardware (in parts (b) and (c) on the right):

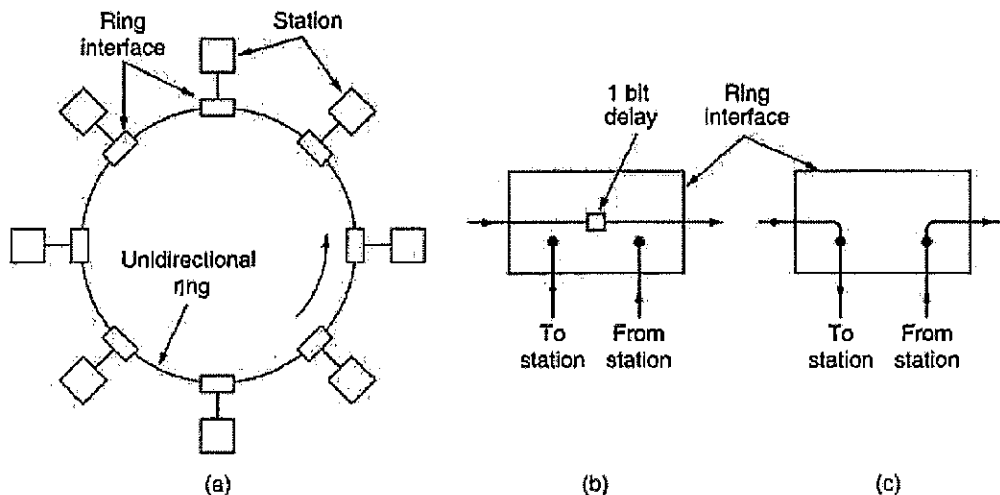


Fig. 4-28. (a) A ring network. (b) Listen mode. (c) Transmit mode.

Tanenbaum at 293.

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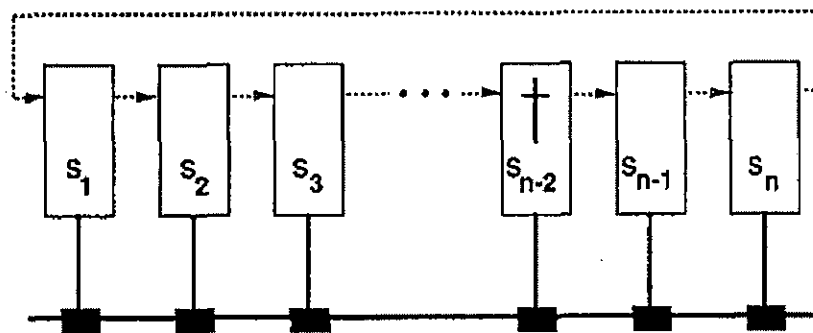
34. As referenced in T. Todd, *The Token Grid Network*, IEEE/ACM Transactions on Networking, 2.3, 279–287 (Ex. 1019, “Todd”), the protocol details for sending messages in networks that follow the token ring protocol were standardized in the IEEE 802.5 and FDDI standards. Todd at 279. The token represents a permission to send. For example, according to a typical scenario, in order for a station, X, to send a message to another station, Y, the station X waits until it is holding the token and the token is “empty.” Then it sends the message along with the token to its successor in the token ring. Each time a station, Z, receives the token along with a message, the station Z checks to see if it is the destination for the message. If Z is the destination, then it copies out the message and marks it as sent. In either case, Z transmits the token and message to its successor. When the original sender gets the token and message back again, it checks to see if it was correctly received by the destination and then it empties out the token and passes it to its successor, for the process to enable the possibility of another station to send a message around the ring. Thus, if there are N stations in a token ring, it will take up to N-1 steps to send a message and up to N steps before another message can be sent around the ring.

### C. Token Bus Networks

35. Another network topology is the token bus topology. In this topology, stations are all connected to a physical bus, which is a broadcast medium such as a

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cable, wire, or metal bar capable of conducting electric signals. In a token bus, when any station transmits on the bus, every other station immediately detects the signal. But if two or more stations transmit at the same time, then their signals can interfere with each other and it is likely that no message is sent or received. Thus, the stations need some protocol of managing when they can send messages, with one of the most common being to organize the stations into a logical (not physical) ring and use a small message token to facilitate message passing. The following figure from Jose Rufino *et al.*, *A Study on the Inaccessibility Characteristics of ISO 8802/4 Token-Bus LANs*, IEEE INFOCOM '92: The Conference on Computer Communications (Ex. 1011, "Rufino") is an illustration of this topology, where stations are coupled to the physical bus at the bottom of the figure but are logically organized in a ring with a token message (shown in the figure as a dagger) being passed "around" this logical ring.



Rufino, Figure 1, at 6.

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Similarly, the following figure (4-25) from Tanenbaum shows another view of a token bus and its logical ring, including a station that is not currently in the logical ring.

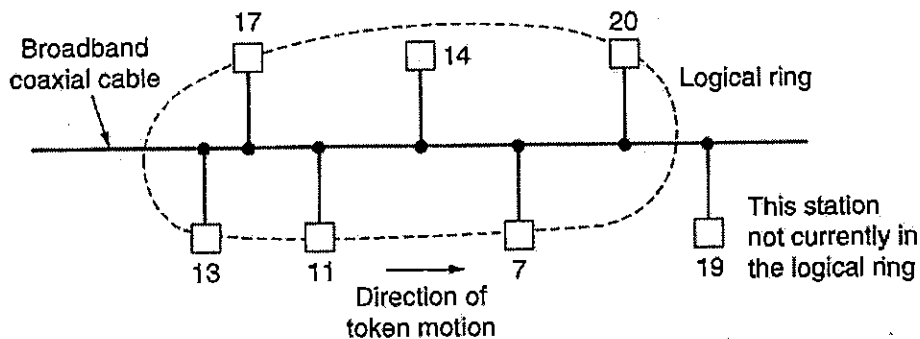


Fig. 4-25. A token bus.

Tanenbaum at 287.

36. As referenced in Rufino, this network topology was standardized in the ISO 8802/4 Token-Bus LAN standard. Rufino at 1. Stations are numbered in a way so that each station knows the identity of its successor station. When a station is holding the token, it is allowed to broadcast a message on the bus, if it has a message ready to send. After broadcasting such a message, or if the station has no message to send, then the station with the token broadcasts the token, identifying its successor as the recipient. Thus, the token “bounces” up and down between stations and the bus in way that logically follows the ordering of stations around the logical ring. In this way, unlike in the token ring topology, a message is sent from a source to a destination in a single step, even if the network has N stations.

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Still, a station wishing to send a message might have to wait as long as  $N-1$  steps before it has the token and has permission to use the bus to send its message.

37. There are some important differences between the token ring and token bus topologies. For example, they have different detailed standards for how messages are formulated, how tokens and message are passed, and how networks are setup. For instance, token ring topologies typically follow the IEEE 802.5 or FDDI standards (e.g., see Todd at 279), whereas token buses typically follow the ISO 8802/4 standard (e.g., see Rufino at 1). Given these differences, a POSITA would not find it obvious how to translate a protocol for a token ring into a protocol for a token bus, or vice versa, without detailed instructions on how to modify the detailed protocols and steps used to send messages and perform overhead operations for a token ring into corresponding functionality in a token bus, or vice versa.

38. For example, as I mention above, messages are sent on a broadcast medium in a token bus, whereas they are sent incrementally around the ring in a token ring, resulting in different message-sending performance and protocol details. In addition, as a POSITA would immediately recognize, a station in a token ring can identify its successor simply as the station on the receiving end of its transmitter, whereas a station in a token bus must keep track of the identity of its successor.



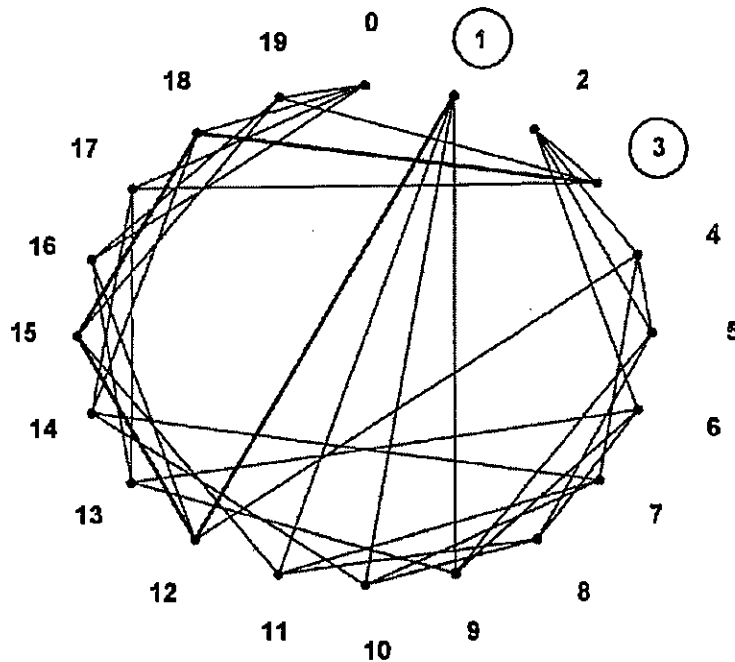
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39. Indeed, this latter issue is a major factor in the different ways in which stations in the respective two topologies can recover from unplanned station failures. In the case of a token bus, for example, as disclosed in Rufino, several steps are needed to recover from a station failure, including detecting a station failure, having some station respond on the bus for a new successor to be found. *See e.g.*, Rufino at 7-8. A station failure in a token ring, on the other hand, as disclosed in Todd, can be effectively handled with no message passing at all, simply by having a failsafe mechanism whereby a failed station is bypassed so as to link a receiver line for the station to a transmitter line for the station. Todd at 286; *see also* Tanenbaum at 292.

## V. SUMMARY OF THE '147 PATENT

40. The '147 Patent is one of several related patents directed to its novel computer network technology. More particularly, the '147 Patent describes methods for disconnecting a node (either in a planned or unplanned manner) from a broadcast channel that overlays a point-to-point network where each node, or participant, is connected to some—but not all—neighboring participants. For example, Fig. 2 of the '147 Patent, reproduced below, shows a network of twenty participants, where each participant is connected to four other participants:

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**Fig. 2**

*Id.* at Fig. 2.

41. Such a network arrangement, where each node in the network, is connected to the same number of other nodes, is known as an *m-regular network*.

*Id.* at 4:40-41. That is, a network is *m-regular* when each node is connected to *m* other nodes in a steady state, and a computer would become disconnected from the broadcast channel only if all *m* of the connections to its neighbouring nodes fail.

*Id.* at 4:41-44. In Fig. 2 above,  $m=4$  because each node is connected to four other nodes of the network. A network is said to be *m-connected* when it would take a failure of *m* computers to divide the graph into disjoint sub-graphs, i.e., separate

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broadcast channels. *Id.* at 4:44-47. The '147 Patent also describes a computer network in which the number of network participants,  $N$ , (in Fig. 2, this is twenty) is greater than the number of connections  $m$  to each participant (in Fig. 2, this is four). *Id.* at Fig. 2. This network topology, where no node is connected to every other node, is known as an *incomplete graph*.

42. The incomplete graph topology relies on participants to disseminate information to other participants. *See id.* at 1:60-2:15. As described in the '147 Patent, to broadcast a message, the originating computer sends the message to each of its neighbors using the overlay network. *Id.* at 7:30-35. Each computer that receives the message then sends the message to its neighbors using the network. *Id.* at 7:36-48. In this way, the message is propagated to each computer of the overlay network using the underlying network, thus broadcasting the message to each computer over a logical broadcast channel.

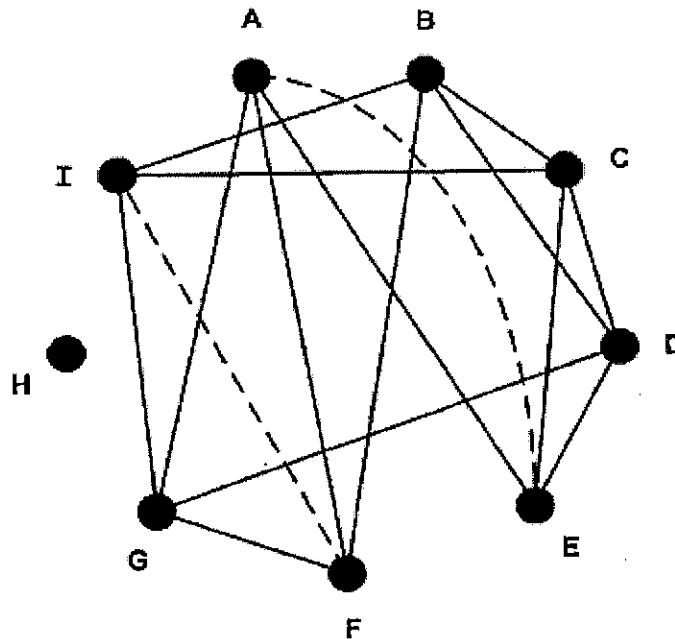
43. The invention claimed in the '147 Patent focuses on processes for removing nodes, or participants, from an existing network or healing disconnections when nodes fail or abruptly leave the network. A computer connected to the network can leave in either a planned or unplanned manner. *Id.* at 8:66-67. The challenged claims at issue relate to unplanned disconnections. For example when a computer leaves the network in an unplanned manner—such as in the event of a power failure—its neighbors discover the computer's absence when

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each unsuccessfully attempts to send a message to the disconnected computer. *Id.* at 9:27–31. When a computer detects that one of its neighbors is disconnected, it broadcasts a port connection request over the broadcast channel indicating that it has an open port that needs a connection and identifying the call-in number for the port. *Id.* at 9:33–38. When the port connection request is received at another computer connected to the broadcast channel that has an open port, the other computer contacts the requesting computer to establish a connection. *Id.* at 9:38–42.

44. Fig. 5B of the ‘147 Patent, reproduced below, illustrates the procedure for healing a disconnection of a computer in an unplanned manner. In particular, Fig. 5B shows an exemplary procedure for computer *H*’s neighboring computers to establish new connections when they discover that computer *H* has disconnected in an unplanned manner (*e.g.* without sending a list of its neighboring computers). *Id.* at 9:42–45. When each of computer *H*’s neighbors discovers that *H* has disconnected, it broadcasts a port connection request indicating that it needs to fill an empty port. *Id.* at 9:45–48. In the example shown in Fig. 5B, the dashed lines indicate that computers *F* and *I* respond to each other’s request and form a connection, and computers *A* and *E* respond to each other’s request and form a connection. *Id.* at 9:48–51.

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**Fig. 5B**

'147 Patent, Fig. 5B.

## VI. CLAIM CONSTRUCTION

45. I understand that during *inter partes* review, claims must be “given their broadest reasonable interpretation consistent with the specification.” The broadest reasonable interpretation does not mean the broadest possible interpretation. Rather, the meaning given to a claim term must be consistent with the use of the claim term in the specification and drawings. Thus, even under the broadest reasonable interpretation, the board’s construction cannot be divorced from the specification and the record evidence, and must be consistent with the one that those skilled in the art would reach.

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46. In my opinion the person of ordinary skill in the art would adopt the following claim constructions consistent with the broadest reasonable construction of these terms in view of the specification of the '147 Patent.

**A. "healing a disconnection of a first computer from a second computer"**

47. In my opinion the person of ordinary skill in the art would understand the term "healing a disconnection of a first computer from a second computer" is properly construed in the context of the '147 Patent as "connecting a first computer to another computer in order to maintain an m-regular network after the second computer has involuntarily been disconnected."

48. The '147 Patent discloses that a computer connected to a broadcast channel can leave in a planned manner or in an unplanned manner. '147 Patent at 2:59-63, 8:66-9:51; Figs. 5A, 5B. The term "healing a disconnection of a first computer from a second computer" refers to the situation where a computer leaves in an unplanned manner. This is diagrammed in Fig. 5B of the '147 Patent. '147 Patent at 9:27-51; Fig. 5B. The file history of the '147 Patent supports the definition, as well, because it states: "Claims [6-10] relate to the situation where a computer is involuntarily disconnected from the M-regular graph computer network. Claim [6] has been amended to indicate that the healing process of the computer network is performed in a way such as to maintain the M-regular graph nature of the computer network." Ex. 1002 (Vol. 3) at 690, '147 Patent File

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History. In my opinion, a POSITA would understand from the specification and the file history that the term, under the BRI standard, “healing a disconnection of a first computer from a second computer” to mean “connecting a first computer to another computer in order to maintain an m-regular network after the second computer has involuntarily been disconnected.”

49. I understand that neither Petitioner nor Dr. Karger provided a definition or construction of “healing a disconnection of a first computer from a second computer”.

**B. “broadcast channel”**

50. In my opinion the person of ordinary skill in the art would understand the term “broadcast channel” is properly construed as “logical channel that overlays an underlying point-to-point communications network.”

51. The specification of the ‘147 Patent supports the construction that the broadcast channel overlays the underlying network. See ‘147 Patent at 4:5-24 (discussing the broadcast channel as an overlay over the network layer), 4:32-36 (describing sending messages using the broadcast channel). Therefore, under the BRI standard, a POSITA would understand that the term “broadcast channel” is a logical channel that overlays an underlying point-to-point communications network.

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52. I understand that neither Petitioner nor Dr. Karger provided a definition or construction of “broadcast channel”.

**C. “connected/connection”**

53. In my opinion the person of ordinary skill in the art would understand the term “connected” is properly construed as “having a connection,” and the term “connection” to mean “an edge between two application programs connected to a logical broadcast channel that overlays an underlying network.” This is supported by the specification of the 147 Patent.

54. The specification of the ‘147 Patent explains that the term “connected” refers to the edges connecting participants. In particular, the specification states that “each of the edges represents an ‘edge’ connection between two computers of the broadcast channel.” ‘147 Patent 4:51–53; Fig. 1. Further the specification identifies that the broadcast channel is made of application programs connecting. ‘147 Patent at 15:15-47.

55. Therefore, under the BRI standard, a POSITA would understand that the term “connected” as “having a connection” and the term “connected” as “an edge between two application programs connected to a logical broadcast channel that overlays an underlying network.”

56. I understand that neither Petitioner nor Dr. Karger provided a definition or construction of “port ordering algorithm”.



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## VII. SUMMARY OF THE SHOUBRIDGE REFERENCE

57. I reviewed Peter J. Shoubridge et al., *Hybrid Routing in Dynamic Networks*, IEEE International Conference on Communications (Ex. 1005, “Shoubridge”). Shoubridge presents a hybrid routing protocol (via an adaptive routing algorithm) for sending packets at the network layer in the presence of dynamic link failures. Shoubridge at 1381. Shoubridge uses a simulation model because he was unable to test his system in real-life. Shoubridge at 1382.

Shoubridge defines its network model as follows:

“Consider the network model as a directed graph  $G$  with  $N$  nodes and  $L$  bidirectional links. Each node functions as a source of user traffic entering the network where traffic can be destined to all other nodes within the network. Routing algorithms are executed **within these same nodes** and update control messages are exchanged between neighbouring nodes for the purpose of maintaining routing tables.”

Shoubridge at 1382, emphasis added.

58. As part of his simulation model, Shoubridge views the nodes of the network graph as fixed, although the edges can fail and come back up dynamically. In particular, Shoubridge states the following:

“Since the routing procedures are triggered by link cost change events,  $G$  has essentially fixed topology with links always existing between nodes and their respective neighbours. Topology change is modelled by having link quality changing between one of two possible states; **a link is either up providing good error free**

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transmission, or a link has failed providing **no useful transmission at all**. This simplified approach requires no topology control as a particular node's neighbours at any given time always belong to the same subset of nodes **as originally defined in G.**”

Shoubridge at 1382, emphasis added

59. Shoubridge describes a hybrid routine strategy, which is described as a blending of a flooding broadcast protocol and a routing-table approach based on routing along shortest paths in the network. With respect to the flooding protocol, Shoubridge states the following:

“Any user packet transmitted from a node is copied and broadcast on all outgoing links. Intermediate transit nodes do not broadcast a packet on the same link that a packet was originally received on. Constrained flooding uniquely identifies packets associated with a particular flood search by using sequence numbering. Nodes store sequence numbers of packets already flooded. If any packets revisit a node with the same sequence number, they are discarded instead of being further broadcast to neighbours. This technique ensures that all nodes are visited at least once and duplicated traffic is kept to a minimum throughout the network.”

Shoubridge at 1382-3.

60. Shoubridge describes a specific network for doing such routing, which is a 64 node network with connectivity of degree 4. Shoubridge states, “[t]he

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network is a large regular graph forming a [M]anhattan grid network that has been wrapped around itself as a torus to avoid edge effects.” Shoubridge at 1383.

61. Besides this 8-by-8 configuration, a POSITA would also understand that there is a non-degenerate 4-by-16 configuration, as well. Such topologies are referred to as “Manhattan” networks, because each node is connected to neighbors in the directions North, South, East, and West, much like the streets of Manhattan. One could also imagine a 2-by-32 or 1-by-64 configuration, but a POSITA would understand these to be degenerate, since nodes in such configurations would not have 4 distinct neighbors. A POSITA would understand Shoubridge is referring to non-degenerate configurations here.

62. Neighbor connections in the 64-node degree-4 Manhattan network with torus wrap-around are chosen according to the North, South, East, and West directional connection rule. A POSITA would understand this to be accomplished, for example, by numbering each node with a unique pair of integers,  $(i,j)$ , such that  $i$  and  $j$  range from 0 to 7 and each node  $(i,j)$  is connected to the nodes  $(i-1,j)$ ,  $(i+1,j)$ ,  $(i,j+1)$ , and  $(i,j-1)$ , with all arithmetic done modulo 8, to make the connections according to the North, South, East, and West directions, respectively. Thus, Shoubridge discloses neighbors defined according to a precise mathematical formula or directional relationship, rather than a random selection process.

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63. Moreover, Shoubridge is silent on how to add or remove nodes from a Manhattan grid network because Shoubridge designs its simulation such that  $G$  has a fixed topology and that no nodes ever leave or are added. Shoubridge at 1382. Furthermore, a POSITA would understand that there is no simple way to add or remove a node from a 64-node degree-4 Manhattan (8-by-8) grid-with-torus-wrap-around network and have it still be a (non-degenerate) degree-4 Manhattan grid-with-torus-wrap-around network. For example, such a 63-node Manhattan graph would have to be configured as a 7-by-9 or 3-by-21 grid and such a 65-node Manhattan graph would have to be configured as a 5-by-13 grid, both of which would require substantial overhead in converting from an 8-by-8 grid. Moreover, a POSITA would understand that there is no non-degenerate  $n$ -node degree-4 Manhattan grid-with-torus-wrap-around network any time  $n$  is prime. In addition, a POSITA would understand that a 64-node degree-4 Manhattan network with torus wrap-around is 4-connected according to Dr. Karger's definition only if it is in a non-degenerate configuration, such as an 8-by-8 configuration or a 4-by-16 configuration. A 64-node degree-4 Manhattan network with torus wrap-around would not be 4-connected by Dr. Karger's definition, for example, if the network were in a 2-by-32 or 1-by-64 configuration. Therefore, the technical details and requirements of Manhattan grid-with-torus-wrap-around networks make them unsuitable for broadcast channel.

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64. Another property of the 64-node degree-4 Manhattan network with torus wrap-around disclosed in Shoubridge is that it is not an overlay network built on top of a point-to-point network, such as the Internet. Instead, Shoubridge discloses a network with explicit connections, such as links in a mobile radio network or wired network. For instance, Shoubridge states with respect to the 64-node degree-4 Manhattan network with torus wrap-around, “[l]ink capacity is fixed at 16kbps to represent a narrowband radio link or perhaps a logical signaling channel.” Shoubridge at 1383. Shoubridge never mentions overlay networks, and instead states, “[f]or efficient routing, nodes require knowledge of network topology.” Shoubridge at 1381. In my opinion, Shoubridge does not teach one skilled in the art how to design or build an m-regular application layer overlay. Shoubridge merely shows an adaptive routing algorithm at the network layer, which is completely different. It would require a POSITA to perform a substantial amount of work to create Shoubridge in a real world network, let alone going from there to an m-regular, incomplete graph application layer overlay.

#### VIII. SUMMARY OF THE DENES REFERENCE

65. I also reviewed Tamás Denes, *The “Evolution” of Regular Graphs of Even Order by their Vertices*, Matematikai Lapok, 27, 3–4 (Ex. 1016, Ex. 1017 “Denes”). Of particular relevance in Denes is the  $ET^{-1}$  transformation (Equation 3). Denes at 13.

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66. Dr. Karger, in his declaration, explains, using discussions, illustrations, and equations, the  $ET^{-1}$  transformation of Denes, stating, “Denes also discloses that a  $k$ -regular non-complete topology may be maintained when a node is removed from a network.” Ex. 1003 at 76-81. *In fact, Denes discloses almost the exact opposite of this.* Dr. Karger is correct in summarizing the actions on a  $k$ -regular graph of the  $ET^{-1}$  equation under the limited circumstances when it can be applied (Denes uses “ $k$ ” instead of “ $m$ ,” but a POSITA would not be confused by this). But he seems to be overlooking crucial details of Definition 3, which precedes this equation, as well as the statement of the equation itself (as well as theorems that follow it in Denes). I reproduce both Definition 3 and the statement of the  $ET^{-1}$  equation below:

Definition 3. Let  $\Gamma_{n,k} = (P, E) \in PR_k$ ,  $p \in P$ , and we take the vertex pairs  $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$  to be neighbors of  $p$  but pairwise not neighbors. Then we take the  $ET$  transformation to be:

$$(3) \quad ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E'), \quad P' = P \setminus \{p\} \\ E' = E \setminus \{(pp_1), (pp_2), \dots, (pp_k)\} \cup \{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$$

Ex. 1016/1017 at 13.

67. A POSITA would understand from these disclosures that the  $ET^{-1}$  equation applies only when both of the following conditions, among others, apply:

- The node  $p$  and all its incident edges must be members of the original graph,  $\Gamma_{n,k}$ . If  $p$  and its incident edges are not members of  $\Gamma_{n,k}$ , then

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the equation doesn't make sense, because  $p$  appears in the equation and Definition 3 requires  $p$  to be in the graph.

- There are  $k/2$  vertex pairs,  $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ , that are neighbors of  $p$  but pairwise not neighbors.

68. Indeed, these conditions are so important that they form the foundations of Denes' Theorem 2, preceded by Definitions 4 and 5, which I reproduce below:

Definition 4. Let  $\Gamma_{n,k} = (P, E)$  be a graph on  $n$  vertices,  $p \in P$ , and  $q_1, q_2, \dots, q_r$  be neighbors of  $p$  in  $\Gamma_n$ . Then we take the subgraph of  $\Gamma_n$  generated by  $p$  (designate this  $G_p = (P', E')$ ), and it turns out this is the subgraph where  $P' = \{q_1, q_2, \dots, q_r\}$  and  $(q_i, q_j) \in E' \Leftrightarrow (q_i, q_j) \in E$ .

Definition 5. Let  $\Gamma_n \in \mathbf{PR}$  and  $p \in \Gamma_n$ . Then the vertex  $p$  is T-characterized if the complement of the subgraph on  $\Gamma_n$  generated by it contains a 1-factor.

Theorem 2. The  $ET^{-1}$  transformation can be applied to a graph  $\Gamma_{n,k} = (P, K) \in \mathbf{PR}_k$  if and only if there exists a T-characterized vertex  $p \in \Gamma_{n,k}$ .

Ex. 1016/1017 at 13.

69. A POSITA would understand that Denes is explaining here that, although some readers might think that the  $ET^{-1}$  equation can always be applied to maintain a graph to be  $m$ -regular after the planned removal of a vertex,  $p$ , this equation actually applies only in limited circumstances, that is, when the graph currently contains the vertex,  $p$ , and when  $p$  is what Denes calls a "T-characterized" vertex, which is inclusive of the bulleted conditions I list above. But Denes does not stop there.

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70. Denes goes on to show, for example, in his Theorem 3, that there are an infinite number of graphs that contain no T-characterized vertex. In other words, the  $ET^{-1}$  equation cannot be used to remove any of the vertices in such graphs. I reproduce Theorem 3 from Denes below:

Theorem 3. For every even  $k \geq 4$  there is a graph  $\Gamma_{n,k} \in \mathbf{PR}_k$  which has no vertex  $p$  which is T-characterized.

Ex. 1016/1017 at 13.

71. Moreover, perhaps to show just how common such  $k$ -regular graphs can be, Denes illustrates such a graph (for  $k=4$ ), for which the  $ET^{-1}$  equation cannot be applied to any of its vertices, in his Figure 2, which I reproduce below:

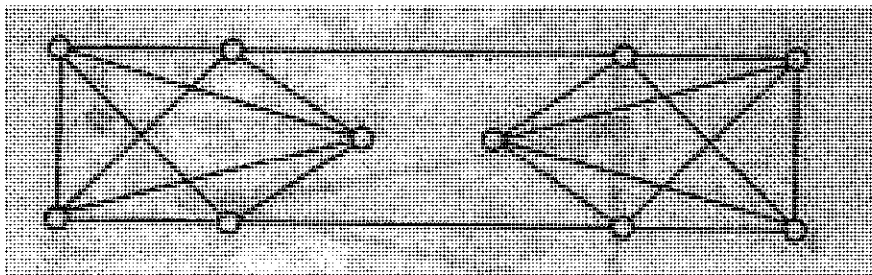


Figure 2

Ex. 1016/1017 at 14.

72. A POSITA would understand that the  $ET^{-1}$  equation cannot be applied to any vertex in this 4-regular graph, because none of the vertices in this graph are T-characterized. In a nutshell, the main problem is that every vertex in this graph has three neighbors that are joined in a triangle, which implies that no vertex has two pairs of neighbors that are themselves not already pairwise neighbors; hence,



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the  $ET^{-1}$  equation cannot be used to maintain this graph to be 4-regular after the removal of any of this graph's vertices. Furthermore, a POSITA would understand that having three of one's neighbors form a triangle is a common occurrence in real-world graphs, such as occurs in social networks when someone has three friends who are themselves mutual friends. Thus, a POSITA would understand from reading Denes that *the  $ET^{-1}$  equation does not alone teach a transformation that works in a manner as to maintain an m-regular graph.*

73. In addition, a POSITA would also understand that the  $ET^{-1}$  equation does not apply to an unplanned removal of a vertex, because such a vertex is not a current member of the graph in that circumstance. This might at first seem like a mere technicality, but a POSITA would understand that this is not the case. In an unplanned removal of a vertex,  $p$ , the neighbors of  $p$  might not know identities of  $p$ 's other neighbors and, until they try to communicate with  $p$ , they might not even know that  $p$  is no longer a member of the network. That is, the information related to  $p$  and its neighbors is no longer available for trying to repair an  $m$ -regular graph after the unplanned removal of  $p$ . Thus, a POSITA would understand that repairing an unplanned removal of a vertex from a network requires a completely different set of transformations than the  $ET^{-1}$  transformation. To sum up, if  $p$  is not currently a member of the network (as is required by the  $ET^{-1}$  equation), then the

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information represented by  $p$  is not available to repair the graph to be  $m$ -regular again.

74. Shoubridge, Rufino, and Todd do not remedy the above deficiencies of Denes, as none of these references disclose the messages and topological changes necessary to heal an unplanned removal of a vertex from an  $m$ -regular network in a manner as to maintain an  $m$ -regular graph. Indeed, my understanding is that Petitioner is pointing only to Denes for teaching this limitation, which, as I have explained, is, in fact, missing from Denes.

75. The '147 Patent, in contrast, explains how to repair an unplanned removal of a vertex (as well as a planned removal) from an  $m$ -regular graph in a manner as to maintain an  $m$ -regular graph. For example, the '147 Patent explains how to heal the situation that arises when two neighboring participants each have an empty internal port and each need to be connected to other participants, which is a situation the '147 Patent calls the "neighbors with empty ports" condition. '147 Patent at 9:52-11:29 and Figures 5C-5F. This technique requires the first computer to recognize the condition to send a "condition check message to the other neighbor[, which] includes a list of the neighbors of the sending computer" to a receiving computer. *Id.* at 9:66-10:4. The receiving computer then sends "a condition repair request to one of the neighbors of the sending computer which is not already a neighbor of the receiving computer[, which then] disconnects from

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one of its neighbors... and connects to the computer that sent the condition repair request.” *Id.* at 10:7–14. Finally, the two computers still in need of a connection connect to each other (if they are not already neighbors) or, if they are neighbors, “repeat the condition repair process until two non-neighbors are in need of connection.” *Id.* at 10:16–24. In my opinion, Petitioner’s citation to Denes only goes to show how that there was a long felt need for the invention of the ‘147 Patent, as the ‘147 Patent provides an elegant solution where Denes could not.

#### **IX. SUMMARY OF THE RUFINO REFERENCE**

76. I also reviewed Jose Rufino *et al.*, *A Study on the Inaccessibility Characteristics of ISO 8802/4 Token-Bus LANs*, IEEE INFOCOM ’92: The Conference on Computer Communications (Ex. 1011, “Rufino”).

77. Rufino discloses a number of methods for managing a token bus consistent with the ISO 8802/4 Token-Bus LAN standard, with particular attention paid to inaccessibility characteristics, such as would cause network partitions. Rufino at Abstract. In particular, Rufino states the following:

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A study of the behaviour of an ISO 8802/4 token-bus with regard to partitions is the central issue of this paper. Token-bus, given its connection with MAP is very relevant in control and automation<sup>3</sup>, where real-time, reliability and accessibility are a must.

This study contributes to a better understanding of the ISO 8802/4 Token-Bus LAN operation having these attributes in mind.

---

<sup>1</sup>LAN level information packet.

<sup>2</sup>User level information packet.

<sup>3</sup>Manufacturing Automation Protocol.

Rufino at 1, right column (emphasis added).

78. As mentioned elsewhere herein, a token bus topology involves stations that are all connected to a shared broadcast medium, such as a metal cable or bar, and are organized in a logical (not physical) ring, e.g., by having each station store the identity or address of its successor. This topology does not form an m-regular network for m being at least 3, of course.

79. Rufino discusses logical ring “house keeping” functions and actions for the sake of the preservation of the integrity of the token bus network, stating the following:

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Several types of protocol data frames are exchanged between peer MAC entities, in order to provide logical ring housekeeping functions, essential for normal ring membership management, and for the preservation of ring integrity in the presence of faults. These functions are supported through the following set of actions:

- Solicit new stations for logical ring entry.
- Find out the successor of a failed station (*who follows*).
- Solicit any station to respond at successor querying.
- Resolve contentions.
- Establish a new successor.
- Bid for token generation.
- Token passing.

Rufino at 3, left column.

80. Of particular relevance in the context of the '147 Patent, are actions disclosed in Rufino for dealing with station failures. For example, Rufino explains that the failure of one station can be detected by the lack of an expected token-passing message. In a variant of a *solicit\_successor* action, the predecessor of the failed station issues a *who\_follows* queries to recover from the station failure. This predecessor station knows it needs to perform this action, because it is the station that just successfully broadcast the token that then was then not resent, and this station knows the token was not resent because it was listening on the shared broadcast medium (i.e., the bus). The *who\_follows* query issued on the bus by this station requests that the station immediately following the failed station in the logical order respond with a *set\_successor* frame containing its identity. Once this

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station successfully responds with a *set\_successor* frame, then the logical successor of the issuer of the *who\_follows* query is set in the querying station, and the normal token-passing protocol can resume. Rufino at 5-7.

81. In my opinion, Rufino's methods apply particularly to token bus architectures in the ISO 8802/4 token-bus LAN standard and, not, for example, to token ring architectures, as is outlined elsewhere herein. For example, Rufino states, "Access control is performed by a token passing protocol, *which establishes a logical ring over the physical bus*. Access to the *shared broadcast medium* for data transmission is only granted to the station which currently holds the token." Rufino at 2, right column (emphasis added). In addition, actions such as *solicit\_successor*, *who\_follows*, and *set\_successor* depend critically on the fact that the stations are connected to a physical broadcast medium (i.e., a bus) and these methods would not work or would be unnecessary in a token-ring architecture. For example, if a station fails in token ring network, then it either partitions the network so that messages cannot be sent from one side to the other or it fails with a fallback bypass that connects a receiving line to a transmitting line for that station, which requires no message passing at all.

## X. SUMMARY OF THE TODD REFERENCE

82. I also reviewed T. Todd, *The Token Grid Network*, IEEE/ACM Transactions on Networking, 2.3, 279–287 (Ex. 1019, "Todd").

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83. Todd describes a token grid network topology, which is a generalization of the token-ring topology to a multiple-dimensional grid. Todd summarizes its contributions as follows:

In this paper, a network referred to as the token grid is introduced. The token grid is a multidimensional extension of the token ring [2], [4] where stations share access to a mesh formed by a set of overlapping rings. Media access is performed by having a station capture one out of a number of tokens circulating within the network. Couplings between the rings are implemented by the user stations in a very simple fashion and under token control. As in a token ring, the network supports the transmission of variable length packets. In the results presented, a dual token ring is used as a basis for performance comparisons with the token grid. This is because unlike other proposed networks, the station transmission hardware requirements for the token grid are identical to that of a dual ring network such as FDDI [4], [3]. Each station in both networks has exactly two transmitters and two receivers. Also, both networks may be implemented with a very small station latency where only a few bits per station need be buffered.

Todd at 279, right column (emphasis added).

84. In addition to Todd explicitly stating that it is extending the token ring topology, and not, for example, a token bus topology, it would be clear to POSITA that Todd is extending a token ring topology, and not a token bus, to a multi-dimensional grid. For example, as Todd states above, each station has exactly two transmitters and two receivers and Todd does not disclose, for example, that stations have connections to one or more buses. *See also* Todd at 282, right

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column. In addition, a POSITA would understand that the citations [2], [3], and [4] are to standards, IEEE 802.5 and FDDI, for token rings:

- [2] ANSI/IEEE Standard 802.5, "Token ring access method and physical layer specifications," 1985.
- [3] F.E. Ross, "An Overview of FDDI: The Fiber Distributed Data Interface," *IEEE J. Select. Areas Commun.*, vol. 7, pp. 1043-1051, Sept. 1989.
- [4] American National Standard, "FDDI token ring media access control (MAC)," ANSI X3.139, 1987.

Todd at 287.

85. The token grid of Todd organizes stations in a grid, where the stations in each row and each column are connected to form a token ring. Todd at 279, right column. Todd illustrates an example implementation of this topology in its Figure 1, which I reproduce below:

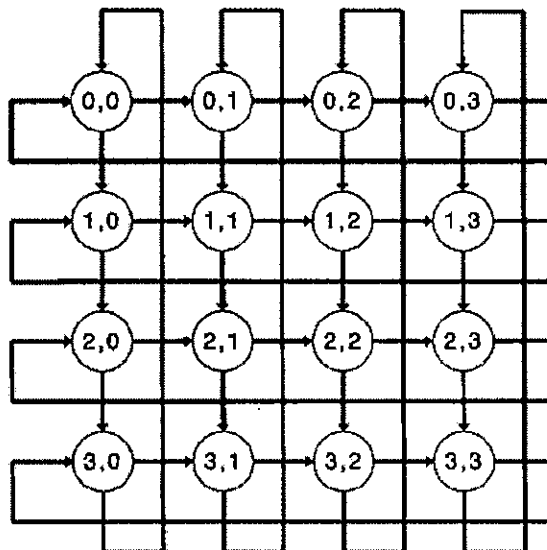


Fig. 1. The token grid (4 × 4-example).



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Todd at 280.

86. As further evidence that Todd is a generalization of the token ring topology, sending and receiving messages in the token grid of Todd is based on stations waiting to receive row or column tokens, or combination row/column tokens, and then transmitting them rather than broadcasting them. For example, Todd gives a summary of the steps for sending and receiving messages as shown below:

PROTOCOL 1:  
BASIC TOKEN GRID PROTOCOL

---

Column Token  $j$  Arrives To Station  $(i, j)$  :

---

1. Capture the token.
  2. If a packet is available, transmit onto Column Ring  $j$ .
  3. Hold Column Token  $j$ . Wait for Row Token  $i$ .
  4. Done.
- 

Row Token  $i$  Arrives To Station  $(i, j)$  :

---

1. Capture the token if a packet is available for Row Ring  $i$  or if Column Token  $j$  is being held.
  2. Transmit onto Row Ring  $i$  if a packet is available.
  3. If the station is not holding Column Token  $j$  then release Row Token  $i$  and go to 5.
  4. Enter the SR state. Generate and release Row/Column Token  $i, j$ .
  5. Done.
- 

Row/Column Token  $i, j$  Arrives To Station  $(i, k)$  :

---

1. Capture the token if a packet is available for Row/Column Ring  $i, j$  or if  $k = j$ .
  2. If a packet is available then transmit onto Row/Column Ring  $i, j$ .
  3. If  $k \neq j$  then release the token and go to 5.
  4. Generate and release Column/Row Token  $i, j$ .
  5. Done.
- 

Column/Row Token  $i, j$  Arrives To Station  $(k, j)$  :

---

1. Capture the token if a packet is available for Column/Row Ring  $i, j$  or if  $k = i$ .
  2. If a packet is available then transmit onto Column/Row Ring  $i, j$ .
  3. If  $k \neq i$  then release the token and go to 5.
  4. Enter the DR state. Regenerate and release Column Token  $j$  and Row Token  $i$ .
  5. Done.
-

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Todd at 281, right column.

87. Of particular relevance to the '147 Patent, Todd discusses the maintenance and reliability of its token grid topology in the presence of station power failures and link failures. Todd at 286. For example, with respect to initialization and maintenance of tokens, Todd states, "Since each station is connected to two independent rings, procedures similar to those in IEEE 802.5 [2] and FDDI [4] may be adopted." Todd at 286. With respect to station failures, Todd states, "As in FDDI [4], it is assumed that in the physical implementation, optical bypass switches are used to maintain ring integrity following a station power failure. When a power failure occurs, the station may be either bypassed in the SR or DR configuration." Todd at 287, right column. A POSITA would understand that Todd does not disclose any message passing as occurring to implement these DR and SR bypass operations, which Todd respectively illustrates in its Figures 2a and 2b, which I reproduce below (where a POSITA would understand that in-coming arrows illustrate receivers and outgoing arrows illustrate transmitters):

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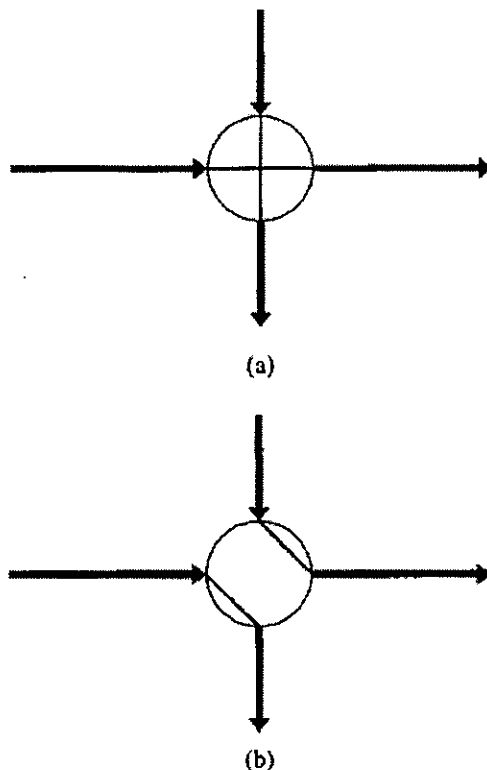


Fig. 2. Station configurations.

Todd at 280.

## XI. ANALYSIS OF CLAIMS AT ISSUE

88. I have reviewed the Board's decision to institute trial regarding whether Shoubridge in view of Denes, Rufino, and/or Todd renders obvious certain claims of the '147 Patent. In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious Claims 6-10 of the '147 Patent.

89. Indeed, Shoubridge, Denes, Rufino, and Todd are not relevant to the subject matter of the '147 Patent. A POSITA would not find it obvious to modify

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Shoubridge's networking layer system to teach the application layer system of the '147 Patent, nor combine with it Denes, Rufino, and Todd to address the invention. The Board failed to consider a number of important technical distinctions between Shoubridge, Denes, Rufino, and Todd and the '147 Patent, including:

- Shoubridge does not teach a broadcast channel
- Denes does not relate to when a node abruptly leaves a node
- The combination of Rufino and Todd would simply not work because they are discussing two different topics that lends themselves to modification

90. I understand that Dr. Karger failed to consider secondary considerations despite having knowledge of the Sony license. I understand from counsel that secondary considerations are additional factors to be considered in determining obviousness. The factors include commercial success, licensing of the patent, long felt need, copying by others, and other factors. I have reviewed Dr. Harry Bims' report on secondary considerations. In my opinion, the secondary considerations are relevant here, especially because that '147 Patent was licensed to Sony for use in Sony's multi-user gaming platform known as Playstation. The fact that Sony specifically sought to license the patent from Boeing shows that Sony thought the patent was nonobvious and relevant.

91. For each claim limitation, the following analyzes the corresponding portions of Shoubridge in view of Denes, Rufino, and/or Todd cited by Petitioner

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to show how a person having skill in the art would understand what the reference actually discloses or teaches.

**A. Claim 6a: “A method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising”**

92. Claim 6a requires a “method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising.” In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

93. For “method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising,” Petitioner cites:

Shoubridge discloses a dynamic computer network including a first computer and a second computer being connected to a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3. See, e.g., Ex. 1005 at 1381 Abstract (“the distribution of traffic loads and network topologies may vary from nearly static to very dynamic. This dynamic behaviour may vary both in space and in time.”); 1381 ¶ 3 (“For efficient routing, nodes require knowledge of network topology. Links may fail or become congested, nodes or users could be mobile, resulting in changes to source-destination

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paths.”); 1383 ¶ 2 (“A 64 node network with connectivity of degree 4 is modeled as  $G$ . The network is a large regular graph forming a Manhattan grid network that has been wrapped around itself as a torus to avoid edge effects.”).

Denes discloses a method of disconnecting a node from another node, the node and the other node being connected in a graph topology, said graph topology forming an  $m$ -regular graph where  $m$  is at least 3. See, e.g., Ex. 1017 at 366 ¶ 4 (“Definition 3. Let  $\Gamma_{n,k} = (P, E) \in PR_k$ ,  $p \in P$ , and we take the vertex pairs  $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$  to be neighbors of  $p$  but pairwise not neighbors. Then we take the ET transformation to be: (3) ET-1:  $\Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$ ,  $P' = P \setminus \{p\}$  and “ $E' = E \setminus \{(pp_1), (pp_2), \dots, (pp_k)\} \cup \{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$ ”); 367 Fig. 2.

Todd discloses a token grid network, which “is a two dimensional network structure arranged in  $R$  rows and  $C$  columns. An example for  $R = C = 4$  is shown in Fig. 1.” Ex. 1019 at 1 col. 2 ¶ 4, Fig. 1; Karger ¶ 232. Todd discloses that the reason it devised a token grid topology is because, in 2-regular systems, “the maximum throughput is severely restricted by the data rate of the shared channel.” Ex. 1019 at 1 col. 1 ¶ 2; Karger ¶ 233. And “[i]n principle, this problem may be addressed using a network topology which permits multiple concurrent packet transmissions.” Ex. 1019 at 1 col. 1 ¶ 2; Karger ¶ 233. In other words, Todd proposes adding additional connections in order to allow for better data transmission. Karger ¶ 233.

As discussed in Ground 1, a POSITA would have been motivated to apply the messaging techniques disclosed in Rufino to Shoubridge.

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Karger ¶ 234. While a POSITA's would have known how to do so by July 2000, Todd (published in 1994) shows that the modification to Rufino can be done "in a very simple fashion" by overlapping token rings. Ex. 1019 at 1 col. 2 ¶ 2; Karger ¶ 234.

Therefore, Ground 4 simply proposes an alternative ground for independent claims 1, 6, and 11 (which require  $m$  to be at least 3). Karger ¶ 235.

Petition at 29, 59-60.

94. Notably Petitioner does not rely on Rufino for this claim element. There is no apparent relation between the portions of Shoubridge, Denes, or Todd cited and method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, where the broadcast channel is an  $m$ -regular graph where  $m$  is at least 3. As I discussed above, the proper constructions of "healing a disconnection of a first computer from a second computer," "connected" and "broadcast channel," as understood by a POSITA and as supported by the claims, specification and extrinsic evidence of the '147 Patent, are respectively "connecting a first computer to another computer in order to maintain an  $m$ -regular network after the second computer has involuntarily been disconnected," "an edge between two application programs connected to a logical broadcast channel that overlays an underlying network," "logical channel that overlays an underlying point-to-point communications

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network.” A POSITA would understand that a “broadcast channel” under the ‘147 Patent operates at the application layer.

95. In particular, Shoubridge does not teach or render obvious a “method for healing a disconnection of a first computer from a second computer” because Shoubridge does address a situation where a node leaves a network abruptly and the network heals itself. Shoubridge does not teach a network where computers leave and enter an m-regular network. Indeed, as discussed above, Shoubridge teaches a simulation where nodes do not leave because Shoubridge relies on a fixed topology where the link value costs are changed. Shoubridge at 1382 (“*G* has essentially fixed topology with links always existing between nodes and their respective neighbors.”). The choice of never having a new node enter or an old node leave in Shoubridge was, of course, by design to make the simulation simpler. Shoubridge at 1382 (“This simplified approach requires no topology control as a particular node’s at any given time always belong to the **same subset of nodes** as originally defined in *G*.”) (emphasis added).

96. Nor does Shoubridge discuss a situation where it has to heal the network. At best, Dr. Karger cites to generalized statements about links failing or being congested. Ex. 1003 at ¶¶128-131,162. However, that situation is not equivalent to the claims, because Shoubridge never has to repair edges or heal the network, the links are simply either there or not. Shoubridge at 1382 (“Topology



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change is modelled by having link quality changing between one of two possible states; a link is either up providing good error free transmission, or a link has failed providing no useful transmission at all.”). There cannot be any repairs as described in the ‘147 Patent in the Shoubridge simulation model, because Shoubridge simulation model does not modify links or connections. See generally, ‘147 Patent at 9:52-10:65; Shoubridge at 1382-1383. This makes sense because the entire purpose of Shoubridge is to discuss adaptive hybrid routing algorithm that is only concerned with routing within the network as it is, not trying to fix connections. Shoubridge at 1381 (discussing routing algorithms). As a result, Shoubridge does not discuss or disclose a situation where nodes leave abruptly, nor how the network heals itself, because the situation does not even arise in Shoubridge.

97. To the extent that Petitioner changes its position, and argues that it would have obvious to a POSITA when applying Shoubridge in the real-world, I disagree. As explained above, Shoubridge has many obstacles to being applied in a real-world manner. Moreover, a real-world Shoubridge would not seek to heal links as, explained above, since its only concern was with routing to every node available not to repair broken links. As such, Shoubridge fails to render obvious this claim element.

98. Moreover, Shoubridge does not teach or disclose a broadcast channel, because it does not discuss an overlay network. Shoubridge is silent with regard to

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overlay networks, and instead teaches only an underlying network which routes packets at the network layer. Indeed, Dr. Karger admits that Shoubridge does not teach an overlay network. Ex. 2010, 11/29/16 Karger Tr. 20:17-23 (admitting that the broadcast channel of the '147 Patent is an overlay); *id.* at 48:17-23 (admitting that Shoubridge does not teach an overlay network); *see also* Ex. 2011, 7/6/16 Karger Tr. at 102:22-103:4, Ex. 2012, 7/7/16 Karger Tr. at 81:7-19. Accordingly, it is my opinion that Shoubridge does not render obvious the claim element because it does disclose or render obvious a broadcast channel.

99. It would not have been obvious to apply Shoubridge over the Internet because Shoubridge rewrites and modifies standard routing protocols and is designed to replace the Internet Protocol. Indeed, applying Shoubridge to the Internet is impracticable as flooding does not work in large networks. Ex. 2013, Vu at 624-626, Figs. 3, 4 and 5 (note that the Vu reference is cited by Shoubridge).

100. Specifically, one would not be motivated to create an overlay network with Shoubridge because flooding would have created significant latency and would have prevented a useful dissemination of information through the use of flooding because of the congestion at the higher layer protocols. Ex. 1005 ("Shoubridge") at 1381 ("flooding is very wasteful of network resources"), at 1384 ("Unfortunately, flooding results in low network utilization and therefore better routing strategies need to be sought."); Ex. 2013, Vu at 624 ("The abundance of

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packets not only puts serious strains on the link capacity, induces higher levels of network congestion, but also dictates a high packet processing capacity at each relay node.”); *see also* Ex. 2007 (“Tanenbaum”) at 351 (describing limited uses of flood search algorithms). Putting Shoubridge’s routing algorithm on the Internet ignores the fact that it’s not a simple design choice, because it requires an understanding of the operation of every layer of the OSI model and the use of standards. A POSITA would not look to Shoubridge and think to make an overlay layer the application level because Shoubridge was specifically about routing algorithms at the network layer. To modify Shoubridge in such a manner is to undermine the point of Shoubridge and is not practical for the reasons stated above.

101. Petitioner also relies on Denes for the element “healing a disconnection of a first computer from a second computer.” Petition at 29-30. In particular, Petitioner cites the formula “ $ET^{-1}: \Gamma_n^k \rightarrow \Gamma_n^{-1} = (P', E')$ ,  $P' = P \setminus \{p\}$ ” and “ $E' = E \setminus \{ (pp1), (pp2), \dots, (ppk) \cup \{ (p1p2), (p3p4), \dots, (pk-1pk) \}$ ”.” Denes at 366. The “ $ET^{-1}$ ” denotes that the graph is removing a node. Petitioner either failed to recognize or failed to disclose that the formula above only applies in the situation where the leaving node leaves in a planned manner, because, as Denes articulates in prose and in mathematics, the leaving the node, “p,” has to be a member of the graph, “ $T_{n,k}$ ,” prior to removal. See Denes at 366 (“The  $ET^{-1}$

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transformation can be applied to a graph  $\Gamma_{n,k} = (P,K) \in PR_k$  **if and only if** there exists a T-characterized vertex  $p \in \Gamma_{n,k}$ .”) (emphasis added); see also ‘147 Patent at Fig. 5A (graph of orderly removal of node where H is a member of the graph); 5B (graph of unplanned removal of node where H is not a member of the graph).

102. That is, the  $ET^{-1}$  transformation requires explicit knowledge of the leaving vertex,  $p$ . For without  $p$ , the  $ET^{-1}$  equation makes no sense. Thus, the equation for the  $ET^{-1}$  transformation cannot apply to the case, as required in claims 6-10, of a healing of a disconnection of a first computer from a second computer. For to perform a healing of a disconnection of a first computer from a second computer, a POSITA would understand that the second computer is no longer connected to the first computer after limitation 6c of claim 6, because if the second computer were still connected to the first computer, the first computer would not need a connection, as is required in limitation 6c. Moreover, given the temporal language of claim 6, a POSITA would understand that the limitations of claim 6 occur in temporal order, first 6b (attempting to send a message from the first computer to the second computer), then 6c (when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection), and then 6d (having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph).

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Therefore, limitation 6d requires a network transformation that does not involve the second computer; hence, the equation for the  $ET^{-1}$  transformation does not apply to limitation 6d. Accordingly, Denes fails to disclose “healing a disconnection of a first computer from a second computer” or any of the other elements of the claim, and Petitioner has not provided sufficient support as why POSITA would modify Denes to disclose the claimed element.

103. Petitioner also relies on Todd, but only for the limitation of “where m is at least 3.” However, Petitioner fails to connect this citation with Shoubridge and Denes and provide a rational motivation to combine. Petitioner explicitly does not refer to or cite to Rufino in element 6a. See Petition at 29-30. Petitioner’s arguments regarding Todd only relate to Rufino, but the noticeable absence of Rufino undermines Petitioner’s position.

104. While Rufino is not relied on by Petitioner for this element (and contradictory to Petitioner above cited reliance on Shoubridge), Petitioner does rely on Rufino for “broadcast channel” in the rest of the claim elements without explaining what in Rufino is the broadcast channel. See Petition at 32 (“[T]he station broadcasts a connection port search message on the broadcast channel....”); *id.* at 33 (“[T]he station sends a who follows query (connection port search message) on the broadcast channel....”); *id.* at 36 (“Rufino discloses broadcasting messages on the broadcast channel to maintain a regular graph....”). To the extent

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that Petitioner is arguing the physical or the logical token ring layers are broadcast channels, I disagree for the reasons set forth below.

105. I disagree with both theories. First, Rufino's physical bus is not a logical channel, nor does it overlay any communications network, let alone an underlying point-to-point communications network because it simply provides physical communications links between computers as shown in the figure below.

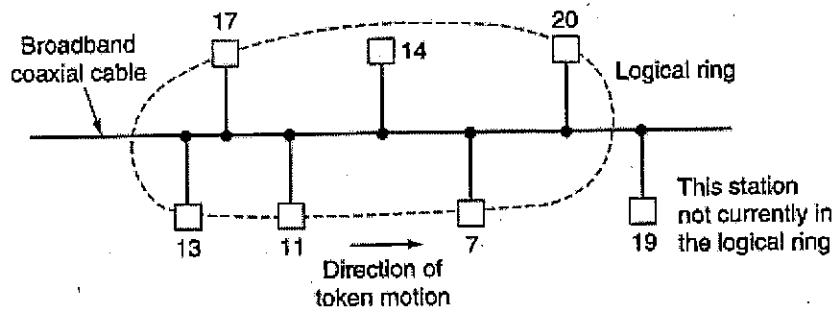


Fig. 4-25. A token bus.

Tanenbaum at 287. As described in my discussion of the token bus network, a special data frame, called a token, “propagates around the logical ring, with only the token holder being permitted to transmit frames. Since only one station at a time holds the token, collisions do not occur” Tanenbaum at 288.

106. Second, the logical token ring is not a broadcast channel because it does not support the broadcasting of messages, but rather only sends “token frames specifically address to its logical neighbour in the ring.” Tanenbaum at 288. The design of the token bus network (IEEE 802.4 Standard) is to have all other frames

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used in token bus network sent either directly to another station or sent to a group of stations on the physical bus. Note that ISO 8802/4 discussed in Rufino is the same as IEEE 802.4 Standard. Tanenbaum at 275. The “who follows” query cited by Petitioner, is actually sent on the physical bus. Tanenbaum at 287-288, 290; *see also* Ex. 2010, 11/29/16 Karger Tr. 68:6-9 (“Q. Is the “who follows” query sent on the physical bus? A. Yes. There is a “who follows” query that is transmitted on the physical bus.”).

107. Additionally, the logical token ring does not overlay a point-to-point communications network as required. Instead, the logical token ring overlays a physical medium. *See* Tanenbaum at 287; Rufino at 9 (“Access control is performed by a token passing protocol, which establishes a logical ring over the physical bus.”). Moreover, as discussed elsewhere herein, Rufino logical ring over a physical bus is at best 2-regular and is not extensible to be  $m$ -regular where  $m$  is at least 3.

108. As explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

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**B. Claim 6b: “attempting to send a message from the first computer to the second computer; and”**

109. Claim 6b requires “attempting to send a message from the first computer to the second computer.” In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

110. For this claim limitation, Petitioner cites:

Shoubridge discloses a dynamic network forming a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3. See, e.g., Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.

Denes discloses a method of disconnecting a first node from the second node. See, e.g., Ex. 1017 at 366 ¶ 4; 367 Fig. 2.

Rufino discloses attempting to send a message from the first computer to the second computer. See, e.g., Ex. 1011 at 0958 ¶ 4 (“Uncontrolled omissions and partitions are a source of asynchrony and inconsistency. This is unacceptable for most systems, let alone real-time ones.”); 0959 col. 1 - ¶ 7 – col. 2 ¶ 1 (“Access control is performed by a token passing protocol, which establishes a logical ring over the physical bus.”); 962 col. 2 ¶¶ 4-5 (“Station withdrawal is achieved through a ring patch between its predecessor and successor stations. For that purpose, the leaving station before passing the token issues a set successor frame, addressed to its predecessor, and carrying the address of its future successor.”); 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“If this station is failed, the token passing operation will not succeed. After the token pass checking period (one slot time) has elapsed a recovery strategy is tried. This includes the repetition of token



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transmission (checked during one more slot time) followed by a variant of the solicit successor procedure. During this who follows query the current token holder waits for a set successor frame, until the end of a three-slot-time period. Under a single station failure assumption, the current token holder will receive, within this period, a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedures.”).

Petition at 30-31.

111. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element attempting to send a message from the first computer to the second computer. As discussed above, Shoubridge in view of Denes, Rufino, and Todd fails to disclose or render obvious Claim 6(a), thus the combination fails to disclose or render obvious Claim 6(b).

112. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

**C. Claim 6c: “when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection”**

113. Claim 6c requires “when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search

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message indicating that the first computer needs a connection.” In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

114. For this claim limitation, Petitioner cites:

Shoubridge discloses a dynamic network forming a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3. See, e.g., Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.

Denes discloses a method of disconnecting a first node from the second node. See, e.g., Ex. 1017 at 366 ¶ 4; 367 Fig 2.

Rufino discloses when the attempt to send a message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection. See, e.g., Ex. 1011 at 0962 col. 2 ¶¶ 4-5 (“Station withdrawal is achieved through a ring patch between its predecessor and successor stations. For that purpose, the leaving station before passing the token issues a set successor frame, addressed to its predecessor, and carrying the address of its future successor.”); 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“If this station is failed, the token passing operation will not succeed. After the token pass checking period (one slot time) has elapsed a recovery strategy is tried. This includes the repetition of token transmission (checked during one more slot time) followed by a variant of the solicit successor procedure. During this who follows query the current token holder waits for a set successor frame, until the end of a three-slot-time period. Under a single station failure assumption, the current token holder will receive, within this period, a

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response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedures.”).

Petition at 33-34.

115. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection. As discussed above, Shoubridge in view of Denes, Rufino, and Todd fails to disclose or render obvious Claim 6(a), thus the combination fails to disclose or render obvious Claim 6(c).

116. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

**D. Claim 6d: “having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph”**

117. Claim 6d requires “having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph.” In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

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118. For this claim limitation, Petitioner cites:

Shoubridge discloses a dynamic network forming a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3. See, e.g., Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.

Denes discloses having a third node not already connected to the first node respond in a manner as to maintain an m-regular graph. See, e.g., Ex. 1017 at 3677 ¶ 4 (“Definition 3. Let  $\Gamma_{n,k} = (P, E) \in PR_k$ ,  $p \in P$ , and we take the vertEx. pairs  $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$  to be neighbors of  $p$  but pairwise not neighbors. Then we take the ET transformation to be: (3) ET-1:  $\Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$ ,  $P' = P \setminus \{p\}$ ” and “ $E' = E \setminus \{(pp_1), (pp_2), \dots, (pp_k) \cup \{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$ ”); 367 Fig. 2.

Rufino discloses having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph. See, e.g., Ex. 1011 at 0960 col. 1 ¶ 3-4 (“Several types of protocol data frames are exchanged between peer MAC entities, in order to provide logical ring housekeeping functions, essential for normal ring membership management, and for the preservation of ring integrity in the presence of faults.”); 0962 col. 2 ¶ 5 (“Station withdrawal is achieved through a ring patch between its predecessor and successor stations. For that purpose, the leaving station before passing the token issues a set successor frame, addressed to its predecessor, and carrying the address of its future successor.”); 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“If this station is failed, the token passing operation will not succeed. After the token pass checking period (one slot time) has elapsed a

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recovery strategy is tried. This includes the repetition of token transmission (checked during one more slot time) followed by a variant of the solicit successor procedure. During this who follows query the current token holder waits for a set successor frame, until the end of a three-slot-time period. Under a single station failure assumption, the current token holder will receive, within this period, a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedures.”).

Petition at 34-35.

119. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element having a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph. As discussed above, Shoubridge in view of Denes, Rufino, and Todd fails to disclose or render obvious Claim 6(a), thus the combination fails to disclose or render obvious Claim 6(d). Moreover, Petitioner only relies on Denes and Rufino for disclosing this claim element. *See* Petition at 34–35; Ex. 1003 at ¶172. However, neither references discloses the claimed element.

120. Petitioner states: “Denes discloses having a third node not already connected to the first node respond in a manner as to maintain an m-regular graph.” Petition at 35. However, this argument is false as Denes does not disclose

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any messaging that would permit a node to “respond” to messages. Indeed, Dr. Karger testified that Denes does not send messages between nodes of graphs. *See* Ex. 2010, 11/29/16 Karger Tr. 55:13-16 (“Q. Does Denes disclose sending messages between nodes of graphs? A. I don't recall him doing so. I doubt it.”). Moreover, as discussed previously, the equation relied on by Petitioner only applies to the situation where the node is part of the graph at the time the transformation is applied as opposed to the abrupt leaving scenario recited in claims 6–10. Furthermore, as explained elsewhere herein, the  $ET^{-1}$  equation of Denes alone is not effective to maintain an  $m$ -regular graph subject to node removals. As such, this element is not disclosed or rendered obvious by Denes.

121. Petitioner also argues that Rufino discloses the claimed element. However, as discussed above, Rufino cannot meet this claim element because of the design of the physical and logical topologies of Rufino's token bus LAN. As discussed above, and admitted by Dr. Karger, the “who follows” query is sent on the physical bus. As shown in the diagram below, the station that responds to the “who follows” query is already connected to the physical bus.

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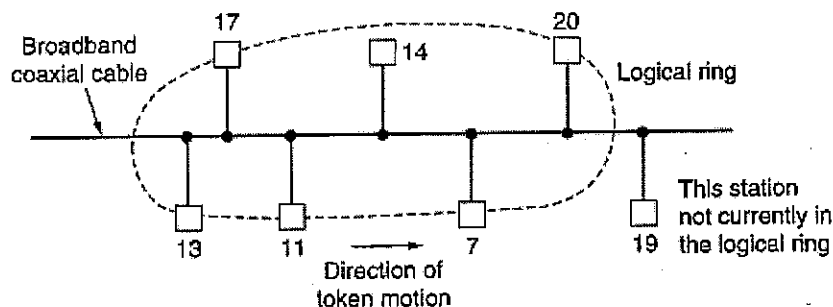


Fig. 4-25. A token bus.

Tanenbaum at 287.

122. Accordingly, there is no way that this claim element be met by Rufino because that alleged third station is already connected to the alleged first computer.

Tanenbaum explains that fact:

An important point to realize is that the physical order in which the stations connected to the cable is not important. Since the cable is inherently a broadcast medium, *each station receives the frame*, discarding those not addressed to it. When a station passes the token, it sends a token frame specifically addressed to its logical neighbor in the ring, irrespective of where that station is physically located on the cable.

Tanenbaum at 288 (emphasis added).

123. This is by design and regulated by an IEEE Standard (802.4)/ ISO 8802/4. A POSITA would not seek to modify the IEEE Standard (802.4)/ ISO 8802/4 to make a complete redesign of the protocol standard as suggested by Petitioner.

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124. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

**E. Claim 7: “The method of claim 6 including: when a third computer receives the connection port search message and the third computer also needs a connection, sending a message from the third computer to the first computer proposing that the first computer and third computer connect.”**

125. Claim 7 requires “when a third computer receives the connection port search message and the third computer also needs a connection, sending a message from the third computer to the first computer proposing that the first computer and third computer connect.” In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

126. For this claim limitation, Petitioner cites:

Rufino discloses when a third computer receives the connection port search message and the third computer also needs a connection, sending a message from the third computer to the first computer proposing that the first computer and third computer connect. See, e.g., Ex. 1011 at 0962 col. 2 ¶ 5 (“Station withdrawal is achieved through a ring patch between its predecessor and successor stations. For that purpose, the leaving station before passing the token issues a set successor frame, addressed to its predecessor, and carrying the address of its future successor.”); 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“If



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this station is failed, the token passing operation will not succeed. After the token pass checking period (one slot time) has elapsed a recovery strategy is tried. This includes the repetition of token transmission (checked during one more slot time) followed by a variant of the solicit successor procedure. During this who follows query the current token holder waits for a set successor frame, until the end of a three-slot-time period. Under a single station failure assumption, the current token holder will receive, within this period, a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedures.”).

Petition at 37-38.

127. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element when a third computer receives the connection port search message and the third computer also needs a connection, sending a message from the third computer to the first computer proposing that the first computer and third computer connect. As discussed above, Shoubridge in view of Denes, Rufino, and Todd fails to disclose or render obvious Claim 6, thus the combination fails to disclose or render obvious Claim 7.

128. Petitioner relies solely on Rufino for this claim element. Petition at 37-38; Ex. 1003 at ¶179. Petitioner also identified that the set\_successor frame is sent on a broadcast channel by the third computer to the first computer. However, set\_successor is sent on the physical bus. See Tanenbaum at 287-288, 290. As

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discussed above, the physical bus of the token bus network is not a broadcast channel. Accordingly, Petitioner's arguments fail to disclose this claim element. Petitioner also fails provide evidence that POSITA would have been motivated to modify the IEEE standard (802.4)/ ISO 8802/4 to change how "set\_successor" would have operated.

129. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

**F. Claim 8: "The method of claim 7 including: when the first computer receives the message proposing that the first computer and third computer connect, sending from the first computer to the third computer a message indicating that the first computer accepts the proposal to connect the first computer to the third computer"**

130. Claim 8 requires "when the first computer receives the message proposing that the first computer and third computer connect, sending from the first computer to the third computer a message indicating that the first computer accepts the proposal to connect the first computer to the third computer." In my opinion, Shoubridge in view of Denes, Rufino, and/or Todd does not render obvious this claim limitation.

131. For this claim limitation, Petitioner cites:

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Rufino discloses when the first computer receives the message proposing that the first computer and third computer connect, sending from the first computer to the third computer a message indicating that the first computer accepts the proposal to connect the first computer to the third computer. See, e.g., Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“If this station is failed, the token passing operation will not succeed. After the token pass checking period (one slot time) has elapsed a recovery strategy is tried. This includes the repetition of token transmission (checked during one more slot time) followed by a variant of the solicit successor procedure. During this who follows query the current token holder waits for a set successor frame, until the end of a three-slot-time period. Under a single station failure assumption, the current token holder will receive, within this period, a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedures.”).

Petition at 39.

132. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element when the first computer receives the message proposing that the first computer and third computer connect, sending from the first computer to the third computer a message indicating that the first computer accepts the proposal to connect the first computer to the third computer. Petitioner only relies on Rufino to disclose this element. See Petition at 39; Karger Decl. at ¶¶183-186. As discussed above, Shoubridge in view of Denes,

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Rufino, and Todd fails to disclose or render obvious Claim 6 or 7, thus the combination fails to disclose or render obvious Claim 8.

133. Moreover, Petitioner's citation to Rufino fails to disclose the claim element. In fact, Rufino clearly states that there is no communications from the alleged first computer to the alleged third computer accepting the proposed connection. See Rufino at 962 col. 2 ¶ 9-961 col. 1 ¶ 1 ("the current token holder [i.e., alleged first computer] will receive ... a response from the successor of the failed station [i.e., alleged third computer]. This establishes a new successor for the current token holder and **ends the recovery procedure.**") (emphasis added). In other words, there is no message from the alleged first computer to the alleged third computer accepting the proposed connection because no message exists. As explained above, the IEEE standard (802.4)/ ISO 8802/4 sets the standard for this protocol and has designed it as such that there is no message sent because the next station is already connected on the physical bus. Petitioner and Dr. Karger fail to provide any explanation or point to the alleged message they are referring to because the message is non-existent. See Petition at 39; Karger Decl. at ¶¶ 183-186. Accordingly, Petitioner has failed to explain how this element is rendered obvious in view of Shoubridge in view of Denes, Rufino, and Todd.

134. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion,

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user packet transmitted from a node is copied and broadcast on all outgoing links. Intermediate transit nodes do not broadcast a packet on the same link that a packet was originally received on.”).

Petition at 41.

141. There is no apparent relation between the cited portions of Shoubridge, Denes, Rufino, or Todd and the claim element wherein each computer connected to the broadcast channel is connected to at least three other computers. Petitioner relies solely on Shoubridge for this claim. Notably, the identified broadcast channel is different from the one Petitioner relies on for claim elements 6(b)-(d). In addition, as discussed above in Claim 6(a), Shoubridge does not disclose a broadcast channel as required by this claim. Similarly, because Shoubridge in view of Denes, Rufino, and Todd fails to disclose or render obvious Claim 6, the combination also fails to disclose or render obvious Claim 10.

142. In addition, as explained further below, there is no motivation to combine Shoubridge, Denes, Rufino, and Todd. As such, in my opinion, Shoubridge in view of Denes, Rufino, and Todd fail to render obvious this claim element.

## **XII. THERE IS NO MOTIVATION TO COMBINE SHOUBRIDGE AND DENES AND RUFINO AND TODD**

143. In my opinion POSITA would not be motivated to combine Shoubridge, Denes, Rufino, and Todd. Petitioner argues that POSITA would be

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motivated to combine Shoubridge with Denes, Rufino, and Todd because they “address the problem of dynamic networks” and “the problem of maintaining a non-complete regular topology.” Petition at 17-19, 58; Karger Decl. at ¶¶ 119-127. I disagree, because Shoubridge, Denes and Rufino, and Todd are disparate systems that one of skill in the art would not have been motivated to combine.

144. I disagree with Petitioners and Dr. Karger’s assessment. As an initial matter, Shoubridge discloses a hybrid routing algorithm using a simulation model, not a real dynamic network. Shoubridge at 1381. Shoubridge’s “dynamic network” simulates changes that “are evenly distributed across all links.” Shoubridge at 1383. A POSITA would understand this assumption is not realistic in the real world, where links are different geographically and in terms of their implementations. In my opinion, a POSITA would not have not have been motivated to combine Shoubridge with Denes and Rufino because neither Denes or Rufino provide any basis to improve the hybrid routing algorithm, which is the essence of Shoubridge, or to his simulation. Moreover, in Shoubridge uses a fixed topology in which nodes never enter or leave the alleged network. Shoubridge at 1382 (“Since the routing procedures are triggered by link cost change events, *G* **has essentially fixed topology with links always existing between nodes and their respective neighbours.** ... This simplified approach requires no topology control as a particular node's neighbours at any given time always belong to the

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same subset of nodes as **originally defined in G.**”(emphasis added). Given Shoubridge’s fixed node topology, a POSITA would have had no reason to modify Shoubridge with Denes, which describes techniques for adding nodes and edges to and removing nodes and edges from a graph. That is, because *nodes* never fail in Shoubridge’s network—only links between nodes fail—the solution for fixing a “link that has no useful transmission at all”—and maintaining an m-regular network—is simply to restore the link or ignore it. *See* Shoubridge at 1382.

145. Petitioners argue that Denes discloses a mathematical principal to remove a node from a network. Petition at 18. This is irrelevant, however, because it does not address the issue of an unplanned or abrupt leaving of the network by a node. Indeed, as discussed above, Denes’  $ET^{-1}$  transformation equation has only limited use and contains many restrictions. Shoubridge discloses his method of simulating a network node change by adjusting the link costs. Shoubridge at 1383 (“To reflect some stochastic behaviour in the simulation model, link cost change events are scheduled with event times derived from two negative exponential probability distributions.”). The argument that one could apply Denes to Shoubridge is further weakened because Shoubridge does not introduce new edges in his simulations, while Denes requires the removal of known existing edges and adding new non-previously existing edges. Indeed, Dr. Karger agreed that “[Shoubridge] is only going to have those edges fail or come

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back, and he's not going to introduce other edges in this simulation...." Ex. 2010, 11/29/16 Karger Tr. 51:20-23; *See* Denes at 366 (describing the disconnection of edges connected to  $p$  and adding edges between pairs of nodes that were previously connected to  $p$ ). Further, a POSITA would not have sought to add the teachings of Denes in Shoubridge because the simulation of a dynamic network was sufficient for its intended purpose, to test a specific hybrid routing algorithm, and would complicate Shoubridge's simulation. Moreover, Shoubridge's simulation of a dynamic network was based on simulating the links, not adding or removal of nodes.

146. Similarly, a POSITA would not have sought to add Rufino into the mix because there were no actual nodes to remove nor does Rufino relate to the overall simulation or the hybrid routing algorithm. Rather Rufino relates to a token bus network, where messages are *only* sent on a physical bus and the logical ring established in Rufino is at best a 2-regular network. Petitioner recognizes that "Rufino relates to token ring which is a 2-regular topology." Petition at 59; *see also id.* at 16 ("Rufino discloses messaging techniques for maintaining a 2-regular non-complete network when a node is disconnected from the network."). In other words, Rufino is directed towards 2-regular systems not "a broadcast channel, said broadcast channel forming an  $m$ -regular graph where  $m$  is at least 3" as required by Claim 6. Notably, and as discussed above, Petitioner's arguments center around



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Rufino's discussion of "who\_follows" and "set\_successor" frames. *See* Petition at 32–37 (citing Rufino at 963 ("During this *who follows* query the current token holder waits for a *set\_successor* frame, until the end of a three-slot-time period.")). The "who\_follows" query involves a station recognizing that its successor station has left the logical token ring and broadcasting a message to all other stations connected to the physical bus that identifies the departed station. *See* Tanenbaum at 292. When the departed station's "sees a WHO\_FOLLOWS frame naming its predecessor, it responds by sending a SET\_SUCCESSOR frame to the station whose successor failed, naming itself as the new successor." *Id.* These operations work in the context of an  $m=2$  logical token ring precisely because each station knows its predecessor and successor stations, and there is only a single station defined as the successor of the failed station. This messaging procedure is not generalizable to  $m$ -regular networks in which  $m$  is at least 3 at least because once  $m$  exceeds 2 there are no longer "predecessor" and "successor" stations who can reply to a WHO\_FOLLOWS query.

147. As discussed above, and admitted by Dr. Karger, these frames are sent on a physical bus as opposed to a token ring. Petitioner does not provide an explanation of how Rufino's physical bus messaging system could be implemented to perform Denes'  $ET^{-1}$  transformation in an  $m$ -regular network in which  $m \geq 3$ . *See* Petition 33, 37-38. That is because Denes' transformation equation does not

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work on a physical bus system, as each node is physically connected to each other (typically by copper wire). Moreover, Rufino, teaches away from the specialized point-to-point graphs solutions proposed by Shoubridge and Denes by stating because these solutions are “costly and complex.” *See* Rufino at 958 (criticizing specialized graph solutions such as “costly and complex.”) Thus, these three systems operate in fundamentally different ways that would completely redesign Rufino’s system to be contrary to its stated goals.

148. In addition, a POSITA would not have sought to add Todd in the mix of Shoubridge, Denes, and Rufino because Todd cannot use Rufino’s messaging system in Todd’s token grid network. Petitioner adds Todd in an attempt to cure the previously noted deficiencies of Rufino, namely how to extend Rufino “from a 2-regular topology to a 4-regular topology.” Petition at 58. But Todd is deficient. In particular, Todd is discussing token ring network as defined by IEEE 802.5 or FDDI while Rufino is discussing a token bus, as standardized in ISO 8802/4. Moreover, Todd’s 4-regular topology relies on modifying the physical connections of each station using an optical bypass switch to modify the pathways (i.e., switching from the DR state to the SR state, which requires no message passing at all) as opposed to the messaging system in Rufino and ISO 8802/4. *See* Todd at 8, Figs. 2, 3, and 4.

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149. In a token ring network, the “ring is not really a broadcast medium, but a collection of individual point-to-point links that happen to form a circle.” Tanenbaum at 298. The topology of a token ring network, in which subsequent stations’ ring interfaces are connected by individual point-to-point connection is illustrated below:

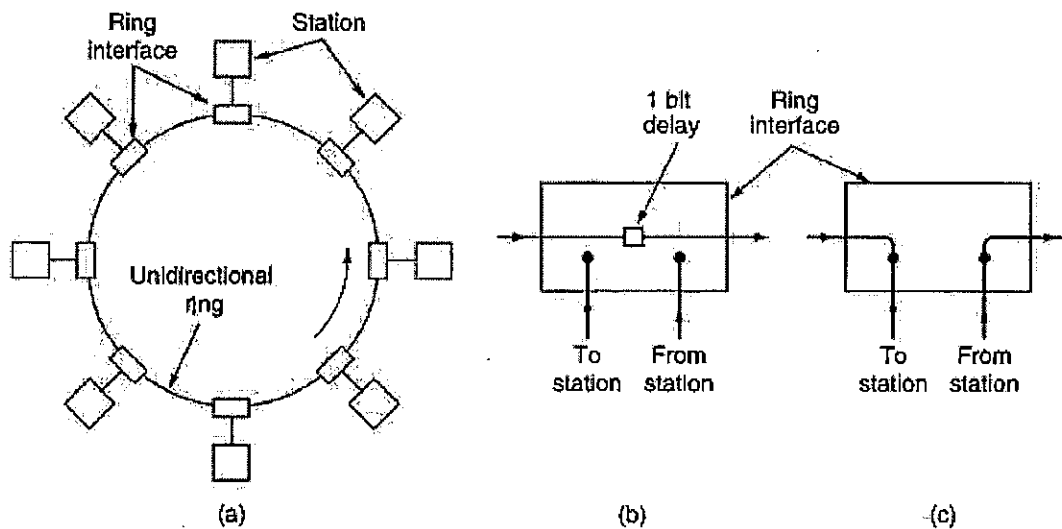


Fig. 4-28. (a) A ring network. (b) Listen mode. (c) Transmit mode.

Tanenbaum at 293.

150. Unlike Rufino’s token bus network, token ring networks do not establish a logical ring over an underlying broadcast bus. *See* Tanenbaum at 287, 292. Rather, in a token ring network the “ring” refers to the physical connections between the stations themselves. Tanenbaum at 292. Todd’s “token grid network” only differs from the traditional token ring network defined in IEEE 802.5 or FDDI in that it is multidimensional. Todd at 1, col. 2 (“The token grid is a

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multidimensional extension of the token ring [2], [4] where stations share access to a mesh formed by a set of overlapping rings.” (referencing [2] “ANSI/IEEE Standard 802.5, “Token ring access method and physical layer specifications, 1985”). Thus, given the incompatibility of the topologies of Rufino’s token bus network and Todd’s token ring network, Petitioner is simply incorrect to say that “Todd... shows that the modification to Rufino can be done ‘in a very simple fashion’ by overlapping token rings.” Petition at 60. Indeed, Petitioner fails even to address the differences between token bus networks and token ring networks—misleadingly characterizing the Rufino reference as “relat[ing] to a token ring” when it is much more complex than what Petitioner seems to think. Petition at 59.

151. The incompatibility of Rufino’s token bus network and Todd’s modified token ring-to-grid network may be best understood with reference to Petitioner’s argument that Todd teaches how “to expand [Rufino’s] messaging techniques from a 2-regular topology to a 4-regular topology.” Petition at 59. Specifically, the way that Rufino and Todd handle the issue of failed nodes is completely different, with Todd’s technique not relying on messaging whatsoever. Rufino discloses using the `who_follows` and `set_successor` control frames in order to define the failed node’s successor as its predecessor’s new successor. In stark contrast, in the Todd token grid network, “optical bypass switches are used to maintain ring integrity following a station power failure.” Todd at 8, col. 2. That

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is, Todd uses the optical bypass physical switches to simply bypass a failed station (in the DR or SR configuration) rather than using messages. In fact, Dr. Karger conceded that token bus network and token grid networks use different procedures for recovering from a failed station:

Q. Is the procedure for recovering from a failed station different in token-bus networks and token ring networks?

A. Well, there are a number of different recovery procedures that one could imagine. Rufino describes a particular recovery mechanism for the token-bus network. Todd describes another recovery mechanism which involves sort of shortcutting a failed station in order to recover from that failure.

Ex. 2010, Karger Tr., 75:9–18.

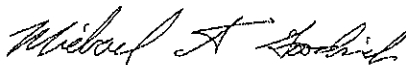
152. Accordingly, in my opinion POSITA would not be motivated to combine Shoubridge, Denes, Rufino, and Todd for the reasons stated above.

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**DECLARATION**

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed in Irvine, California on this 12th day of December, 2016.

A handwritten signature in cursive script, appearing to read "Michael A. Goodrich".

Michael Goodrich, Ph.D.

# APPENDIX A

## CURRICULUM VITAE

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### EDUCATION

Ph.D.	1987	<i>Efficient Parallel Techniques for Computational Geometry</i> Computer Sciences, Purdue Univ. (M.J. Atallah, advisor)
M.S.	1985	Computer Sciences, Purdue Univ.
B.A.	1983	Mathematics and Computer Science, Calvin College

### PROFESSIONAL EXPERIENCE

April '07 to present	Chancellor's Professor, Dept. of Computer Science Univ. of California, Irvine
July '12 to June '13	Chair, Dept. of Computer Science Univ. of California, Irvine
October '06 to June '12	Assoc. Dean for Faculty Dev., Bren School of Info. and Comp. Sci. Univ. of California, Irvine
July '01 to March '07	Professor, Dept. of Computer Science Univ. of California, Irvine
Fall '00	Visiting Professor of Computer Science Brown Univ.
July '96 to June '02	Professor of Computer Science (on leave, from July '01) Johns Hopkins Univ.
July '92 to June '96	Associate Professor of Computer Science Johns Hopkins Univ.
Spring '94	Visiting Associate Professor of Computer Science Univ. of Illinois, Urbana-Champaign
July '87 to June '92	Assistant Professor of Computer Science Johns Hopkins Univ.

### RESEARCH INTERESTS

Algorithm and Data Structure Design  
Information Assurance and Security  
Parallel and Distributed Computing  
Graph and Geometric Algorithms

### HONORS AND AWARDS

- *Compere Loveless Fellowship in Computer Sciences*, Purdue Univ., 1985
- *Research Initiation Award*, National Science Foundation, 1988
- *Oraculum Award for Excellence in Teaching*, Johns Hopkins, 1993, 1994, 1995
- *ACM Recognition of Service Award*, 1996
- *Robert B. Pond, Sr. Award for Excellence in Undergraduate Teaching*, Johns Hopkins, 1998
- *Elected Senior Member*, the Institute of Electrical and Electronics Engineers (IEEE), 1999
- *Spirit of Technology Transition Award*, DARPA Dynamic Coalitions Program, 2002



- *Brown Univ. Award for Technological Innovation* (with R. Tamassia, N. Triandopoulos, D. Yao, and D. Ellis), 2006
- *ACM Distinguished Scientist*, 2006
- *2006 IEEE Computer Society Technical Achievement Award*, “for outstanding contributions to the design of parallel and distributed algorithms for fundamental combinatorial and geometric problems”
- *Fulbright Scholar*, 2007, for senior specialist service to University of Aarhus, Denmark
- *Fellow of the San Diego Supercomputer Center*, 2007
- *Fellow of the American Association for the Advancement of Science (AAAS)*, “for distinguished contributions to parallel and distributed algorithms for combinatorial and geometric problems, and excellence in teaching, academic and professional service, and textbook writing,” 2007
- *Fellow of the Institute of Electrical and Electronics Engineers (IEEE)*, “for contributions to parallel and distributed algorithms for combinatorial and geometric problems,” 2009
- *Fellow of the ACM*, “for contributions to data structures and algorithms for combinatorial and geometric problems,” 2009
- *ICS Dean’s Award for Research*, “for his contributions in the area of parallel and distributed algorithms,” 2014
- *Chancellor’s Award for Excellence in Fostering Undergraduate Research*, Univ. of California, Irvine, 2016
- *Faculty Mentor of the Month*, Undergraduate Research Opportunities Program (UROP), Univ. of California, Irvine, April 2016

## PUBLICATIONS

### Patents and Patent Applications:

- P-1. G. Ateniese, B. de Medeiros, and M.T. Goodrich, “Intermediated Delivery Scheme for Asymmetric Fair Exchange of Electronic Items,” U.S. Patent Application US 2004/0073790 A1, April 15, 2004.
- P-2. M.T. Goodrich and R. Tamassia, “Efficient Authenticated Dictionaries with Skip Lists and Commutative Hashing,” U.S. Patent 7,257,711, August 14, 2007.
- P-3. J.W. Green, J.L. Schultz, Y. Amir, and M.T. Goodrich, “High Refresh-Rate Retrieval of Freshly Published Content using Distributed Crawling,” U.S. Patent 7,299,219, November 20, 2007.
- P-4. R. Tamstorf, M.T. Goodrich, D. Eppstein, “Attribute Transfer Between Computer Models Including Identifying Isomorphic Regions in Polygonal Meshes,” U.S. Patent 8,681,145, March 25, 2014. (also Application US 2010/0238166 A1, September 23, 2010).
- P-5. N. Triandopoulos, M.T. Goodrich, D. Nguyen, O. Ohrimenko, C. Papamanthou, R. Tamassia, C.V. Lopes, “Techniques for Verifying Search Results Over a Distributed Collection,” U.S. Patent, 9,152,716, October 6, 2015.

### Books and Monographs:

- B-1. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java*, John Wiley and Sons, Inc., 1998.
- B-2. M.T. Goodrich and C.C. McGeoch, eds., *Algorithm Engineering and Experimentation*, Lecture Notes in Computer Science (LNCS), Vol. 1619, Springer-Verlag, 1999.

- B-3. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Second Edition*, John Wiley and Sons, Inc., 2001.
- B-4. M.T. Goodrich and R. Tamassia, *Algorithm Design: Foundations, Analysis, and Internet Examples*, John Wiley and Sons, Inc., 2002.
- B-5. M.T. Goodrich and S.G. Kobourov, eds., *10th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science, Vol. 2528, Springer-Verlag, 2002.
- B-6. M.T. Goodrich, R. Tamassia, and D. Mount, *Data Structures and Algorithms in C++*, John Wiley and Sons, Inc., 2004.
- B-7. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Third Edition*, John Wiley and Sons, Inc., 2004.
- B-8. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Fourth Edition*, John Wiley and Sons, Inc., 2006.
- B-9. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Fifth Edition*, John Wiley and Sons, Inc., 2011.
- B-10. M.T. Goodrich and R. Tamassia, *Introduction to Computer Security*, Addison-Wesley, Inc., 2011.
- B-11. M.T. Goodrich, R. Tamassia, and D. Mount, *Data Structures and Algorithms in C++, Second Edition*, John Wiley and Sons, Inc., 2011.
- B-12. M.T. Goodrich, R. Tamassia, and M. Goldwasser, *Data Structures and Algorithms in Python*, John Wiley and Sons, Inc., 2013.
- B-13. M.T. Goodrich, R. Tamassia, and M. Goldwasser, *Data Structures and Algorithms in Java, Sixth Edition*, John Wiley and Sons, Inc., 2014.
- B-14. M.T. Goodrich and R. Tamassia, *Algorithm Design and Applications*, Wiley, 2015.

**Book Chapters:**

- Ch-1. M.J. Atallah and M.T. Goodrich, "Deterministic Parallel Computational Geometry," in *Synthesis of Parallel Algorithms*, J.H. Reif, ed., Morgan Kaufmann, 497–536, 1993.
- Ch-2. M.T. Goodrich, "The Grand Challenges of Geometric Computing," in *Developing a Computer Science Agenda for High-Performance Computing*, U. Vishkin, ed., ACM Press, 64–68, 1994.
- Ch-3. M.T. Goodrich, "Parallel Algorithms in Geometry," *CRC Handbook of Discrete and Computational Geometry*, J.E. Goodman and J. O'Rourke, eds., CRC Press, Inc., 669–682, 1997.
- Ch-4. M.T. Goodrich and K. Ramaiyer, "Geometric Data Structures," *Handbook of Computational Geometry*, J.-R. Sack and J. Urrutia, eds., Elsevier Science Publishing, 463–489, 2000.
- Ch-5. M.T. Goodrich and R. Tamassia, "Simplified Analyses of Randomized Algorithms for Searching, Sorting, and Selection," *Handbook of Randomized Computing*, S. Rajasekaran, P.M. Pardalos, J.H. Reif, and J.D.P. Rolim, eds., Kluwer Academic Publishers, Vol. 1, 23–34, 2001.
- Ch-6. M.T. Goodrich, "Parallel Algorithms in Geometry," *Handbook of Discrete and Computational Geometry, Second Edition*, J.E. Goodman and J. O'Rourke, eds., Chapman & Hall/CRC Press, Inc., 953–967, 2004. (Revised version of Ch-3.)
- Ch-7. C. Duncan and M.T. Goodrich, "Approximate Geometric Query Structures," *Handbook of Data Structures and Applications*, Chapman & Hall/CRC Press, Inc., 26-1–26-17, 2005.

- Ch-8. M.T. Goodrich, R. Tamassia, and L. Vismara, "Data Structures in JDSL," *Handbook of Data Structures and Applications*, Chapman & Hall/CRC Press, Inc., 43-1-43-22, 2005.
- Ch-9. Y. Cho, L. Bao and M.T. Goodrich, "Secure Location-Based Access Control in WLAN Systems," *From Problem Toward Solution: Wireless and Sensor Networks Security*, Zhen Jiang and Yi Pan, eds., Nova Science Publishers, Inc., Chapter 17, 2007.
- Ch-10. M.T. Goodrich and M.J. Nelson, "Distributed Peer-to-Peer Data Structures," *Handbook of Parallel Computing: Models, Algorithms and Applications*, R. Rajasekaran and J. Reif, eds., CRC Press, 17-1-17-17, 2008.
- Ch-11. C.A. Duncan and M.T. Goodrich, "Planar Orthogonal and Polyline Drawing Algorithms," *Handbook of Graph Drawing and Visualization*, CRC Press, Inc., 223-246, 2013.

**Journal Papers:**

- J-1. M.J. Atallah and M.T. Goodrich, "Efficient Parallel Solutions to Some Geometric Problems," *Journal of Parallel and Distributed Computing*, 3(4), 1986, 492-507.
- J-2. M.T. Goodrich, "Finding the Convex Hull of a Sorted Point Set in Parallel," *Information Processing Letters*, 26, 1987, 173-179.
- J-3. H. ElGindy and M.T. Goodrich, "Parallel Algorithms for Shortest Path Problems in Polygons," *The Visual Computer*, 3(6), 1988, 371-378.
- J-4. M.J. Atallah and M.T. Goodrich, "Parallel Algorithms For Some Functions of Two Convex Polygons," *Algorithmica*, 3, 1988, 535-548.
- J-5. M.J. Atallah, R. Cole, and M.T. Goodrich, "Cascading Divide-and-Conquer: A Technique for Designing Parallel Algorithms," *SIAM Journal on Computing*, 18(3), 1989, 499-532.
- J-6. M.T. Goodrich, "Triangulating a Polygon in Parallel," *Journal of Algorithms*, 10, 1989, 327-351.
- J-7. M.T. Goodrich and M.J. Atallah, "On Performing Robust Order Statistics in Tree-Structured Dictionary Machines," *Journal of Parallel and Distributed Computing*, 9(1), 1990, 69-76.
- J-8. M.T. Goodrich and J.S. Snoeyink, "Stabbing Parallel Segments with a Convex Polygon," *Computer Vision, Graphics and Image Processing*, 49, 1990, 152-170.
- J-9. J. Johnstone and M.T. Goodrich, "A Localized Method for Intersecting Plane Algebraic Curve Segments," *The Visual Computer*, 7(2-3), 1991, 60-71.
- J-10. M.T. Goodrich, "Intersecting Line Segments in Parallel with an Output-Sensitive Number of Processors," *SIAM Journal on Computing*, 20(4), 1991, 737-755.
- J-11. R. Cole and M.T. Goodrich, "Optimal Parallel Algorithms for Point-Set and Polygon Problems," *Algorithmica*, 7, 1992, 3-23.
- J-12. M.T. Goodrich, "A Polygonal Approach to Hidden-Line and Hidden-Surface Elimination," *Computer Vision, Graphics, and Image Processing: Graphical Models and Image Processing*, 54(1), 1992, 1-12.
- J-13. M.T. Goodrich, S. Shauck, and S. Guha, "Parallel Methods for Visibility and Shortest Path Problems in Simple Polygons," *Algorithmica*, 8, 1992, 461-486, with addendum in *Algorithmica*, 9, 1993, 515-516.
- J-14. M.T. Goodrich, C. Ó'Dúnlaing, and C. Yap "Constructing the Voronoi Diagram of a Set of Line Segments in Parallel," *Algorithmica*, 9, 1993, 128-141.
- J-15. M.T. Goodrich, "Constructing the Convex Hull of a Partially Sorted Set of Points," *Computational Geometry: Theory and Applications*, 2, 1993, 267-278.

- J-16. M.T. Goodrich, "Constructing Arrangements Optimally in Parallel," *Discrete and Computational Geometry*, 9, 1993, 371-385.
- J-17. M.T. Goodrich, M.J. Atallah, and M. Overmars, "Output-Sensitive Methods for Rectilinear Hidden Surface Removal," *Information and Computation*, 107(1), 1993, 1-24.
- J-18. M.J. Atallah, P. Callahan, and M.T. Goodrich, "P-Complete Geometric Problems," *Int. Journal of Computational Geometry & Applications*, 3(4), 1993, 443-462.
- J-19. M.J. Atallah, M.T. Goodrich, and S.R. Kosaraju, "Parallel Algorithms for Evaluating Sequences of Set-Manipulation Operations," *Journal of the ACM*, 41(6), 1994, 1049-1088.
- J-20. M.T. Goodrich, "Efficient Piecewise-Linear Function Approximation Using the Uniform Metric," *Discrete and Computational Geometry*, 14, 1995, 445-462.
- J-21. H. Brönnimann and M.T. Goodrich, "Almost Optimal Set Covers in Finite VC-Dimension," *Discrete and Computational Geometry*, 14, 1995, 463-479.
- J-22. M.T. Goodrich, "Planar Separators and Parallel Polygon Triangulation," *J. Computer and System Sciences*, 51(3), 1995, 374-389.
- J-23. M.T. Goodrich, M. Ghouse, and J. Bright, "Sweep Methods for Parallel Computational Geometry," *Algorithmica*, 15(2), 1996, 126-153.
- J-24. M.T. Goodrich and S.R. Kosaraju, "Sorting on a Parallel Pointer Machine with Applications to Set Expression Evaluation," *Journal of the ACM*, 43(2), 1996, 331-361.
- J-25. A. Garg, M.T. Goodrich, and R. Tamassia, "Planar Upward Tree Drawings with Optimal Area," *International Journal of Computational Geometry & Applications*, 6(3), 1996, 333-356.
- J-26. M.H. Nodine, M.T. Goodrich, and J.S. Vitter, "Blocking for External Graph Searching," *Algorithmica*, 16(2), 1996, 181-214.
- J-27. R. Cole, M.T. Goodrich, C. Ó Dúnlaing, "A Nearly Optimal Deterministic Parallel Voronoi Diagram Algorithm," *Algorithmica*, 16, 1996, 569-617.
- J-28. G. Das and M.T. Goodrich, "On the Complexity of Optimization Problems for 3-Dimensional Convex Polyhedra and Decision Trees," *Computational Geometry: Theory and Applications*, 8, 1997, 123-137.
- J-29. M.T. Goodrich and R. Tamassia, "Dynamic Ray Shooting and Shortest Paths in Planar Subdivisions via Balanced Geodesic Triangulations," *J. Algorithms*, 23, 1997, 51-73.
- J-30. M. Ghouse and M.T. Goodrich, "Fast Randomized Parallel Methods for Planar Convex Hull Construction," *Computational Geometry: Theory and Applications*, 7, 1997, 219-235.
- J-31. L.P. Chew, M.T. Goodrich, D.P. Huttenlocher, K. Kedem, J.M. Kleinberg, and D. Kravets, "Geometric Pattern Matching under Euclidean Motion," *Computational Geometry: Theory and Applications*, 7, 1997, 113-124.
- J-32. M.T. Goodrich and E.A. Ramos, "Bounded-Independence Derandomization of Geometric Partitioning with Applications to Parallel Fixed-Dimensional Linear Programming," *Discrete & Computational Geometry*, 18(4), 1997, 397-420.
- J-33. M.T. Goodrich, "An Improved Ray Shooting Method for Constructive Solid Geometry Models via Tree Contraction," *International Journal of Computational Geometry & Applications*, 8(1), 1998, 1-23.
- J-34. G. Barequet, A.J. Briggs, M.T. Dickerson, and M.T. Goodrich, "Offset-Polygon Annulus Placement Problems," *Computational Geometry: Theory and Applications*, 11(3-4), 1998-99, 125-141.

- J-35. M.T. Goodrich and R. Tamassia, "Dynamic Trees and Dynamic Point Location," *SIAM J. Comput.*, **28**(2), 1999, 612–636.
- J-36. G. Barequet, S.S. Bridgeman, C.A. Duncan, M.T. Goodrich, and R. Tamassia, "GeomNet: Geometric Computing Over the Internet," *IEEE Internet Computing*, **3**(2), 1999, 21–29.
- J-37. M.T. Goodrich, J.S.B. Mitchell, and M.W. Orletsky, "Approximate Geometric Pattern Matching Under Rigid Motion," *IEEE Trans. on Pattern Analysis and Machine Intelligence*, **21**(4), 1999, 371–379.
- J-38. M.T. Goodrich, "Communication-Efficient Parallel Sorting," *SIAM Journal on Computing*, **29**(2), 1999, 416–432.
- J-39. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees and Their Use for Drawing Very Large Graphs," *Journal of Graph Algorithms and Applications*, **4**(3), 2000, 19–46. Also available at [www.cs.brown.edu/publications/jgaa/](http://www.cs.brown.edu/publications/jgaa/).
- J-40. M.T. Goodrich and C.G. Wagner, "A Framework for Drawing Planar Graphs with Curves and Polyline," *Journal of Algorithms*, **37**, 2000, 399–421.
- J-41. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees: Combining the Benefits of  $k$ -D Trees and Octrees," *J. Algorithms*, **38**, 2001, 303–333.
- J-42. G. Barequet, M. Dickerson, and M.T. Goodrich, "Voronoi Diagrams for Polygon-Offset Distance Functions," *Discrete and Computational Geometry*, **25**(2), 2001, 271–291.
- J-43. C.C. Cheng, C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Drawing Planar Graphs with Circular Arcs," *Discrete and Computational Geometry*, **25**(3), 2001, 405–418.
- J-44. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "A Randomized Algorithm for Triangulating a Simple Polygon in Linear Time," *Discrete and Computational Geometry*, **26**(2), 2001, 245–265.
- J-45. R. Tamassia, M.T. Goodrich, L. Vismara, M. Handy, G. Shubina, R. Cohen, B. Hudson, R.S. Baker, N. Gelfand, and U. Brandes, "JDSL: The Data Structures Library in Java," *Dr. Dobbs Journal*, **323**, 2001, 21–31.
- J-46. G. Barequet, D.Z. Chen, O. Daescu, M.T. Goodrich, and J.S. Snoeyink, "Efficiently Approximating Polygonal Paths in Three and Higher Dimensions," *Algorithmica*, **33**(2), 2002, 150–167.
- J-47. T. Chan, M.T. Goodrich, S.R. Kosaraju, and R. Tamassia, "Optimizing Area and Aspect Ratio in Straight-Line Orthogonal Tree Drawings," *Computational Geometry: Theory and Applications*, **23**(2), 2002, 153–162.
- J-48. C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Planarity-Preserving Clustering and Embedding for Large Planar Graphs," *Computational Geometry: Theory and Applications*, **24**(2), 2003, 95–114.
- J-49. A.L. Buchsbaum and M.T. Goodrich, "Three-Dimensional Layers of Maxima," *Algorithmica*, **39**, 2004, 275–286.
- J-50. G. Barequet, M.T. Goodrich, and C. Riley, "Drawing Graphs with Large Vertices and Thick Edges," *J. of Graph Algorithms and Applications (JGAA)*, **8**(1), 2004, 3–20.
- J-51. G. Barequet, M.T. Goodrich, A. Levi-Steiner, and D. Steiner, "Contour Interpolation by Straight Skeletons," *Graphical Models (GM)*, **66**(4), 2004, 245–260.
- J-52. P. Gajer, M.T. Goodrich, and S.G. Kobourov, "A Multi-Dimensional Approach to Force-Directed Layouts of Large Graphs," *Computational Geometry: Theory and Applications*, **29**(1), 3–18, 2004.

- J-53. G. Barequet, P. Bose, M.T. Dickerson, and M.T. Goodrich, "Optimizing a Constrained Convex Polygonal Annulus," *J. of Discrete Algorithms (JDA)*, 3(1), 1–26, 2005.
- J-54. A. Bagchi, A.L. Buchsbaum, and M.T. Goodrich, "Biased Skip Lists," *Algorithmica*, 42(1), 31–48, 2005.
- J-55. M. Dickerson, D. Eppstein, M.T. Goodrich, J. Meng, "Confluent Drawings: Visualizing Non-planar Diagrams in a Planar Way," *J. of Graph Algorithms and Applications (JGAA)*, 9(1), 31–52, 2005.
- J-56. A. Bagchi, A. Chaudhary, M.T. Goodrich, C. Li, and M. Shmueli-Scheuer, "Achieving Communication Efficiency through Push-Pull Partitioning of Semantic Spaces to Disseminate Dynamic Information," *IEEE Trans. on Knowledge and Data Engineering (TKDE)*, 18(10), 1352–1367, 2006.
- J-57. D. Eppstein, M.T. Goodrich, and J.Y. Meng, "Confluent Layered Drawings," *Algorithmica*, 47(4), 439–452, 2007.
- J-58. A. Bagchi, A. Chaudhary, D. Eppstein, and M.T. Goodrich, "Deterministic Sampling and Range Counting in Geometric Data Streams," *ACM Transactions on Algorithms*, 3(2), Article 16, 2007, 18 pages.
- J-59. D. Eppstein, M.T. Goodrich, and D. Hirschberg, "Improved Combinatorial Group Testing Algorithms for Real-World Problem Sizes," *SIAM Journal on Computing*, 36(5), 1360–1375, 2007.
- J-60. D. Eppstein, M.T. Goodrich, and J.Z. Sun, "Skip Quadrees: Dynamic Data Structures for Multidimensional Point Sets," *Int. Journal on Computational Geometry and Applications*, 18(1/2), 131–160, 2008.
- J-61. M.T. Goodrich, "Probabilistic Packet Marking for Large-Scale IP Traceback," *IEEE/ACM Transactions on Networking*, 16(1), 15–24, 2008.
- J-62. M.T. Goodrich and D.S. Hirschberg, "Improved Adaptive Group Testing Algorithms with Applications to Multiple Access Channels and Dead Sensor Diagnosis," *Journal of Combinatorial Optimization*, 15(1), 95–121, 2008.
- J-63. M.T. Goodrich, R. Tamassia, and D. Yao, "Notarized Federated ID Management and Authentication," *Journal of Computer Security*, 16(4), 399–418, 2008.
- J-64. M.T. Goodrich, "Pipelined Algorithms to Detect Cheating in Long-Term Grid Computations," *Theoretical Computer Science*, 408, 199–207, 2008.
- J-65. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Motorcycle Graphs: Canonical Quad Mesh Partitioning," *Computer Graphics Forum*, special issue on papers from 6th European Symp. on Geometry Processing (SGP), 27(6), 1477–1486, 2008.
- J-66. M.T. Goodrich, M. Sirivianos, J. Solis, C. Soriente, G. Tsudik, E. Uzun, "Using Audio in Secure Device Pairing," *Int. J. Security and Networks*, 4(1/2), 57–68, 2009.
- J-67. M.T. Goodrich, "On the Algorithmic Complexity of the Mastermind Game with Black-Peg Results," *Information Processing Letters*, 109, 675–678, 2009.
- J-68. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Approximate Topological Matching of Quad Meshes," *The Visual Computer*, 25(8), 771–783, 2009.
- J-69. D. Eppstein and M.T. Goodrich, "Succinct Greedy Geometric Routing Using Hyperbolic Geometry," *IEEE Transactions on Computers*, 60(11), 1571–1580, 2011. Posted online Dec. 2010, IEEE Computer Society Digital Library.
- J-70. D. Eppstein, M.T. Goodrich, and D. Strash, "Linear-Time Algorithms for Geometric Graphs

- with Sublinearly Many Edge Crossings," *SIAM Journal on Computing*, 39(8), 3814–3829, 2010.
- J-71. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, "Efficient Authenticated Data Structures for Graph Connectivity and Geometric Search Problems," *Algorithmica*, 60(3), 505–552, 2011.
- J-72. D. Eppstein and M.T. Goodrich, "Straggler Identification in Round-Trip Data Streams via Newton's Identities and Invertible Bloom Filters," *IEEE Transactions on Knowledge and Data Engineering (TKDE)*, 23(2), 297–306, 2011.
- J-73. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Planar Drawings of Higher-Genus Graphs," *Journal of Graph Algorithms and Applications*, 15(1), 7–32, 2011.
- J-74. M.T. Dickerson, M.T. Goodrich, T.D. Dickerson, and Y.D. Zhuo "Round-Trip Voronoi Diagrams and Doubling Density in Geographic Networks," *Transactions on Computational Science*, M.L. Gavrilova et al. (Eds.), Vol. 14, LNCS 6970, 211–238, 2011.
- J-75. M.T. Goodrich, "Randomized Shellsort: A Simple Data-Oblivious Sorting Algorithm," *Journal of the ACM*, 58(6), Article No. 27, 2011.
- J-76. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Lombardi Drawings of Graphs," *Journal of Graph Algorithms and Applications (JGAA)*, 16(1), 85–108, 2012.
- J-77. E. Wolf-Chambers, D. Eppstein, M.T. Goodrich, and M. Löffler, "Drawing Graphs in the Plane with a Prescribed Outer Face and Polynomial Area," *Journal of Graph Algorithms and Applications (JGAA)*, 16(2), 243–259, 2012.
- J-78. M.T. Goodrich, D. Nguyen, O. Ohrimenko, C. Papamanthou, R. Tamassia, N. Triandopoulos, and C.V. Lopes, "Efficient Verification of Web-Content Searching Through Authenticated Web Crawlers," *Proc. VLDB*, 5(10):920-931, 2012.
- J-79. D. Eppstein, M.T. Goodrich, D. Strash, and L. Trott, "Extended Dynamic Subgraph Statistics Using h-Index Parameterized Data Structures," *Theoretical Computer Science*, 447, 44–52, 2012.
- J-80. M.T. Goodrich, "Learning Character Strings via Mastermind Queries, With a Case Study Involving mtDNA," *IEEE Transactions on Information Theory*, 58(11), 6726–6736, 2012.
- J-81. A.U. Asuncion and M.T. Goodrich, "Nonadaptive Mastermind Algorithms for String and Vector Databases, with Case Studies," *IEEE Transactions on Knowledge and Data Engineering (TKDE)*, 25(1), 131–144, 2013.
- J-82. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Drawing Trees with Perfect Angular Resolution and Polynomial Area," *Discrete & Computational Geometry*, 49(2), 157–182, 2013.
- J-83. E. Angelino, M.T. Goodrich, M. Mitzenmacher and J. Thaler, "External Memory Multimap," *Algorithmica*, 67(1), 23–48, 2013.
- J-84. D. Eppstein, M.T. Goodrich, M. Löffler, D. Strash and L. Trott, "Category-Based Routing in Social Networks: Membership Dimension and the Small-World Phenomenon," *Theoretical Computer Science*, 514, 96–104, 2013.
- J-85. M.T. Goodrich, "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," *Algorithmica*, 68(4), 835–858, 2014.
- J-86. Michael J. Bannister, William E. Devanny, David Eppstein, and M.T. Goodrich, "The Galois Complexity of Graph Drawing: Why Numerical Solutions are Ubiquitous for Force-Directed,

Spectral, and Circle Packing Drawings,” *Journal of Graph Algorithms and Applications*, 19(2), 619–656, 2015.

**Papers in Peer-Reviewed Proceedings:**

- C-1. M.J. Atallah and M.T. Goodrich, “Efficient Parallel Solutions to Geometric Problems,” *1985 IEEE Int. Conf. on Parallel Processing (ICPP)*, 411–417. (Preliminary version of J-1.)
- C-2. F. Berman, M.T. Goodrich, C. Koelbel, W. Robison, and K. Showell, “Prep-P: A Mapping Preprocessor for CHiP Computers,” *1985 IEEE Int. Conf. on Parallel Processing*, 731–733.
- C-3. M.J. Atallah and M.T. Goodrich, “Parallel Algorithms For Some Functions of Two Convex Polygons,” *24th Allerton Conf. on Communication, Control and Computing*, 1986, 758–767. (Preliminary version of J-4.)
- C-4. M.J. Atallah and M.T. Goodrich, “Efficient Plane Sweeping in Parallel,” *2nd ACM Symp. on Computational Geometry (SoCG)*, 1986, 216–225.
- C-5. M.T. Goodrich, “A Polygonal Approach to Hidden-Line Elimination,” *25th Allerton Conf. on Communication, Control, and Computing*, 1987, 849–858. (Preliminary version of J-12.)
- C-6. M.J. Atallah, R. Cole, and M.T. Goodrich, “Cascading Divide-and-Conquer: A Technique for Designing Parallel Algorithms,” *28th IEEE Symp. on Foundations of Computer Science (FOCS)*, 1987, 151–160. (Preliminary version of J-5.)
- C-7. M.J. Atallah, M.T. Goodrich, and S.R. Kosaraju, “Parallel Algorithms for Evaluating Sequences of Set-Manipulation Operations,” *3rd Aegean Workshop on Computing (AWOC), Lecture Notes in Computer Science (LNCS)*: 319, Springer-Verlag, 1988, 1–10. (Preliminary version of J-19.)
- C-8. R. Cole and M.T. Goodrich, “Optimal Parallel Algorithms for Polygon and Point-Set Problems,” *4th ACM Symp. on Computational Geometry (SoCG)*, 1988, 201–210. (Preliminary version of J-11.)
- C-9. M.T. Goodrich, “Intersecting Line Segments in Parallel with an Output-Sensitive Number of Processors,” *1989 ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 127–137. (Preliminary version of J-10.)
- C-10. M.T. Goodrich and S.R. Kosaraju, “Sorting on a Parallel Pointer Machine with Applications to Set Expression Evaluation,” *30th IEEE Symp. on Foundations of Computer Science (FOCS)*, 1989, 190–195. (Preliminary version of J-24.)
- C-11. M.T. Goodrich, C. Ó’Dúnlaing, and C. Yap “Constructing the Voronoi Diagram of a Set of Line Segments in Parallel,” *Lecture Notes in Computer Science 382, Algorithms and Data Structures (WADS)*, Springer-Verlag, 1989, 12–23. (Preliminary version of J-14.)
- C-12. M.T. Goodrich and J.S. Snoeyink, “Stabbing Parallel Segments with a Convex Polygon,” *Lecture Notes in Computer Science 382, Algorithms and Data Structures (WADS)*, Springer-Verlag, 1989, 231–242. (Preliminary version of J-8.)
- C-13. J. Johnstone and M.T. Goodrich, “A Localized Method for Intersecting Plane Algebraic Curve Segments,” *New Advances in Computer Graphics: Proc. of Computer Graphics International ’89*, R.A. Earnshaw, B. Wyvel, eds., Springer-Verlag, 1989, 165–181. (Preliminary version of J-9.)
- C-14. M.J. Atallah, P. Callahan, and M.T. Goodrich, “P-Complete Geometric Problems,” *2nd ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 1990, 317–326. (Preliminary version of J-18.)



- C-15. R. Cole, M.T. Goodrich, C. Ó Dúnlaing, "Merging Free Trees in Parallel for Efficient Voronoi Diagram Construction", *17th Int. Conf. on Automata, Languages, and Programming (ICALP)*, 1990, 432–445. (Preliminary version of J-27.)
- C-16. M.T. Goodrich, M.J. Atallah, and M. Overmars, "An Input-Size/Output-Size Trade-Off in the Time-Complexity of Rectilinear Hidden-Surface Removal", *17th Int. Conf. on Automata, Languages, and Programming (ICALP)*, 1990, 689–702. (Preliminary version of J-17.)
- C-17. M.T. Goodrich, M. Ghouse, and J. Bright, "Generalized Sweep Methods for Parallel Computational Geometry," *2nd ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 1990, 280–289. (Preliminary version of J-23.)
- C-18. M.T. Goodrich, "Applying Parallel Processing Techniques to Classification Problems in Constructive Solid Geometry," *1st ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 1990, 118–128. (Preliminary version of J-33.)
- C-19. M.T. Goodrich, S. Shauck, and S. Guha, "Parallel Methods for Visibility and Shortest Path Problems in Simple Polygons," *6th ACM Symp. on Computational Geometry (SoCG)*, 1990, 73–82. (Preliminary version of J-13.)
- C-20. M. Ghouse and M.T. Goodrich, "In-Place Techniques for Parallel Convex Hull Algorithms," *3rd ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 1991, 192–203. (Preliminary version of J-30.)
- C-21. M.T. Goodrich, "Constructing Arrangements Optimally in Parallel," *3rd ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 1991, 169–179. (Preliminary version of J-16.)
- C-22. M.T. Goodrich and R. Tamassia, "Dynamic Trees and Dynamic Point Location," *23rd ACM Symp. on Theory of Computing (STOC)*, 1991, 523–533. (Preliminary version of J-35.)
- C-23. M.T. Goodrich, "Using Approximation Algorithms to Design Parallel Algorithms that May Ignore Processor Allocation," *32nd IEEE Symp. on Foundations of Computer Science (FOCS)*, 1991, 711–722.
- C-24. M.T. Goodrich, "Planar Separators and Parallel Polygon Triangulation," *24th ACM Symp. on Theory of Computing (STOC)*, 1992, 507–516. (Preliminary version of J-22.)
- C-25. M.T. Goodrich, Y. Matias, U. Vishkin, "Approximate Parallel Prefix Computation and Its Applications," *7th IEEE Int. Parallel Processing Symp (IPPS)*, 1993, 318–325.
- C-26. M. Ghouse and M.T. Goodrich, "Experimental Evidence for the Power of Random Sampling in Practical Parallel Algorithms," *7th IEEE Int. Parallel Processing Symp (IPPS)*, 1993, 549–556.
- C-27. L.P. Chew, M.T. Goodrich, D.P. Huttenlocher, K. Kedem, J.M. Kleinberg, and D. Kravets, "Geometric Pattern Matching under Euclidean Motion," *5th Canadian Conf. on Computational Geometry (CCCG)*, 1993, 151–156. (Preliminary version of J-31.)
- C-28. M.T. Goodrich, "Geometric Partitioning Made Easier, Even in Parallel," *9th ACM Symp. on Computational Geometry (SoCG)*, 1993, 73–82.
- C-29. M.T. Goodrich and R. Tamassia, "Dynamic Ray Shooting and Shortest Paths via Balanced Geodesic Triangulations," *9th ACM Symp. on Computational Geometry (SoCG)*, 1993, 318–327. (Preliminary version of J-29.)
- C-30. A. Garg, M.T. Goodrich, and R. Tamassia, "Area-Efficient Upward Tree Drawings," *9th ACM Symp. on Computational Geometry (SoCG)*, 1993, 359–368. (Preliminary version of J-25.)
- C-31. M.H. Nodine, M.T. Goodrich, and J.S. Vitter, "Blocking for External Graph Searching," *12th ACM Symp. on Principles of Database Systems (PODS)*, 1993, 222–232. (Preliminary

- version of J-26.)
- C-32. E.M. Arkin, M.T. Goodrich, J.S.B. Mitchell, D. Mount, and S.S. Skiena, "Point Probe Decision Trees for Geometric Concept Classes," *Lecture Notes in Computer Science 709: Algorithms and Data Structures (WADS)*, Springer-Verlag, 1993, 95–106.
  - C-33. M.T. Goodrich, J.J. Tsay, D.E. Vengroff, and J.S. Vitter, "External-Memory Computational Geometry," *34th IEEE Symp. on Foundations of Computer Science (FOCS)*, 1993, 714–723.
  - C-34. M.T. Goodrich, Y. Matias, and U. Vishkin, "Optimal Parallel Approximation Algorithms for Prefix Sums and Integer Sorting," *5th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 1994, 241–250.
  - C-35. H. Brönnimann and M.T. Goodrich, "Almost Optimal Set Covers in Finite VC-Dimension," *10th ACM Symp. on Computational Geometry (SoCG)*, 1994, 293–302. (Preliminary version of J-21.)
  - C-36. M.T. Goodrich, "Efficient Piecewise-Linear Function Approximation Using the Uniform Metric," *10th ACM Symp. on Computational Geometry (SoCG)*, 1994, 322–331. (Preliminary version of J-20.)
  - C-37. M.J. Atallah, M.T. Goodrich, and K. Ramaiyer, "Biased Finger Trees and Three-Dimensional Layers of Maxima," *10th ACM Symp. on Computational Geometry (SoCG)*, 1994, 150–159.
  - C-38. M.T. Goodrich, J.S.B. Mitchell, and M.W. Orletsky, "Practical Methods for Approximate Geometric Pattern Matching under Rigid Motions," *10th ACM Symp. on Computational Geometry (SoCG)*, 1994, 103–112. (Preliminary version of J-37.)
  - C-39. N.M. Amato, M.T. Goodrich, E.A. Ramos, "Parallel Algorithms for Higher-Dimensional Convex Hulls," *35th IEEE Symp. on Foundations of Computer Science (FOCS)*, 1994, 683–694.
  - C-40. P.J. Tanenbaum, M.T. Goodrich, and E.R. Scheinerman, "Characterization and Recognition of Point-Halfspace and Related Orders," *2nd Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 894, Springer-Verlag, 1994, 234–245.
  - C-41. Y.J. Chiang, M.T. Goodrich, E.F. Grove, R. Tamassia, D.E. Vengroff, and J.S. Vitter, "External-Memory Graph Algorithms," *6th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 1995, 139–149.
  - C-42. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Computing Faces in Segment and Simplex Arrangements," *27th ACM Symp. on Theory of Computing (STOC)*, 1995, 672–682.
  - C-43. P. Callahan, M.T. Goodrich, and K. Ramaiyer, "Topology B-Trees and Their Applications," *1995 Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 955, Springer-Verlag, 381–392.
  - C-44. G. Das and M.T. Goodrich, "On the Complexity of Approximating and Illuminating Three-Dimensional Convex Polyhedra," *1995 Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 955, Springer-Verlag, 74–85. (Preliminary version of J-28.)
  - C-45. M.T. Goodrich, "Fixed-Dimensional Parallel Linear Programming via Relative  $\epsilon$ -Approximations," *7th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 1996, 132–141. (Preliminary version of J-32.)
  - C-46. M. Chrobak, M.T. Goodrich, and R. Tamassia, "Convex Drawings of Graphs in Two and Three Dimensions," *12th ACM Symp. on Computational Geometry (SoCG)*, 1996, 319–328.
  - C-47. M.T. Goodrich, "Communication-Efficient Parallel Sorting," *28th ACM Symp. on Theory of*

- Computing* (STOC), 1996, 247–256. (Preliminary version of J-38.)
- C-48. T. Chan, M.T. Goodrich, S.R. Kosaraju, and R. Tamassia, “Optimizing Area and Aspect Ratio in Straight-Line Orthogonal Tree Drawings,” *4th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1190, Springer-Verlag, 1996, 63–75. (Preliminary version of J-47.)
- C-49. M.T. Goodrich, “Randomized Fully-Scalable BSP Techniques for Multi-Searching and Convex Hull Construction,” *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 767–776.
- C-50. C.A. Duncan, M.T. Goodrich, and E.A. Ramos, “Efficient Approximation and Optimization Algorithms for Computational Metrology,” *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 121–130.
- C-51. M.T. Goodrich, M. Orletsky, and K. Ramaiyer, “Methods for Achieving Fast Query Times in Point Location Data Structures,” *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 757–766.
- C-52. M.T. Goodrich, L.J. Guibas, J. Hershberger, P.J. Tanenbaum, “Snap Rounding Line Segments Efficiently in Two and Three Dimensions,” *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 284–293.
- C-53. G. Barequet, S.S. Bridgeman, C.A. Duncan, M.T. Goodrich, and R. Tamassia, “Classical Computational Geometry in GeomNet,” *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 412–414.
- C-54. G. Barequet, A. Briggs, M. Dickerson, C. Dima, and M.T. Goodrich, “Animating the Polygon-Offset Distance Function,” *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 479–480, and the *Video Review for the 13th ACM Symp. on Computational Geometry* (SoCG).
- C-55. G. Barequet, A. Briggs, M. Dickerson, and M.T. Goodrich, “Offset-Polygon Annulus Placement Problems,” *1997 Workshop on Algorithms and Data Structures* (WADS), 1997, 378–391. (Preliminary version of J-34.)
- C-56. G. Barequet, M. Dickerson, and M.T. Goodrich, “Voronoi Diagrams for Polygon-Offset Distance Functions,” *1997 Workshop on Algorithms and Data Structures* (WADS), 1997, 200–209. (Preliminary version of J-42.)
- C-57. N. Gelfand, M.T. Goodrich, and R. Tamassia, “Teaching Data Structure Design Patterns,” *29th ACM SIGCSE Technical Symp. on Computer Science Education*, 1998, 331–335.
- C-58. M.T. Goodrich and R. Tamassia, “Teaching the Analysis of Algorithms with Visual Proofs,” *29th ACM SIGCSE Technical Symp. on Computer Science Education*, 1998, 207–211.
- C-59. G. Barequet, D.Z. Chen, O. Daescu, M.T. Goodrich, and J.S. Snoeyink, “Efficiently Approximating Polygonal Paths in Three and Higher Dimensions,” *1998 ACM Symp. on Computational Geometry* (SoCG), 1998, 317–326. (Preliminary version of J-46.)
- C-60. M.T. Goodrich and C.G. Wagner, “A Framework for Drawing Planar Graphs with Curves and Polyines,” *6th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1547, Springer-Verlag, 1998, 153–166. (Preliminary version of J-40.)
- C-61. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, “Balanced Aspect Ratio Trees and Their Use for Drawing Very Large Graphs,” *6th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1547, Springer-Verlag, 1998, 111–124. (Preliminary version of J-39.)
- C-62. M.T. Goodrich, M. Handy, B. Hudson, and R. Tamassia, “Abstracting Positional Information

- in Data Structures: Locators and Positions in JDLSL," *OOPSLA '98 Technical Notes*, 1998.
- C-63. M.T. Goodrich and J.G. Kloss II, "Tiered Vector: An Efficient Dynamic Array for JDLSL," *OOPSLA '98 Technical Notes*, 1998.
- C-64. M.T. Goodrich, M. Handy, B. Hudson, and R. Tamassia, "Accessing the Internal Organization of Data Structures in the JDLSL Library," *Int. Workshop on Algorithm Engineering and Experimentation (ALENEX)*, Springer-Verlag, Lecture Notes in Computer Science, Vol. 1619, 1999, 124-139.
- C-65. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees: Combining the Benefits of  $k$ -D Trees and Octrees," *10th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 1999, 300-309. (Preliminary version of J-41.)
- C-66. R.S. Baker, M. Boilen, M.T. Goodrich, R. Tamassia, and B.A. Stibel, "Testers and Visualizers for Teaching Data Structures," *30th ACM SIGCSE Technical Symp. on Computer Science Education*, 1999, 261-265.
- C-67. M.T. Goodrich and R. Tamassia, "Using Randomization in the Teaching of Data Structures and Algorithms," *30th ACM SIGCSE Technical Symp. on Computer Science Education*, 1999, 53-57. (Preliminary version of Ch-5.)
- C-68. G. Barequet, C. Duncan, M.T. Goodrich, S. Kumar, M. Pop, "Efficient Perspective-Accurate Silhouette Computation," *15th ACM Symp. on Computational Geometry (SoCG)*, 1999, 417-418, and the *Video Review for the 15th ACM Symp. on Computational Geometry (SoCG)*.
- C-69. C.C. Cheng, C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Drawing Planar Graphs with Circular Arcs," *7th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 1731, Springer-Verlag, 1999, 117-126. (Preliminary version of J-43.)
- C-70. C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Planarity-Preserving Clustering and Embedding for Large Planar Graphs," *7th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 1731, Springer-Verlag, 1999, 186-196. (Preliminary version of J-48.)
- C-71. M.T. Goodrich and J.G. Kloss II, "Tiered Vectors: Efficient Dynamic Arrays for Rank-Based Sequences," *1999 Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 1663, Springer-Verlag, 1999, 205-216.
- C-72. M.T. Goodrich, "Competitive Tree-Structured Dictionaries," *11th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 2000, 494-495.
- C-73. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Computing the Arrangement of Curve Segments: Divide-and-Conquer Algorithms via Sampling," *11th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 2000, 705-706.
- C-74. S. Bridgeman, M.T. Goodrich, S.G. Kobourov, and R. Tamassia, "PILOT: An Interactive Tool for Learning and Grading," *31st ACM SIGCSE Technical Symp. on Computer Science Education*, 2000, 139-143.
- C-75. S. Bridgeman, M.T. Goodrich, S.G. Kobourov, and R. Tamassia, "SAIL: A System for Generating, Archiving, and Retrieving Specialized Assignments in LaTeX," *31st ACM SIGCSE Technical Symp. on Computer Science Education*, 2000, 300-304.
- C-76. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Linear-Time Triangulation of a Simple Polygon Made Easier Via Randomization," *16th ACM Symp. on Computational Geometry (SoCG)*, 2000, 201-212. (Preliminary version of J-44.)
- C-77. A.L. Buchsbaum, M.T. Goodrich, and J.R. Westbrook, "Range Searching Over Tree Cross Products," *8th European Symp. on Algorithms (ESA)*, Lecture Notes in Computer

- Science 1879, Springer-Verlag, 2000, 120–131.
- C-78. C.A. Duncan, M.T. Dickerson, and M.T. Goodrich, “ $k$ -D Trees are Better When Cut on the Longest Side,” *8th European Symp. on Algorithms (ESA)*, Lecture Notes in Computer Science 1879, Springer-Verlag, 2000, 179–190.
- C-79. P. Gajer, M.T. Goodrich, and S.G. Kobourov, “A Fast Multi-Dimensional Algorithm for Drawing Large Graphs,” *8th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 1984, Springer-Verlag, 2001, 211–221. (Preliminary version of J-52.)
- C-80. G. Ateniese, B. de Medeiros, and M.T. Goodrich, “TRICERT: A Distributed Certified E-mail Scheme,” *Network and Distributed Systems Security Symp. (NDSS)*, 2001, 47–56.
- C-81. M.T. Goodrich and R. Tamassia, “Teaching Internet Algorithmics,” *32nd ACM SIGCSE Technical Symp. on Computer Science Education*, 2001, 129–133.
- C-82. M. Pop, G. Barequet, C.A. Duncan, M.T. Goodrich, W. Hwang, and S. Kumar, “Efficient Perspective-Accurate Silhouette Computation and Applications,” *17th ACM Symp. on Computational Geometry (SoCG)*, 2001, 60–68.
- C-83. M.T. Goodrich and R. Tamassia, “Implementation of an Authenticated Dictionary with Skip Lists and Commutative Hashing,” *DARPA Information Survivability Conf. & Exposition II (DISCEX)*, IEEE Press, 2001, 68–82.
- C-84. A. Bagchi, A. Chaudhary, R. Garg, M.T. Goodrich, and V. Kumar, “Seller-Focused Algorithms for Online Auctioning,” *2001 Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 2125, Springer-Verlag, 2001, 135–147.
- C-85. A. Anagnostopoulos, M.T. Goodrich, R. Tamassia, “Persistent Authenticated Dictionaries and Their Applications,” *Information Security Conf. (ISC)*, Lecture Notes in Computer Science 2200, Springer-Verlag, 2001, 379–393.
- C-86. M.T. Goodrich, R. Tamassia, and J. Hasic, “An Efficient Dynamic and Distributed Cryptographic Accumulator,” *5th Information Security Conf. (ISC)*, Lecture Notes in Computer Science 2433, Springer-Verlag, 2002, 372–388.
- C-87. A.L. Buchsbaum and M.T. Goodrich, “Three-Dimensional Layers of Maxima,” *10th European Symp. on Algorithms (ESA)*, Lecture Notes in Computer Science 2461, Springer-Verlag, 2002, 257–267. (Preliminary version of J-49.)
- C-88. A. Bagchi, A.L. Buchsbaum, and M.T. Goodrich, “Biased Skip Lists,” *13th Int. Symp. on Algorithms and Computation (ISAAC)*, Lecture Notes in Computer Science 2518, Springer-Verlag, 2002, 1–13. (Preliminary version of J-54.)
- C-89. M.T. Goodrich, “Efficient Packet Marking for Large-Scale IP Traceback,” *9th ACM Conf. on Computer and Communications Security (CCS)*, 2002, 117–126. (Preliminary version of J-61.)
- C-90. M.T. Goodrich, R. Tamassia, N. Triandopoulos, and R. Cohen, “Authenticated Data Structures for Graph and Geometric Searching,” *RSA Conf.—Cryptographers’ Track (CT-RSA)*, Lecture Notes in Computer Science 2612, Springer-Verlag, 2003, 295–313. (Preliminary version of J-71.)
- C-91. M.T. Goodrich, M. Shin, R. Tamassia, and W.H. Winsborough, “Authenticated Dictionaries for Fresh Attribute Credentials,” *1st Int. Conf. on Trust Management (iTrust)*, Lecture Notes in Computer Science 2692, Springer-Verlag, 2003, 332–347.
- C-92. G. Barequet, M.T. Goodrich, A. Levi-Steiner, and D. Steiner, “Straight-Skeleton Based Contour Interpolation,” *14th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 2003, 119–127. (Preliminary version of J-51.)

- C-93. G. Barequet, M.T. Goodrich, and C. Riley, "Drawing Graphs with Large Vertices and Thick Edges," *2003 Workshop and Data Structures and Algorithms (WADS)*, Lecture Notes in Computer Science 2748, Springer-Verlag, 2003, 281–293. (Preliminary version of J-50.)
- C-94. A. Bagchi, A. Chaudhary, M.T. Goodrich, and S. Xu, "Constructing Disjoint Paths for Secure Communication," *17th Int. Symp. on Distributed Computing (DISC)*, Lecture Notes in Computer Science 2848, Springer-Verlag, 2003, 181–195.
- C-95. M. Dickerson, D. Eppstein, M.T. Goodrich, J. Meng, "Confluent Drawings: Visualizing Non-planar Diagrams in a Planar Way," *11th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 2912, Springer-Verlag, 2003, 1–12. (Preliminary version of J-55.)
- C-96. F. Brandenburg, D. Eppstein, M.T. Goodrich, S. Kobourov, G. Liotta, P. Mutzel, "Selected Open Problems in Graph Drawing," *11th Int. Symp. on Graph Drawing (GD)*, Lecture Notes in Computer Science 2912, Springer-Verlag, 2003, 515–539.
- C-97. A. Bagchi, A. Chaudhary, D. Eppstein, and M.T. Goodrich, "Deterministic Sampling and Range Counting in Geometric Data Streams," *20th ACM Symp. on Computational Geometry (SoCG)*, 144–151, 2004. (Preliminary version of J-58.)
- C-98. M.T. Goodrich, J.Z. Sun, and R. Tamassia, "Efficient Tree-Based Revocation in Groups of Low-State Devices," *Advances in Cryptology (CRYPTO)*, Springer, Lecture Notes in Computer Science 3152, 511–527, 2004.
- C-99. D. Eppstein, M.T. Goodrich, and J.Y. Meng, "Confluent Layered Drawings," *12th Int. Symp. on Graph Drawing (GD)*, Springer, Lecture Notes in Computer Science 3383, 184–194, 2004. (Preliminary version of J-57.)
- C-100. M.J. Atallah, K.B. Frikken, M.T. Goodrich, and R. Tamassia, "Secure Biometric Authentication for Weak Computational Devices," *9th Int. Conf. on Financial Cryptography and Data Security*, Springer, Lecture Notes in Computer Science 3570, 357–371, 2005.
- C-101. M.T. Goodrich, "Leap-Frog Packet Linking and Diverse Key Distributions for Improved Integrity in Network Broadcasts," *IEEE Symp. on Security and Privacy (S&P)*, 196–207, 2005.
- C-102. D. Eppstein, M.T. Goodrich, and J.Z. Sun, "The Skip Quadtree: A Simple Dynamic Data Structure for Multidimensional Data," *21st ACM Symp. on Computational Geometry (SoCG)*, 296–305, 2005. (Preliminary version of J-60.)
- C-103. M.J. Atallah, M.T. Goodrich, and R. Tamassia, "Indexing Information for Data Forensics," *3rd Applied Cryptography and Network Security Conf. (ACNS)*, Lecture Notes in Computer Science 3531, Springer, 206–221, 2005.
- C-104. W. Du and M.T. Goodrich, "Searching for High-Value Rare Events with Uncheatable Grid Computing," *3rd Applied Cryptography and Network Security Conf. (ACNS)*, Lecture Notes in Computer Science 3531, Springer, 122–137, 2005.
- C-105. L. Arge, D. Eppstein, and M.T. Goodrich, "Skip-Webs: Efficient Distributed Data Structures for Multi-Dimensional Data Sets," *24th ACM Symp. on Principles of Distributed Computing (PODC)*, 2005.
- C-106. D. Eppstein, M.T. Goodrich, and D. Hirschberg, "Improved Combinatorial Group Testing for Real-World Problem Sizes," *Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 3608, Springer, 86–98, 2005. (Preliminary version of J-59.)
- C-107. A. Chaudhary and M.T. Goodrich, "Balanced Aspect Ratio Trees Revisited," *Workshop on Algorithms and Data Structures (WADS)*, Lecture Notes in Computer Science 3608, Springer,

- 73–85, 2005.
- C-108. M.T. Goodrich, R. Tamassia, and D. Yao, “Accredited DomainKeys: A Service Architecture for Improved Email Validation,” *2nd Conf. on Email and Anti-Spam (CEAS)*, 1–8, 2005.
- C-109. M.T. Goodrich, G.S. Lueker, and J.Z. Sun, “C-Planarity of Extrovert Clustered Graphs,” *13th Int. Symp. Graph Drawing (GD)*, 211–222, 2005.
- C-110. D. Eppstein, M.T. Goodrich, J.Y. Meng, “Delta-Confluent Drawings,” *13th Int. Symp. Graph Drawing (GD)*, 165–176, 2005.
- C-111. M.T. Goodrich, M.J. Nelson, and J.Z. Sun, “The Rainbow Skip Graph: A Fault-Tolerant Constant-Degree Distributed Data Structure,” *17th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 384–393, 2006.
- C-112. M.T. Goodrich, M. Sirivianos, J. Solis, G. Tsudik, E. Uzun, “Loud And Clear: Human-Verifiable Authentication Based on Audio,” *26th IEEE Int. Conf. on Distributed Computing Systems (ICDCS)*, 1–8, 2006. (Preliminary version of J-66.)
- C-113. M.T. Goodrich, R. Tamassia, and D. Yao, “Notarized Federated Identity Management for Web Services,” *20th IFIP WG Working Conf. on Data and Application Security (DBSec)*, Springer, Lecture Notes in Computer Science, Vol. 4127, 133–147, 2006. (Preliminary version of J-63.)
- C-114. M.T. Goodrich and D.S. Hirschberg, “Efficient Parallel Algorithms for Dead Sensor Diagnosis and Multiple Access Channels,” *18th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA)*, 118–127, 2006. (Preliminary version of J-62.)
- C-115. Y. Cho, L. Bao, and M.T. Goodrich, “LAAC: A Location-Aware Access Control Protocol,” *Int. Workshop on Ubiquitous Access Control (IWUAC)*, 1–7, 2006.
- C-116. M.B. Dillencourt, D. Eppstein, and M.T. Goodrich, “Choosing Colors for Geometric Graphs via Color Space Embeddings,” *14th Int. Symp. Graph Drawing (GD)*, Lecture Notes in Computer Science, Vol. 4372, Springer, 294–305, 2006.
- C-117. D. Eppstein, M.T. Goodrich, and N. Sitchinava, “Guard Placement for Wireless Localization,” *23rd ACM Symp. on Computational Geometry (SoCG)*, 27–36, 2007.
- C-118. M.T. Goodrich, C. Papamanthou, and R. Tamassia, “On the Cost of Persistence and Authentication in Skip Lists,” *6th Workshop on Experimental Algorithms (WEA)*, LNCS 4525, 94–107, 2007.
- C-119. M.J. Atallah, M. Blanton, M.T. Goodrich, and S. Polu, “Discrepancy-Sensitive Dynamic Fractional Cascading, Dominated Maxima Searching, and 2-d Nearest Neighbors in Any Minkowski Metric,” *Workshop on Algorithms and Data Structures (WADS)*, LNCS, Vol. 4619, Springer, 114–126, 2007.
- C-120. D. Eppstein and M.T. Goodrich, “Space-Efficient Straggler Identification in Round-Trip Data Streams via Newton’s Identities and Invertible Bloom Filters,” *Workshop on Algorithms and Data Structures (WADS)*, LNCS, Vol. 4619, Springer, 2007, 638–649. (Preliminary version of J-72.)
- C-121. M.T. Goodrich and J.Z. Sun, “Checking Value-Sensitive Data Structures in Sublinear Space,” *18th Int. Symp. on Algorithms and Computation (ISAAC)*, LNCS, vol. 4835, Springer, 2007, 353–364.
- C-122. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, “Super-Efficient Verification of Dynamic Outsourced Databases,” *RSA Conf.—Cryptographers’ Track (CT-RSA)*, LNCS, vol. 4964, Springer, 2008, 407–424.

- C-123. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Approximate Topological Matching of Quadrilateral Meshes," *IEEE Int. Conf. on Shape Modeling and Applications (SMI)*, 2008, 83–92. (Preliminary version of J-68.)
- C-124. G. Barequet, D. Eppstein, M.T. Goodrich, and A. Waxman, "Straight Skeletons of Three-Dimensional Polyhedra," *16th European Symp. on Algorithms (ESA)*, LNCS, vol. 5193, 2008, 148–160.
- C-125. M.T. Goodrich, C. Papamanthou, R. Tamassia, and N. Triandopoulos, "Athos: Efficient Authentication of Outsourced File Systems," *11th Information Security Conf. (ISC)*, LNCS, vol. 5222, 2008, 80–96.
- C-126. L. Arge, M.T. Goodrich, M. Nelson, and N. Sitchinava, "Fundamental Parallel Algorithms for Private-Cache Chip Multiprocessors," *20th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA)*, 2008, 197–206.
- C-127. D. Eppstein and M.T. Goodrich, "Succinct Greedy Graph Drawing in the Hyperbolic Plane," *16th Int. Symp. on Graph Drawing (GD)*, LNCS, vol. 5417, Springer, 2008, 14–25. (Preliminary version of J-69.)
- C-128. D. Eppstein and M.T. Goodrich, "Studying (Non-Planar) Road Networks Through an Algorithmic Lens," *16th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems (GIS)*, 2008, 125–134. **Best Paper Award.**
- C-129. M. Dickerson and M.T. Goodrich, "Two-Site Voronoi Diagrams in Geographic Networks," *16th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems (GIS)*, 2008, 439–442.
- C-130. D. Eppstein, M.T. Goodrich, and D. Strash, "Linear-Time Algorithms for Geometric Graphs with Sublinearly Many Crossings," *20th ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 2009, 150–159. (Preliminary version of J-70.)
- C-131. M.T. Goodrich, "The Mastermind Attack on Genomic Data," *30th IEEE Symp. on Security and Privacy (SSP)*, 2009, 204–218. (Preliminary version of J-80.)
- C-132. W. Du, D. Eppstein, M.T. Goodrich, and G.S. Lueker, "On the Approximability of Geometric and Geographic Generalization and the Min-Max Bin Covering Problem," *Algorithms and Data Structures Symp. (WADS)*, LNCS, vol. 5664, Springer, 2009, 242–253.
- C-133. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, J.Z. Sun, "Reliable Resource Searching in P2P Networks," *5th Int. ICST Conf. on Security and Privacy in Communication Networks (SecureComm)*, Lecture Notes of ICST, vol. 19, Springer, 2009, 437–447.
- C-134. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Planar Drawings of Higher-Genus Graphs," *17th Int. Symp. on Graph Drawing (GD)*, LNCS, Springer, vol. 5849, 2009, 45–56. (Preliminary version of J-73.)
- C-135. D. Eppstein, M.T. Goodrich, L. Trott, "Going Off-road: Transversal Complexity in Road Networks," *17th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems (GIS)*, 2009, 23–32.
- C-136. M.T. Goodrich and Darren Strash, "Succinct Greedy Geometric Routing in the Euclidean Plane," *20th Int. Symp. on Algorithms and Computation (ISAAC)*, LNCS, vol. 5878, Springer, 2009, 781–791.
- C-137. M.T. Goodrich, "Randomized Shellsort: A Simple Oblivious Sorting Algorithm," *21st ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 2010, 1262–1277. (Preliminary version of J-75.)



- C-138. L. Arge, M.T. Goodrich, and N. Sitchinava, "Parallel External Memory Graph Algorithms," *24th IEEE Int. Parallel & Distributed Processing Symp. (IPDPS)*, 2010, 1–11.
- C-139. G. Wang, T. Luo, M.T. Goodrich, W. Du, and Z. Zhu, "Bureaucratic Protocols for Secure Two-Party Sorting, Selection, and Permuting," *5th ACM Symp. on Information, Computer and Communications Security*, 2010, 226–237.
- C-140. M.T. Dickerson, M.T. Goodrich, and T.D. Dickerson, "Round-Trip Voronoi Diagrams and Doubling Density in Geographic Networks," *7th Int. Symp. on Voronoi Diagrams in Science and Engineering (ISVD)*, IEEE Press, 132–141, 2010. (Preliminary version of J-74.)
- C-141. M.T. Dickerson, D. Eppstein, and M.T. Goodrich, "Cloning Voronoi Diagrams via Retroactive Data Structures," *18th European Symp. on Algorithms (ESA)*, LNCS, vol. 6346, 2010, 362–373.
- C-142. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Lombardi Drawings of Graphs," *18th Int. Symp. on Graph Drawing (GD)*, LNCS, vol. 6502, 2010, 195–207. (Preliminary version of J-76.)
- C-143. E. Wolf-Chambers, D. Eppstein, M.T. Goodrich, and M. Löffler, "Drawing Graphs in the Plane with a Prescribed Outer Face and Polynomial Area," *18th Int. Symp. on Graph Drawing (GD)*, LNCS, vol. 6502, 2010, 129–140. (Preliminary version of J-77.)
- C-144. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Drawing Trees with Perfect Angular Resolution and Polynomial Area," *18th Int. Symp. on Graph Drawing (GD)*, LNCS, vol. 6502, 2010, 183–194. (Preliminary version of J-82.)
- C-145. A.U. Asuncion and M.T. Goodrich, "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitive Binary Attribute Vectors," *Workshop on Privacy in the Electronic Society (WPES)*, held in conjunction with the 17th ACM Conf. on Computer and Communications Security (CCS), 2010, 21–30. (Preliminary version of J-81.)
- C-146. D. Eppstein, M.T. Goodrich, D. Strash, and L. Trott, "Extended Dynamic Subgraph Statistics Using h-Index Parameterized Data Structures," *4th Annual Int. Conf. on Combinatorial Optimization and Applications (COCOA)*, LNCS, vol. 6508, 2010, 128–141. (Preliminary version of J-79.)
- C-147. M.T. Goodrich and D. Strash, "Priority Range Trees," *21st Int. Symp. on Algorithms and Computation (ISAAC)*, LNCS, vol. 6506, 2010, 97–108.
- C-148. D. Eppstein, M.T. Goodrich, R. Tamassia, "Privacy-Preserving Data-Oblivious Geometric Algorithms for Geographic Data," *18th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems (GIS)*, 2010, 13–22.
- C-149. M.T. Goodrich, "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," *8th Workshop on Analytic Algorithmics and Combinatorics (ANALCO)*, in conjunction with the ACM-SIAM Symp. on Discrete Algorithms (SODA), 2011. (Preliminary version of J-85.)
- C-150. M.T. Goodrich and F. Kerschbaum, "Privacy-Enhanced Reputation-Feedback Methods to Reduce Feedback Extortion in Online Auctions," *ACM Conf. on Data and Application Security and Privacy (CODASPY)*, 2011, 273–282.
- C-151. M.T. Goodrich, "Data-Oblivious External-Memory Algorithms for the Compaction, Selection, and Sorting of Outsourced Data," *23rd ACM Symp. on Parallelism in Algorithms and Architectures (SPAA)*, 2011, 379–388.

- C-152. M.T. Goodrich and M. Mitzenmacher, "Brief Announcement: Large-Scale Multimaps," *23rd ACM Symp. on Parallelism in Algorithms and Architectures (SPAA)*, 2011, 259–260.
- C-153. D. Eppstein, M.T. Goodrich, F. Uyeda, and G. Varghese, "What's the Difference? Efficient Set Synchronization without Prior Context," *SIGCOMM* 218–229, 2011.
- C-154. D. Eppstein, M.T. Goodrich, and M. Löffler, "Tracking Moving Objects with Few Handovers," *Algorithms and Data Structures Symp. (WADS)*, 362–373, LNCS, vol. 6844, 2011.
- C-155. M.T. Goodrich and M. Mitzenmacher, "Privacy-Preserving Access of Outsourced Data via Oblivious RAM Simulation," *38th Int. Colloquium on Automata, Languages and Programming (ICALP)*, LNCS, vol. 6756, 2011, 576–587.
- C-156. M.T. Goodrich and P. Pszona, "External-Memory Network Analysis Algorithms for Naturally Sparse Graphs," *European Symp. on Algorithms (ESA)*, LNCS, vol. 6942, 664–676, 2011.
- C-157. C. Duncan, D. Eppstein, M.T. Goodrich, S.G. Kobourov and M. Löffler, "Planar and Poly-Arc Lombardi Drawings," *Int. Symp. Graph Drawing (GD)*, LNCS, vol. 7034, 308–319, 2011.
- C-158. R. Chernobelskiy, K. Cunningham, M.T. Goodrich, S.G. Kobourov and L. Trott, "Force-Directed Lombardi-Style Graph Drawing," *Int. Symp. Graph Drawing (GD)*, LNCS, vol. 7034, 320–331, 2011.
- C-159. M.T. Goodrich and M. Mitzenmacher, "Invertible Bloom Lookup Tables," *49th Allerton Conf. on Communication, Control, and Computing*, IEEE Press, **invited paper**, 2011.
- C-160. M.T. Goodrich, M. Mitzenmacher, O. Ohrimenko, and R. Tamassia, "Oblivious RAM Simulation with Efficient Worst-Case Access Overhead," *ACM Cloud Computing Security Workshop (CCSW)*, in conjunction with the 17th ACM Conf. on Computer and Communications Security (CCS), 95–100, 2011.
- C-161. M.T. Goodrich and J.A. Simons, "Fully Retroactive Approximate Range and Nearest Neighbor Searching," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 292–301, 2011.
- C-162. E. Angelino, M.T. Goodrich, M. Mitzenmacher and J. Thaler, "External Memory Multimaps," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 384–394, 2011. (Preliminary version of J-83.)
- C-163. M.T. Goodrich, N. Sitchinava, and Q. Zhang, "Sorting, Searching, and Simulation in the MapReduce Framework," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 374–383, 2011.
- C-164. D. Eppstein, M.T. Goodrich, M. Löffler, D. Strash and L. Trott, "Category-Based Routing in Social Networks: Membership Dimension and the Small-World Phenomenon," *IEEE Int. Conf. on Computational Aspects of Social Networks (CASoN)*, 102–107, 2011. (Preliminary version of J-84.)
- C-165. M.T. Goodrich, O. Ohrimenko, M. Mitzenmacher, and R. Tamassia, "Privacy-Preserving Group Data Access via Stateless Oblivious RAM Simulation," *23rd ACM-SIAM Symp. on Discrete Algorithms (SODA)*, 157–167, 2012.
- C-166. M.T. Goodrich, O. Ohrimenko, M. Mitzenmacher, and R. Tamassia, "Practical Oblivious Storage," *2nd ACM Conf. on Data and Application Security and Privacy (CODASPY)*, 13–24, 2012.
- C-167. M.T. Goodrich and M. Mitzenmacher, "Anonymous Card Shuffling and its Applications

- to Parallel Mixnets," *39th Int. Colloquium on Automata, Languages and Programming (ICALP)*, Springer, LNCS, vol. 6756, 576–587, 2012.
- C-168. M.T. Goodrich, O. Ohrimenko, and R. Tamassia, "Graph Drawing in the Cloud: Privately Visualizing Relational Data using Small Working Storage," *20th Int. Symp. on Graph Drawing (GD)*, Springer, LNCS, vol. 7704, 43–54, 2012.
- C-169. F.J. Brandenburg, D. Eppstein, A. Gleissner, M.T. Goodrich, K. Hanauer, and J. Reislhuber, "On the Density of Maximal 1-Planar Graphs," *20th Int. Symp. on Graph Drawing (GD)*, Springer, LNCS, vol. 7704, 327–338, 2012.
- C-170. M.J. Bannister, D. Eppstein, M.T. Goodrich, and L. Trott, "Force-Directed Graph Drawing Using Social Gravity and Scaling," *20th Int. Symp. on Graph Drawing (GD)*, Springer, LNCS, vol. 7704, 414–425, 2012.
- C-171. M.T. Goodrich and J.A. Simons, "More Graph Drawing in the Cloud: Data-Oblivious st-Numbering, Visibility Representations, and Orthogonal Drawing of Biconnected Planar Graphs," *20th Int. Symp. on Graph Drawing (GD)*, Springer, LNCS, vol. 7704, 569–570, 2012.
- C-172. M.T. Goodrich, D.S. Hirschberg, M. Mitzenmacher, and J. Thaler, "Cache-Oblivious Dictionaries and Multimaps with Negligible Failure Probability," *Mediterranean Conf. on Algorithms (MedAlg)*, Springer, LNCS, vol. 7659, 203–218, 2012.
- C-173. D. Eppstein, M.T. Goodrich, and D.S. Hirschberg, "Combinatorial Pair Testing: Distinguishing Workers from Slackers," *Algorithms and Data Structures Symp. (WADS)*, Springer, LNCS, vol. 8037, 316–327, 2013.
- C-174. D. Eppstein, M.T. Goodrich, and J.A. Simons, "Set-Difference Range Queries," *25th Canadian Conf. on Computational Geometry (CCCG)*, 2013, <http://www.cccg.ca/proceedings/2013/>.
- C-175. M.T. Goodrich and P. Pszona, "Cole's Parametric Search Technique Made Practical," *25th Canadian Conf. on Computational Geometry (CCCG)*, 2013, <http://www.cccg.ca/proceedings/2013/>.
- C-176. L. Arge, M.T. Goodrich, F. van Walderveen, "Computing Betweenness Centrality in External Memory," *IEEE Int. Conf. on Big Data (BigData)*, 368–375, 2013.
- C-177. M.T. Goodrich and P. Pszona, "Achieving Good Angular Resolution in 3D Arc Diagrams," *21st Int. Symp. Graph Drawing (GD)*, Springer, LNCS, vol. 8242, 161–172, 2013.
- C-178. M.T. Goodrich and P. Pszona, "Streamed Graph Drawing and the File Maintenance Problem," *21st Int. Symp. Graph Drawing (GD)*, Springer, LNCS, vol. 8242, 256–267, 2013.
- C-179. M.T. Goodrich, "Zig-zag Sort: A Simple Deterministic Data-Oblivious Sorting Algorithm Running in  $O(n \log n)$  Time," *46th ACM Symp. on Theory of Computing (STOC)*, 684–693, 2014.
- C-180. D. Eppstein, M.T. Goodrich, M. Mitzenmacher, and P. Pszona, "Wear Minimization for Cuckoo Hashing: How Not to Throw a Lot of Eggs into One Basket," *Symp. on Experimental Algorithms (SEA)*, Springer, LNCS, vol. 8504, 162–173, 2014.
- C-181. O. Ohrimenko, M.T. Goodrich, and R. Tamassia, and E. Upfal, "The Melbourne Shuffle: Improving Oblivious Storage in the Cloud," *41st Int. Colloq. on Automata, Languages, and Programming (ICALP)*, Springer, LNCS, vol. 8573, 556–567, 2014.
- C-182. M.J. Bannister, W.E. Devanny, M.T. Goodrich, J.A. Simons, and Lowell Trott, "Windows into Geometric Events: Data Structures for Time-Windowed Querying of Temporal Point

- Sets," *26th Canadian Conf. on Computational Geometry (CCCG)*, 2014.
- C-183. M.J. Bannister, W.E. Devanny, D. Eppstein and M.T. Goodrich, "The Galois Complexity of Graph Drawing: Why Numerical Solutions are Ubiquitous for Force-Directed, Spectral, and Circle Packing Drawings," *22nd Int. Symp. Graph Drawing (GD)*, Springer, LNCS, vol. 8871, 149–161, 2014. (Preliminary version of J-86.)
- C-184. M.J. Alam, D. Eppstein, M.T. Goodrich, S. Kobourov and S. Pupyrev, "Balanced Circle Packings for Planar Graphs," *22nd Int. Symp. Graph Drawing (GD)*, Springer, LNCS, vol. 8871, 125–136, 2014.
- C-185. M. Bannister, M.T. Goodrich, and P. Sampson, "Force-Directed 3D Arc Diagrams," *22nd Int. Symp. Graph Drawing (GD)*, Springer, LNCS, vol. 8871, 521–522, 2014.
- C-186. M.T. Goodrich and P. Pszona, "Two-Phase Bicriterion Search for Finding Fast and Efficient Electric Vehicle Routes," *22nd ACM SIGSPATIAL Int. Conf. on Adv. Geographic Information Systems (GIS)*, 193–202, 2014.
- C-187. M.T. Goodrich and J. Simons, "Data-Oblivious Graph Algorithms in Outsourced External Memory," *8th Int. Conf. on Combinatorial Optimization and Applications (COCOA)*, LNCS, Vol. 8881, 241–257, 2014.
- C-188. M.T. Goodrich, T. Johnson, M. Torres, "Knuthian Drawings of Series-Parallel Flowcharts," *23rd Int. Symp. on Graph Drawing and Network Visualization (GD)*, Springer, LNCS, vol. 9411, 556–557, 2015. (See also <http://arxiv.org/abs/1508.03931>.)
- C-189. E. Ghosh, M.T. Goodrich, O. Ohrimenko, and R. Tamassia, "Poster: Zero-Knowledge Authenticated Order Queries and Applications," *IEEE Symp. on Security and Privacy*, 2015. (See also <https://eprint.iacr.org/2015/283>.)
- C-190. M.T. Goodrich and A. Eldawy, "Parallel Algorithms for Summing Floating-Point Numbers," *28th ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 13–22, 2016.
- C-191. W.E. Devanny, M.T. Goodrich, and K. Jetviroj, "Parallel Equivalence Class Sorting: Algorithms, Lower Bounds, and Distribution-Based Analysis," *28th ACM Symp. on Parallel Algorithms and Architectures (SPAA)*, 265–274, 2016.
- C-192. D. Eppstein, M.T. Goodrich, J. Lam, N. Mamano, M. Mitzenmacher, and M. Torres, "Models and Algorithms for Graph Watermarking," *19th Information Security Conf. (ISC)*, 2016. Best Student Paper Award.
- C-193. E. Ghosh, M.T. Goodrich, O. Ohrimenko, R. Tamassia, "Verifiable Zero-Knowledge Order Queries and Updates for Fully Dynamic Lists and Trees," *10th Conf. on Security and Cryptography for Networks (SCN)*, 216–236, 2016.
- C-194. M.T. Goodrich, E. Kornaropoulos, M. Mitzenmacher, R. Tamassia, "More Practical and Secure History-Independent Hash Tables," *21st European Symp. on Research in Computer Security (ESORICS)*, 2016.
- C-195. J.J. Besa Vial, W.E. Devanny, D. Eppstein, and M.T. Goodrich, "Scheduling Autonomous Vehicle Platoons Through an Unregulated Intersection," *2016 Workshop on Algorithmic Approaches for Transportation Modeling, Optimization, and Systems (ATMOS)*.
- C-196. M.J. Alam, M.B. Dillencourt, and M.T. Goodrich, "Capturing Lombardi Flow in Orthogonal Drawings by Minimizing the Number of Segments," *24th Int. Symp. on Graph Drawing and Network Visualization (GD)*, 2016.
- C-197. M.J. Alam, M.T. Goodrich, and T. Johnson, "Sibling-First Recursive Graph Drawing for Java Bytecode," *24th Int. Symp. on Graph Drawing and Network Visualization (GD)*, 2016.

- C-198. M.T. Goodrich, S. Gupta, and M. Torres, "A Topological Algorithm for Determining How Road Networks Evolve Over Time," *24th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems (GIS)*, 2016.
- C-199. M.J. Alam, M.T. Goodrich, and T. Johnson, "J-Viz: Finding Algorithmic Complexity Attacks via Graph Visualization of Java Bytecode," *13th IEEE Symp. on Visualization for Cyber Security (VizSec)*, 2016.
- C-200. M.T. Goodrich, E. Kornaropoulos, M. Mitzenmacher, and R. Tamassia, "Auditable Data Structures," *2nd IEEE Symp. on Security and Privacy (EuroS&P)*, 2017.

#### Other Publications:

- O-1. M.T. Goodrich, "Guest Editor's Introduction," *International Journal of Computational Geometry & Applications*, **2**(2), 1992, 113–116.
- O-2. M.T. Goodrich, "Parallel Algorithms Column 1: Models of Computation," *SIGACT News*, **24**(4), 1993, 16–21.
- O-3. M.T. Goodrich, V. Mirelli, M. Orletsky, and J. Salowe, "Decision tree construction in fixed dimensions: Being global is hard but local greed is good," Technical Report TR-95-1, Johns Hopkins University, Department of Computer Science, Baltimore, MD 21218, May 1995.
- O-4. R. Tamassia, P.K. Agarwal, N. Amato, D.Z. Chen, D. Dobkin, R.L.S. Drysdale, S. Fortune, M.T. Goodrich, J. Hersberger, J. O'Rourke, F.P. Preparata, J.-R. Sack, S. Suri, I.G. Tollis, J.S. Vitter, and S. Whitesides, "Strategic Directions in Computational Geometry Working Group Report," *ACM Computing Surveys*, **28A**(4), December 1996.
- O-5. G.A. Gibson, J.S. Vitter, and J. Wilkes, A. Choudhary, P. Corbett, T.H. Cormen, C.S. Ellis, M.T. Goodrich, P. Highnam, D. Kotz, K. Li, R. Muntz, J. Pasquale, M. Satyanarayanan, D.E. Vengroff, "Report of the Working Group on Storage I/O Issues in Large-Scale Computing," *ACM Computing Surveys*, **28A**(4), December 1996.
- O-6. T.H. Cormen and M.T. Goodrich, "A Bridging Model for Parallel Computation, Communication, and I/O," *ACM Computing Surveys*, **28A**(4), December 1996.
- O-7. M.T. Goodrich, "Computer Science Issues in the National Virtual Observatory," in *Virtual Observatories of the Future*, ASP Conf. Series, vol. 225, R.J. Brunner, S.G. Djorgovski, and A.S. Szalay, eds., 329–332, 2001.
- O-8. M.T. Dickerson and M.T. Goodrich, "Matching Points to a Convex Polygonal Boundary," Proceedings of the 13th Canadian Conf. on Computational Geometry (CCCG'01), 89–92, 2001.
- O-9. M.T. Goodrich, "Guest Editor's Foreword," *Algorithmica*, **33**(3), 271, 2002.
- O-10. M.T. Goodrich, M. Shin, C.D. Straub, and R. Tamassia, "Distributed Data Authentication (System Demonstration)," *DARPA Information Survivability Conf. and Exposition*, IEEE Press, Volume 2, 58–59, 2003.
- O-11. M.T. Goodrich and R. Tamassia, "Efficient and Scalable Infrastructure Support for Dynamic Coalitions," *DARPA Information Survivability Conf. and Exposition*, IEEE Press, Volume 2, 246–251, 2003.

#### PROFESSIONAL SERVICE

##### Guest Editor:

- Int. Journal of Computational Geometry & Applications*, **2**(2), 1992
- Journal of Computer & System Sciences*, **52**(1), 1996

*Computational Geometry: Theory and Applications*, 12(1–2), 1999.  
*Algorithmica*, 33(3), 2002.

*Editorial Board Membership:*

*Computational Geometry: Theory and Applications*, 2006–2015  
*Journal of Computer & System Sciences*, 1994–2011  
*Journal of Graph Algorithms and Applications*, 1996–2011  
*Int. Journal of Computational Geometry & Applications*, 1993–2010  
*Information Processing Letters*, 1995–1997

*Journal Advisory Board Membership:*

*Int. Journal of Computational Geometry & Applications*, 2010–  
*Journal of Graph Algorithms and Applications*, 2011–

*Program Committee Service:*

7th ACM Symp. on Computational Geometry (SoCG), 1991  
 1991 Workshop on Algorithms and Data Structures (WADS)  
 8th ACM Symp. on Computational Geometry (SoCG), 1992  
 25th ACM Symp. on Theory of Computing (STOC), 1993  
*Chair*, 26th ACM Symp. on Theory of Computing (STOC), 1994  
 11th ACM Symp. on Computational Geometry (SoCG), 1995  
 DAGS '95 Conf. on Electronic Publishing and the Information Superhighway  
 1996 SIAM Discrete Mathematics Conference  
 1997 Workshop on Algorithms and Data Structures (WADS)  
 International Symposium on Graph Drawing (GD), 1997  
 1999 Workshop on Algorithms and Data Structures (WADS)  
*Co-chair*, Workshop on Algorithm Engineering and Experimentation (ALENEX), 1999  
 International Symposium on Graph Drawing (GD), 2000  
 2000 Workshop on Algorithm Engineering (WAE)  
 41st IEEE Symp. on Foundations of Computer Science (FOCS), 2000  
 2001 Workshop on Algorithms and Data Structures (WADS)  
 International Symposium on Graph Drawing (GD), 2001  
 Workshop on Algorithm Engineering and Experimentation (ALENEX), 2002  
 18th ACM Symp. on Computational Geometry (SoCG), 2002  
 13th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2002  
*Co-Chair*, Graph Drawing 2002  
 International Symposium on Graph Drawing (GD), 2003  
 16th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2005  
 32nd Int. Colloq. on Automata, Languages and Programming (ICALP), 2005  
 12th Int. Computing and Combinatorics Conference (COCOON), 2006  
 13th ACM Conf. on Computer and Communication Security (CCS), 2006  
 15th Annual European Symposium on Algorithms (ESA), 2007  
 5th International Conference on Applied Cryptography and Network Security (ACNS), 2007  
 21st IEEE International Parallel & Distributed Processing Symposium (IPDPS), 2007  
 19th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA), 2007  
 5th Workshop on Algorithms and Models for the Web-Graph (WAW), 2007  
 7th International Workshop on Experimental Algorithms (WEA), 2008  
 Second International Frontiers of Algorithmics Workshop (FAW), 2008

16th ACM Int. Symp. on Advances in Geographic Information Systems (GIS), 2008  
 17th ACM Int. Symp. on Advances in Geographic Information Systems (GIS), 2009  
 31st IEEE Symposium on Security and Privacy (SSP), 2010  
 18th Int. Symp. on Graph Drawing (GD), 2010  
 2011 Workshop on Analytic Algorithmics and Combinatorics (ANALCO)  
 8th Workshop on Algorithms and Models for the Web Graph (WAW), 2011  
 19th International Symposium on Graph Drawing (GD), 2011  
 24th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA), 2012  
 20th European Symposium on Algorithms (ESA), 2012  
 2013 IEEE Int. Conf. on Big Data (BigData), 2013  
 30th IEEE Int. Conf. on Data Engineering (ICDE), 2014  
 21st ACM Conf. on Computer and Communication Security (CCS), 2014  
 Symposium on Algorithms and Data Structures (WADS), 2015  
 ACM Cloud Computing Security Workshop (CCSW), 2015  
 International Symposium on Graph Drawing (GD), 2015  
*co-chair*, 2016 Workshop on Algorithm Engineering and Experiments (ALENEX)  
 2016 Workshop on Massive Data Algorithmics (MASSIVE)  
 2016 Int. Symposium on Algorithms and Computation (ISAAC)  
 29th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA), 2017

*Conference Committee Service:*

Conference chair, 12th ACM Symposium on Computational Geometry, 1996  
 Organizer, 1st CGC Workshop on Computational Geometry, 1996  
 Co-chair, 1999 Dagstuhl Workshop on Computational Geometry, 1999  
 Conference chair, Graph Drawing 2002

*Steering Committee and Executive Committee Service:*

Member at large, ACM SIG on Algorithms & Comp. Theory (SIGACT) Exec. Comm., 1993–97  
 Member, Exec. comm. for 1996 Federated Computing Research Conference (FCRC)  
 co-Founder and member, Steering Comm. for Workshop on Algorithm Engineering  
 and Experimentation (ALENEX), 1999– (chair since 2014)  
 co-Chair, Steering Comm. for ACM Symposium on Computational Geometry, 1999–2001  
 Member, Steering Comm. for Graph Drawing Conference, 2000–2003, 2014–  
 Conference Chair, ACM SIG on Algorithms & Comp. Theory (SIGACT), 2005–2009

*Review Panelist:*

National Science Foundation, 2000–2016

*Ph.D. Advisees:*

Mujtaba Ghouse	"Randomized Parallel Computational Geometry in Theory and Practice," May 1993.
Paul Tanenbaum	"On Geometric Representations of Partially Ordered Sets," May 1995 (co-advised with Prof. Edward Scheinerman).
Mark Orletsky	"Practical Methods for Geometric Searching Problems with Experimental Validation," May 1996.
Kumar Ramaier	"Geometric Data Structures and Applications," Aug. 1996.
Christian Duncan	"Balanced Aspect Ratio Trees," Aug. 1999.
Christopher Wagner	"Graph Visualization and Network Routing," Oct. 1999 (co-advised with Prof. Lenore Cowen).
Stephen Kobourov	"Algorithms for Drawing Large Graphs," May 2000.
Amitabha Bagchi	"Efficient Strategies for Topics in Internet Algorithmics," Oct. 2002.

Amitabh Chaudhary "Applied Spatial Data Structures for Large Data Sets," Oct. 2002.  
 Jeremy Yu Meng "Confluent Graph Drawing," June 2006.  
 Jonathan Zheng Sun "Algorithms for Hierarchical Structures, with Applications to Security and Geometry," August 2006.  
 Nodari Sitchinava "Parallel External Memory Model—A Parallel Model for Multi-core Architectures," Sept. 2009.  
 Darren Strash "Algorithms for Sparse Geometric Graphs and Social Networks," May 2011.  
 Lowell Trott "Geometric Algorithms for Social Network Analysis," May 2013.  
 Joseph Simons "New Dynamics in Geometric Data Structures," May 2014.  
 Pawel Pszona "Practical Algorithms for Sparse Graphs," May 2014.

*Ph.D. Committee Service:*

John Augustine	UC-Irvine	Advancement to candidacy, September 2003
Nikos Triandopoulos	Brown U.	Thesis prelim., February 2004
Einar Mykletun	UC-Irvine	Advancement to candidacy, March 2004
Kartic Subr	UC-Irvine	Advancement to candidacy, September 2004
S. Joshua Swamidass	UC-Irvine	Advancement to candidacy, April 2005
Jeong Hyun Yi	UC-Irvine	Thesis defense, August, 2005
Nodari Sitchinava	UC-Irvine	Advancement to candidacy, chair, December 2005
John Augustine	UC-Irvine	Thesis defense, July 2006
Maithili Narasimha	UC-Irvine	Thesis defense, August, 2006
Josiah Carlson	UC-Irvine	Advancement to candidacy, August 2006
Xiaomin Liu	UC-Irvine	Advancement to candidacy, September 2006
Gabor Madl	UC-Irvine	Advancement to candidacy, September 2006
Nikos Triandopoulos	Brown U.	Thesis defense, September 2006
Rabia Nuray-Turan	UC-Irvine	Advancement to candidacy, May 2007
S. Joshua Swamidass	UC-Irvine	Thesis defense, June 2007
Michael Sirivianos	UC-Irvine	Advancement to candidacy, June 2007
Kevin Wortman	UC-Irvine	Advancement to candidacy, August 2007
Di Ma	UC-Irvine	Advancement to candidacy, December 2007
Josiah Carlson	UC-Irvine	Thesis defense, December 2007
Michael Nelson	UC-Irvine	Advancement to candidacy, chair, March 2008
Minas Gjoka	UC-Irvine	Advancement to candidacy, June 2008
Sara Javanmardi	UC-Irvine	Advancement to candidacy, June 2008
Ali Zandi	UC-Irvine	Advancement to candidacy, September 2008
Jihye Kim	UC-Irvine	Thesis defense, September 2008
Darren Strash	UC-Irvine	Advancement to candidacy, December 2008
Kevin Wortman	UC-Irvine	Topic defense, January 2009
Nodari Sitchinava	UC-Irvine	Topic defense, chair, June 2009
Fabio Soldo	UC-Irvine	Advancement to candidacy, July 2009
Emil De Cristofaro	UC-Irvine	Advancement to candidacy, July 2009
Di Ma	UC-Irvine	Thesis defense, August 2009
Yanbin Lu	UC-Irvine	Advancement to candidacy, December 2009
Anh Le	UC-Irvine	Advancement to candidacy, April 2010
Lowell Trott	UC-Irvine	Advancement to candidacy, June 2010
Xiaomin Liu	UC-Irvine	Thesis defense, August 2010



Josh Olsen	UC-Irvine	Advancement to candidacy, September 2010
Yasser Altowim	UC-Irvine	Advancement to candidacy, December 2010
Angela Wong	UC-Irvine	Advancement to candidacy, May 2011
Joshua Hill	UC-Irvine	Advancement to candidacy, September 2011
Alex Abatzoglou	UC-Irvine	Advancement to candidacy, September 2011
Michael Wolfe	UC-Irvine	Masters Thesis defense, October 2011
Olya Ohrimenko	Brown Univ.	PhD Thesis proposal, October 2011
Yanbin Lu	UC-Irvine	PhD Thesis defense, November 2011
Chun Meng	UC-Irvine	Advancement to candidacy, December 2011
Abinash Ramakrishnan	UC-Irvine	Advancement to candidacy, March 2012
Pegah Sattari	UC-Irvine	PhD Thesis defense, April 2012
Michael Bannister	UC-Irvine	PhD Thesis defense, May 2015
Yingyi Bu	UC-Irvine	PhD Thesis defense, August 2015
Jenny Lam	UC-Irvine	PhD Thesis defense, November 2015
Timothy Johnson	UC-Irvine	Advancement to candidacy, chair, June 2016
Jiayu Xu	UC-Irvine	Advancement to candidacy, November 2016
Sky Faber	UC-Irvine	PhD Thesis defense, November 2016

*University Service:*

Ph.D. Requirements Committee, Dept. of Computer Science, chair: 1987–89  
 Graduate Admissions Committee, Dept. of Computer Science, 1991–1993 (chair: 1992)  
 Faculty Recruiting Committee, Dept. of Computer Science, 1993,95,96 (chair: 1996)  
 Steering Committee, Whiting School of Engineering, 1990–93 (chair, 1993)  
 Johns Hopkins Homewood Academic Computing Oversight Committee, 1990–93  
 Curriculum Committee, Whiting School of Engineering, 1994–96  
 Strategic Planning Committee, Whiting School of Engineering, 1999–00  
 Graduate Policy Committee, UCI Dept. of Information & Computer Science (ICS), 2001–02  
 Faculty Search Committee in Cryptography, UCI Dept. of ICS, 2001–03  
 School of Info. and Computer Science Executive Committee, 2002–04  
 UCI Committee on Educational Policy (CEP), 2002–03, 2004–06  
 UCI Change of Major Criteria Committee, 2002–03  
 UCI CEP Policy Subcommittee, 2002–2003  
 Distinguished Faculty Search Committee, Bren School of ICS, 2004–11 (chair, 2007–08)  
 Equity Advisor, Bren School of ICS, 2005–09  
 Dean's Advisory Council, Bren School of ICS, 2007–13  
 Associate Dean for Faculty Development, Bren School of ICS, 2006–12  
 Chair, Department of Computer Science, Bren School of ICS, 2012–13  
 Master of Computer Science Development Committee, Bren School of ICS, 2013–2016  
 Strategic Planning Committee, Dept. of Computer Science, Bren School of ICS, 2015–16

*Courses Taught and Developed:*

Advanced Parallel Computing (developed and taught at Hopkins)  
 Cyber-Puzzlers (designed and taught at UCI)  
 Computer Literacy (taught at Purdue, developed at Hopkins)  
 Computer Programming for Scientists and Engineers (taught at Purdue)  
 Computer Security Algorithms (developed and taught at UCI)  
 Computational Models (revised and taught at Hopkins)

Computational Geometry (revised and taught at Hopkins and UCI)  
 Compiler Theory and Design (revised and taught at Hopkins)  
 Computer Graphics (taught at Hopkins)  
 Cyber-Fraud Detection and Prevention (designed and taught at UCI)  
 Data Structures (revised and taught at Hopkins and UCI)  
 Graph Algorithms (revised and taught at UCI)  
 Formal Languages and Automata Theory (revised and taught at UCI)  
 Introduction to Algorithms (developed and taught at Hopkins and UCI)  
 Internet Algorithmics (developed and taught at Hopkins, Brown, and UCI)  
 Design and Analysis of Algorithms (revised and taught at Hopkins and UCI)  
 Parallel Algorithms (developed and taught at Hopkins and Univ. of Illinois)

*Scientific Consulting:*

APAC Security, Inc., 2005  
 Algomagic Technologies, Inc., 2000–2005  
 Army Research Laboratory, Fort Belvoir, 1995  
 AT&T, 1998  
 Battelle Research Triangle, Columbus Division, 1996  
 Brown University, 2000–2007  
 3M, 2015  
 Purdue University, 2002  
 The National Science Foundation, 1990–2016  
 Univ. of Miami, 1999  
 Walt Disney Animation Studios, 2009

*Technical Expert Consulting:*

- 2011–12, Technical expert, Sidley Austin LLP (Los Angeles) and IGT Technologies
- 2012, Technical expert and deponent, Jones Day (Irvine) and Quiksilver
- 2013–14, Technical expert and deponent, Kirkland & Ellis, LLP (New York) and Content-Guard Holdings
- 2013–14, Technical expert, Kirkland & Ellis, LLP (Chicago) and Apple
- 2013–14, Technical expert and deponent, Jeffer Mangels Butler & Mitchell, LLP (Irvine) and Uniloc
- 2014–15, Technical expert, deponent, and testifying witness, McKool Smith, PC (Dallas) and ContentGuard Holdings
- 2014–16, Technical expert and deponent, Fenwick & West, LLP (San Francisco) and Symantec
- 2014–, Technical expert, Kirkland & Ellis, LLP (Chicago)
- 2016, Technical expert, deponent, and testifying witness, Dentons US LLP
- 2016–, Technical expert, Kramer Levin Naftalis & Frankel LLP (Menlo Park, CA) and Acceleration Bay LLC
- 2016–, Technical expert, Sheppard Mullin Richter & Hampton LLP (Los Angeles)
- 2016–, Technical expert, Kramer Levin Naftalis & Frankel LLP (Menlo Park, CA) and Finjan, Inc.

**GRANTS AND CONTRACTS**

1. PI, "Research Initiation Award: Parallel and Sequential Computational Geometry," National Science Foundation (NSF Grant CCR-8810568), \$32,914, 1988-90.
2. co-PI, "Paradigms for Parallel Algorithm Design," NSF and DARPA (as NSF Grant CCR-8908092), \$523,837, 1989-93 (with S.R. Kosaraju (PI), S. Kasif, and G. Sullivan).
3. PI, "Parallel Computation and Computational Geometry," NSF (Grant CCR-9003299), \$67,436, 1990-93.
4. co-PI, "A Facility for Experimental Validation," NSF (Grant CDA-9015667), \$1,476,147, 1991-96 (with G. Masson (PI), J. Johnstone, S. Kasif, S.R. Kosaraju, S. Salzberg, S. Smith, G. Sullivan, L. Wolff, and A. Zwarico).
5. PI, "Parallel Network Algorithms for Cell Suppression," The Bureau of the Census (JSA 91-23), \$14,998 1991-92.
6. PI, "A Geometric Framework for the Exploration & Analysis of Astrophysical Data," NSF (Grant IRI-9116843), \$535,553, 1991-96 (with S. Salzberg and H. Ford (from Physics and Astronomy Dept.)).
7. PI, "Research Experiences for Undergraduates supplement to IRI-9116843," NSF, \$4,000, 1993-94 (with S. Salzberg and H. Ford).
8. PI, "Constructing, Maintaining, and Searching Geometric Structures," NSF (Grant CCR-9300079), \$134,976, 1993-96.
9. co-PI, "Robust and Applicable Geometric Computing," Army Research Office (ARO MURI Grant DAAH04-96-1-0013), \$4,500,000, 1996-2000 (with F. Preparata (PI, Brown U.), R. Tamassia (Brown U.), S. Rao Kosaraju, J. Vitter (Duke U.), and P. Agarwal (Duke U.)). Subaward size: \$1,466,640.
10. PI, "Application-Motivated Geometric Algorithm Design," NSF (Grant CCR-9625289), \$107,389, 1996-98.
11. co-PI, "vBNS Connectivity for the Johns Hopkins University," NSF, \$350,000, 1997-99 (with T.O. Poehler (PI), D.J. Binko, J.G. Neal, and A.S. Szalay).
12. co-PI, "Product Donation, Technology for Education Program," Intel Corporation, \$480,071, 1997-2001 (with T.O. Poehler (PI), J.H. Anderson, A.S. Szalay, and M. Robbins).
13. co-PI, "A Networked Computing Environment for the Manipulation & Visualization of Geometric Data" (Research Infrastructure), NSF, \$1,638,785, 1997-2003 (with L.B. Wolff (PI), Y. Amir, S.R. Kosaraju, S. Kumar, R. Tamassia (Brown U.), R.H. Taylor, and D. Yarowsky).
14. PI, "Geometric Algorithm Design and Implementation," NSF, Grant CCR-9732300, \$224,982, 1998-2002.
15. PI, "Certification Management Infrastructure - Certificate Revocation," \$52,023, 1998, NSA LUCITE grant.
16. PI, "Software Engineering Data Loading, Analysis, and Reporting," \$41,614, 1998, NSA LUCITE grant.
17. PI, "Establishing a LUCITE Collaboration Environment," \$10,018, 1998, NSA LUCITE grant.
18. PI, "In Support of a Secure Multilingual Collaborative Computing Environment," \$51,471, 1999-2000, NSA LUCITE grant.
19. PI, "Accessing Large Distributed Archives in Astronomy and Particle Physics," \$199,981. subcontract to UCI from Johns Hopkins Univ. on NSF Grant PHY-9980044 (total budget, \$2,500,000), 1999-2004.

20. PI, "Efficient and Scalable Infrastructure Support for Dynamic Coalitions," \$1,495,000, DARPA Grant F30602-00-2-0509, 2000-2003 (with Robert Cohen and Roberto Tamassia), including \$227,893 subaward to UCI (with Gene Tsudik).
21. PI, "Graph Visualization and Geometric Algorithm Design," \$400,000, NSF Grant CCR-0098068, 2001-2004 (with Roberto Tamassia).
22. PI, "Collaborative Research: Teaching Data Structures to the Millennium Generation," \$125,000, NSF Grant DUE-0231467, 2003-2005.
23. PI, "Collaborative Research: An Algorithmic Approach to Cyber-Security," \$100,000, NSF Grant CCR-0311720, 2003-2006.
24. PI, "The OptIPuter," \$900,000, subcontract from UCSD on NSF ITR grant CCR-0225642 (total budget, \$13.5 million), 2002-2007 (with Padhraic Smyth and Kane Kim).
25. PI, "ITR: Algorithms for the Technology of Trust," \$300,000, NSF Grant CCR-0312760, 2003-2009.
26. co-PI, "SDCI Data New: Trust Management for Open Collaborative Information Repositories: The CalSWIM Cyberinfrastructure," NSF grant OCI-0724806, \$1,103,590, 2007-2012.
27. co-PI, "Support for Machine Learning Techniques for Cyber-Fraud Detection," Experian Corporation, \$200,000 gift, 2008.
28. PI, "IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0713046, \$224,851, 2007-2009.
29. PI, "Collaborative Research: Algorithms for Graphs on Surfaces," \$400,000, NSF Grant CCR-0830403, 2008-2011.
30. PI, "ROA Supplement: IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0847968, \$25,000, 2008-2009.
31. co-investigator, "Scalable Methods for the Analysis of Network-Based Data," Office of Naval Research: Multidisciplinary University Research Initiative (MURI) Award, number N00014-08-1-1015, \$529,152, 2008-2014.
32. PI, "EAGER: Usable Location Privacy for Mobile Devices," NSF Grant 0953071, \$300,000, 2009-2011.
33. PI, "TC:Large:Collaborative Research: Towards Trustworthy Interactions in the Cloud," NSF Grant 1011840, \$500,000, 2010-2015.
34. PI, "TWC: Medium: Collaborative: Privacy-Preserving Distributed Storage and Computation," NSF Grant 1228639, \$390,738, 2012-2016.
35. PI, "Support for Research on Geometric Motion Planning," 3M Corporation, \$40,000 gift, 2014.
36. PI, "A4V: Automated Analysis of Algorithm Attack Vulnerabilities," subcontract 10036982-UCI from University of Utah for DARPA agreement no. AFRL FA8750-15-2-0092, \$980,000, 2015-2019.
37. PI, "TWC: Small: Collaborative: Practical Security Protocols via Advanced Data Structures," NSF Grant 1526631, \$166,638, 2015-2017.

#### SELECTED INVITED TALKS (RECENT YEARS ONLY)

- "Probabilistic Packet Marking for Large-Scale IP Traceback," Purdue Univ., 2003
- "Algorithms for Data Authentication," Harvey Mudd College, 2003
- "Efficient Tree-Based Revocation in Groups of Low-State Devices," Univ. of Arizona, 2004

- “Leap-Frog Packet Linking and Diverse Key Distributions for Improved Integrity in Network Broadcasts,” Southern California Security and Cryptography Workshop, 2005
- “Is Your Business Privacy Protected?,” NEXT Connections, 2005
- “Distributed Peer-to-peer Data Structures,” Harvard Univ., 2006
- “Balancing Life with an Academic Research Career,” Grace Hopper Conference, 2006
- “Computer Security in the Large,” Univ. Texas, San Antonio, 2006
- “Inspirations in Parallelism and Computational Geometry,” Brown Univ., 2006
- “Efficiency and Security Issues for Distributed Data Structures,” Computer Science Distinguished Lecture Series, Johns Hopkins Univ., 2006
- “Efficiency and Security Issues for Distributed Data Structures,” UCLA, 2006
- “Efficiency and Security Issues for Distributed Data Structures,” Edison Distinguished Lecturer Series, Univ. of Notre Dame, 2006
- “Efficiency and Security Issues for Distributed Data Structures,” Computer Science Distinguished Lecturer Series, Texas A & M Univ., 2006
- “Algorithms for Secure Computing and Searching with Applications to Medical Informatics,” Purdue Univ., 2006
- “Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security,” Univ. of Southern California, 2007
- “Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security,” Univ. California, San Diego, 2007
- “Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security,” Univ. Minnesota, 2007
- “Blood on the Database: How Algorithms for Testing Blood Samples can be Used for Database Integrity,” Invited Keynote, 21st Annual IFIP WG 11.3 Working Conference on Data and Applications Security (DBSec), 2007
- “Space-Efficient Straggler Identification,” ALCOM Seminar, Univ. of Aarhus, 2007
- “Blood on the Computer: How Algorithms for Testing Blood Samples can be used in Modern Applications,” ALCOM Seminar, Univ. of Aarhus, 2007
- “Studying Road Networks Through an Algorithmic Lens,” ALCOM Seminar, Univ. of Aarhus, 2008
- “Studying Geometric Graph Properties of Road Networks Through an Algorithmic Lens,” International Workshop on Computing: from Theory to Practice, 2009
- “Randomized Shellsort: A Simple Oblivious Sorting Algorithm,” Distinguished Lecture Series, Department of Computer Science, Brown University, 2009
- “Simulating Parallel Algorithms in the MapReduce Framework with Applications to Parallel Computational Geometry,” MASSIVE 2010
- “Data Cloning Attacks for Nearest-Neighbor Searching based on Retroactive Data Structures,” Department of Computer Science, UCSB, 2011
- “Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitive Binary Attribute Vectors,” Department of Computer Science Distinguished Lecturer Series, Univ. of Illinois, Chicago, 2011
- “Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitive Binary Attribute Vectors,” Department of Computer Sciences, Purdue

Univ., 2011

- “Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons,” Department of Computer Science, Brown Univ., 2012
- “Using Data-Oblivious Algorithms for Private Cloud Storage Access,” Qatar University, 2013
- “Using Data-Oblivious Algorithms for Private Cloud Storage Access,” Department of Computer Science and Engineering Distinguished Speaker Series, University of Buffalo, 2013
- “Force-Directed Graph Drawing Using Social Gravity and Scaling,” invited talk, ICERM Workshop on Stochastic Graph Models, Providence, RI, 2014
- “Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis,” invited key-note speaker, Algorithms for Big Data, Frankfurt, Germany, 2014
- “Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis,” Brown University, Providence, RI, 2014
- “Studying Road Networks Through an Algorithmic Lens,” Bold Aspirations Visitor and Lecture, University of Kansas, 2015
- “Learning Character Strings via Mastermind Queries, with Case Studies,” Invited Lecture, Workshop on Pattern Matching, Data Structures and Compression, Bar-Ilan University, Tel Aviv, Israel, 2016
- “Invertible Bloom Lookup Tables and Their Applications in Data Analysis,” University of Hawaii, 2016
- “Invertible Bloom Lookup Tables,” Purdue University, 2016
- “Combinatorial Pair Testing: Distinguishing Workers from Slackers,” Calvin College, 2016
- “Invertible Bloom Lookup Tables,” University of California, Riverside, 2016

#### PROFESSIONAL SOCIETY MEMBERSHIPS

American Association for the Advancement of Science (AAAS), Fellow  
 IEEE and IEEE Computer Society, Fellow  
 Association for Computing Machinery (ACM), Fellow

2/6/2017

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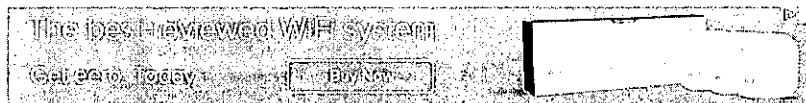
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CNET • Tech Culture • All Blu-ray players bow to the PlayStation 3?

# All Blu-ray players bow to the PlayStation 3?

With the PS3 priced less than almost all standalone Blu-ray players, is it the best deal?



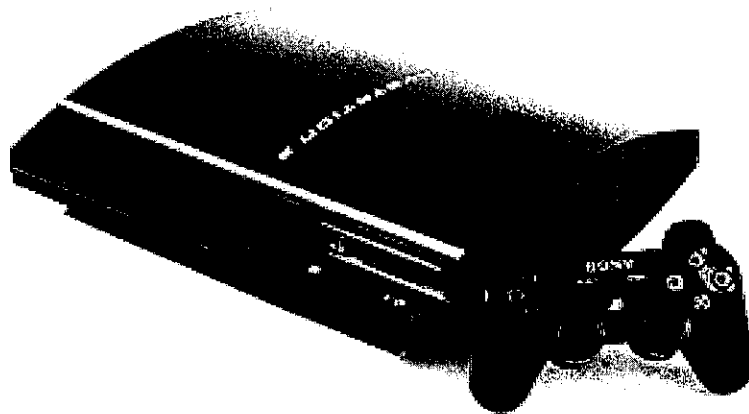
Tech Culture



by Matthew Moskovciak

December 13, 2006 12:51 PM PST

@cnetmoskovciak



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CNET

After a long wait, we're finally starting to get in a new wave of first-generation Blu-ray players. CNET will be posting full reviews for both the Panasonic DMP-BD10 and the Philips BDP9000 shortly, but I've already taken some long looks at each in terms of picture quality, and they've got a lot to be worried about. Not because they look worse than HD DVD; in fact, the picture-quality gap is almost gone between the two formats. And not because they're bad players; both of them put out a pristine Blu-ray image that blows DVD out of the water. The problem is that, excluding some very minor differences, all the Blu-ray players I've seen offer essentially the same picture quality. That's a problem because the 20GB PlayStation 3 retails for \$500, which is \$800 less than the Panasonic DMP-BD10 and around \$400 less than the Philips BDP9000. Even with eBay inflation, we're seeing the 20GB PS3 go for \$600.

What are the arguments against buying the PS3 for home theater use? Not many, but there are some to consider. One thing that comes to mind is that some people would like a standard remote for navigation rather than using a controller. Well, Sony will soon be offering a standard-style remote for the PS3. Problem solved. However, there is an ugly little detail for those who love their universal remote: the PS3 does not have an infrared receptor, so you won't be able to program a fancy Harmony macro that says "Watch Blu-ray." This is a legitimate issue, but don't be surprised if universal remote manufacturers come out with combination IR plus Bluetooth remotes (or a USB IR plug-in for the front of the PS3) that will make this a nonissue.

Two new Blu-ray players that we haven't seen yet, the Sony BDSP1 and the Pioneer Elite BDP-HD1, have a slight edge in that they claim to output 1080p/24. This could be a slight knock against the PS3 since it can't currently do that, although we've seen reports that it might be able to in the future. Probably the highest disadvantage of the PS3 is that it currently does not upscale

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regular DVDs. Sony has promised an update in the future, but there's no guarantee it will do as good of a job as the DMP-BD10 and the BDP9000--both are more than competent upscaling DVD players. That being said, with the power of the Cell processor and its current excellent Blu-ray picture quality, we're betting the PS3 will be up to the task.

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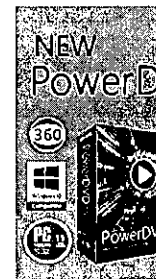
**Snapchat's not just for sexting anymore**

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## The Key to Autonomous Driving

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Self-driving cars are a hot topic, but the road to autonomous driving is complicated. What is key to the success of this next generation technology?



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Figure 1. Location of the study area.

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27

# Sexting and Brexit: Things we



2/6/2017

All Blu-ray players bow to the PlayStation 3? - CNET

# learned from Snap's IPO filing

Snapchat, the disappearing-photo app founded by a college dropout, is growing up and looking to raise \$3 billion.

## Tech Industry



by Richard Nieva  
February 2, 2017 5:17 PM PST  
@richardnieva



by Shara Tibken  
February 2, 2017 5:17 PM PST  
@sharatibken

This may be the first time the word "sexting" has been included in an SEC filing.

Snap, the parent company of Snapchat, just released its IPO filing, and included that tidbit about how it was first dismissed as an app for sending nudes. There's plenty of other juicy information Snapchat shared about its business as the five-year-old company prepares to go public. The popular mobile app, known for its self-detonating photos and videos, said Thursday it aims to raise \$3 billion.

Evan Spiegel, a 26-year-old Stanford University dropout, co-founded the app in 2011. Since then, teens and young people have flocked to it, to document everything from concerts to morning commutes.



CEO Evan Spiegel's salary will go down to \$1 from \$500,000 after Snap goes public.

Michael Kovac/Getty Images

The Los Angeles company has already built up its fair share of lore, as it emerges as one of the tech industry's newest power players. Spiegel has already stared down Facebook's Mark Zuckerberg, reportedly balking at his \$3 billion takeover offer in 2013. The company was the target of a lawsuit by an ousted co-founder.

And, of course, it began life derided as nothing more than a "sexting" app.

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**The money.** Snap is valued at \$20 billion to \$25 billion. It's looking to raise \$3 billion in the offering.

## More stories

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Spiegel is engaged to supermodel Miranda Kerr.  
Steve Granitz/WireImage



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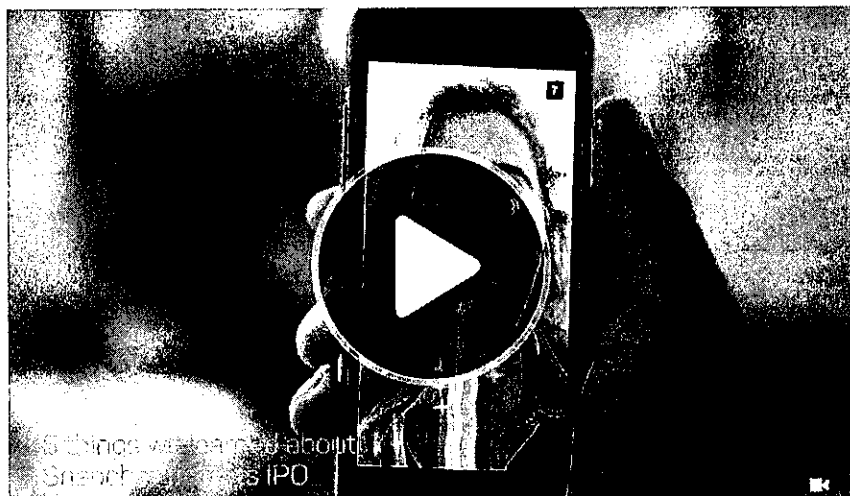
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2/6/2017

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Share Snapshots and video -- every day. On average, more than 60 percent of the company's daily active users create Snaps with its camera every day. Users visit Snapchat more than 18 times a day, on average, and spend 25 to 30 minutes on the app. (I'm tired just typing that.)

By comparison, Facebook has 1.86 billion people on its platform -- two out of every seven on the planet -- and 1.2 billion use it daily. So the user points for now go to Zuckerberg.

**Confusing.** It can be hard to use Snapchat. You have to swipe and tap and there are no explicit directions on how to do things. The company knows that. The lack of intuition in its user interface is listed as a risk factor.

**Slowing growth?** Snap warned that its daily active user base may not continue to grow, and that its user growth showed a slowdown in the past couple of quarters of 2016. In the beginning of the September quarter, its base increased 7 percent from the June quarter. But in the latter part of the September period, its user base was "relatively flat," which resulted in an overall 4 percent sequential rise. It also added only 4.5 percent more users from September to December (before that, the user base had risen sequentially in the double digits on a percentage basis).

screen-shot-2017-02-02-at-4-27-18-pm.png

Snapchat's user numbers.

Snapchat

**iPhone effect.** The "majority" of Snap's users have iPhones. "As a result, although our products work with Android mobile devices, we have prioritized development of our products to operate with iOS operating systems rather than smartphones with Android operating systems." Sorry, Google.

**Spectacles.** Snap's first device, the video camera-equipped Snapchat Spectacles, went on sale in September for \$130. They became a hot holiday gift, with people lining up for hours at Spectacles vending machines that popped up around the country.

Snap doesn't really make any money from them, though, and "substantially all" of its revenue comes from advertising. Despite making "significant investments" to make Spectacles, "we are not yet able to determine whether users will purchase or use Spectacles in the future," Snap said.

**FDA.** Its Spectacles are regulated by the US Food and Drug Administration and other state and foreign regulatory agencies. And it "may develop future products that are regulated as medical devices by the FDA."

**More on Snapchat**

Snapchat isn't disappearing. Get used to it

Snapchat is growing up, files for IPO

Oh Snap, Spectacles are ridiculously fun

**Potty humor.** The IPO filing includes references to party goats, pooping while on your phone and, of course, sexting. Not your average S-1.

**Brexit.** The UK's plan to leave the European Union isn't just causing turmoil for Europeans. It also could hurt Snap. The company plans to base "a significant portion" of its non-US operations in the UK, and it has licensed a portion of its intellectual property to its UK subsidiary. "No assurance can be given about the impact of the outcome, and our business, including operational and tax policies, may be seriously harmed or require reassessment if our European operations or presence become a significant part of our business."

**Net neutrality.** Snap says the open internet is important to its success. Because so much of what people do on Snapchat -- send high quality videos and pictures -- requires lots of bandwidth, the company favors net neutrality. That's the idea that all data on the internet is treated equally, and no company or website gets special treatment. But Net neutrality could fall by the wayside under President Donald Trump.

Snap co-founders Evan Spiegel and Bobby Murphy

Spiegel and Bobby Murphy cofounded the app as fraternity brothers at Stanford University.

Getty Images

**Control.** Even if Evan Spiegel or Bobby Murphy is terminated from the company, they'll "continue to have the ability to exercise the same significant voting power," and potentially still control stockholder decisions. The company also says neither co-founder can take on the duties of the other, and it wouldn't be easy for Snap to quickly find a suitable replacement.

**Charity.** Snap has been operating a new charity, the Snap Foundation, since the beginning of this month (yes, a whopping two days). The company and the co-founders have each pledged that after the IPO they'll donate up to 13 million shares of their Class A common stock to the foundation over the next 15 to 20 years. The group will support arts, education and youth.

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**Ad dollars.** "Substantially all" of Snap's revenue comes from advertisers, but it doesn't have long-term commitments from most advertisers despite recent efforts to set up such deals. There's not a single advertiser or content partner that accounts for more than 10 percent of Snap's revenue. Many of its advertisers just started working with the company and spend only "a relatively small portion of their overall advertising budget" with Snap.

**Google Cloud.** Talk about frenemies. Google is listed as a competitor -- partly because of YouTube -- but it's also an ally. Snap relies on the search giant's cloud service for storage and bandwidth. The company said it made a \$2 billion deal with Google over five years to use its cloud service.

Michael Lynton, CEO of Sony Entertainment, said last month that he's leaving Sony to become chairman of Snap's board full-time.

Michael Lynton, CEO of Sony Entertainment, said last month that he's leaving Sony to become chairman of Snap's board full-time.

Matt Winkelmeyer/Getty Images

**The competition.** Other big competitors (who are sometimes friends) include Apple, Facebook (and its Instagram and WhatsApp businesses), Twitter, Kakeo, Line, Naver and Tencent. "Many of our current and potential competitors have significantly greater resources and broader global recognition and occupy better competitive positions in certain markets than we do," Snap warned.

Who's not listed as a competitor? Camera makers like Canon (even though Snap calls itself a camera company).

**Instagram.** Snapchat called out Facebook-owned Instagram for ripping off its marquee feature, Stories, which lets users post a string of videos and pictures that disappear after 24 hours. Instagram Stories "largely mimics" Snapchat's own feature, and it "may be directly competitive." Yeah, we can see that.

**The media.** Snap warns that negative media coverage could affect its brand, and therefore the success of the company. The company has already had its share of bad press, including a lawsuit from an ousted co-founder. Basically, Snap's message to the press: Please don't write bad stuff about us.

**Growing team.** The company has 1,859 employees, up 600 over the past year. And that's just the beginning. It plans to add to the head count "rapidly" through hiring and acquisitions. That's where the \$3 billion it hopes to raise will come in handy.

*CNET Magazine: Check out a sampling of the stories you'll find in CNET's newsstand edition.*

*Batteries Not Included: The CNET team shares experiences that remind us why tech stuff is cool.*

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2/6/2017

All Blu-ray players bow to the PlayStation 3? - CNET

tech companies are doing to save the rhino, learn how Tetris conquered the world, and more in the Winter issue of CNET Magazine.

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TOP BRANDS: LG / T-mobile. Un-leash.

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10 Comments

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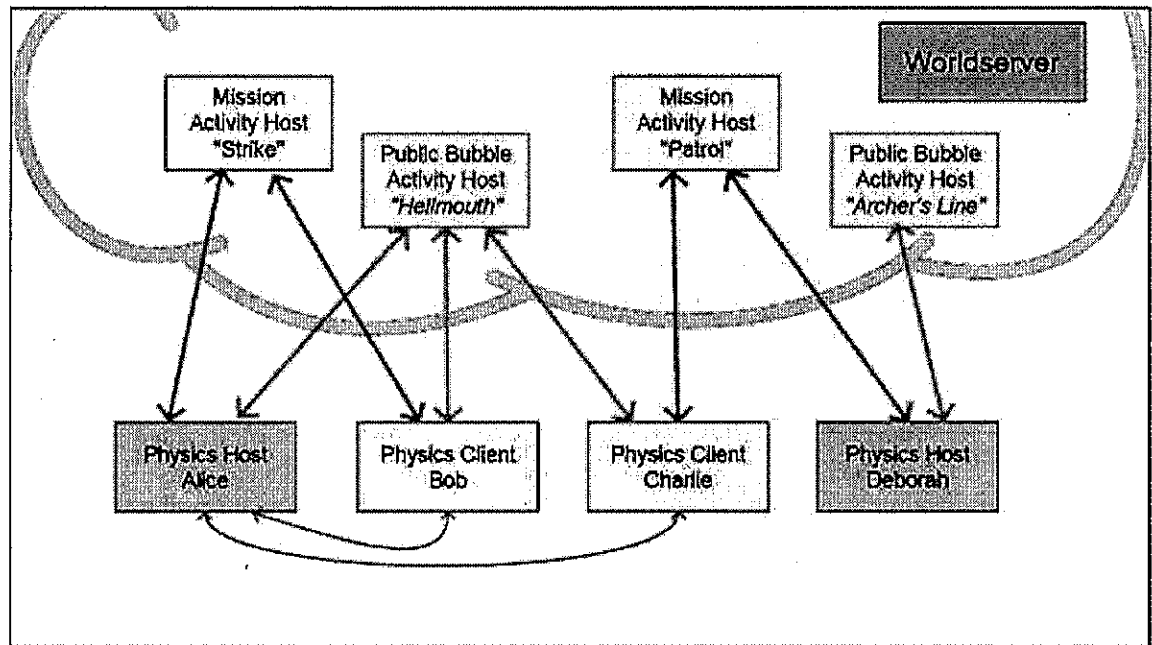
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6,732,147	Sony PlayStation Product
<p><b>“Sony PlayStation Product”</b> refers to the PlayStation 3, PlayStation 4 running, for example, the PlayStation game Destiny.</p>	
<p><b>Claim 6</b></p>	
<p><b>claim 6(a):</b> A method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising:</p>	<p>The Sony PlayStation Product meets the recited claim language because it includes functionality to for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3.</p> <p>The Sony PlayStation Product includes functionality for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3. This functionality controls players disconnecting from a game session, and attempts to heal a game session by making new connections. The match server, host server or peer will communicate with another player that had an established communication channel with the disconnecting play and that can be connected to the game session to maintain an optimized game session or match and to create an optimized connectivity mesh of players. The functionality will initiate an attempt by the match server, host server, or peer to find a connection port to another player that can be used to maintain an m-regular graph in the game session or match and to create an optimized connectivity mesh of players. The functionality creates m-regular topologies of players when setting up logical and physical network topologies in order to do the following:</p> <ul style="list-style-type: none"> <li>• manage states when different players leave, are kicked, or are disconnected.</li> <li>• manage the game during gameplay and to relay content through different NAT configurations;</li> <li>• route game data using optimal paths and relays;</li> <li>• distribute VoIP chat data among the players; and</li> <li>• determine which game a player should be matched to;</li> <li>• ensure no players are overloaded for optimal gameplay in a connectivity mesh;</li> <li>• create a game session with logical and physical network topologies</li> <li>• connect players to other players for matchmaking;</li> </ul> <p>As shown below, utilizes a “hybrid” peer-to-peer network topology, where additional game player’s consoles as participants can forward data from one neighbor participant to another neighbor participant and non-client servers called “activity hosts” and can also communicate with each other as additional participants in the network, including PlayStation 3 (PS3) and PlayStation 4 (PS4) consoles (e.g. Physics Hosts and Physics Clients) and Activity Hosts (e.g. Mission Activity Hosts and Public Bubble Activity Hosts)</p>



... and uniquely complicated networking topology


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 7.  
 Exhibit 2029 [http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 78.(Physics Host (PS4))

As shown below, the product allows multiple participants to play the game online concurrently, allowing for reduced latency and frequent updates for a better online experience:



## Host Migration!

- Dedicated Servers!
- Need to be cost-feasible
- Need to preserve peer-to-peer responsiveness
- Can we instead “fix” our Host Migration problems?

DESTINY 

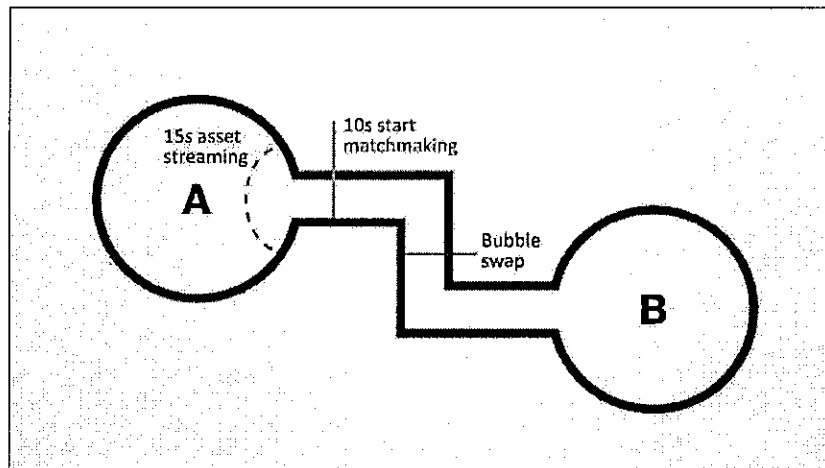
At this point, I'm sure some of you are thinking — just use dedicated servers! If we just never Host Migrate, because we put all our Physics Hosts in the cloud, we never have to solve all these pesky problems.

There's a couple strong reasons we didn't simply run dedicated servers that were traditional Physics Hosts.

For one thing, they need to be cost-feasible. To support our launch, we'd have needed hundreds of thousands of headless PS3-Parity executables in the cloud, and that becomes a significant continuous cost to maintain, especially if our player-retention continues to stay as strong as it has.

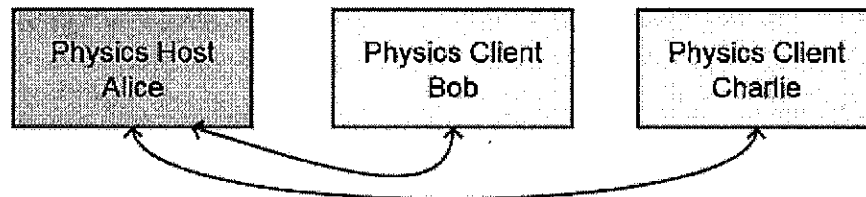
Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 53.

The product will retry to connect until a connection is successfully established by seamlessly swap players to the new game during matchmaking transitions to a networked game to heal a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3:



The neat thing we also do during these transitions is matchmake you to a new networked game. In order to meet new strangers in bubble B, we start matchmaking for a new host at the 10s mark, and are ready to seamlessly swap you to the new game when we perform our bubble swap.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 36.



So, let's supposed we've got 3 players in this public bubble – Alice, Bob, and Charlie.

They're Peer-to-peer connected to each other using traditional Reach networking, and Alice is the Physics Host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 96.

## Activity Host Separation

- This cool upside is also a downside
- Have to separate Public and Private scripts
- Very limited communication between Activity Hosts
- We've only scratched the surface here!

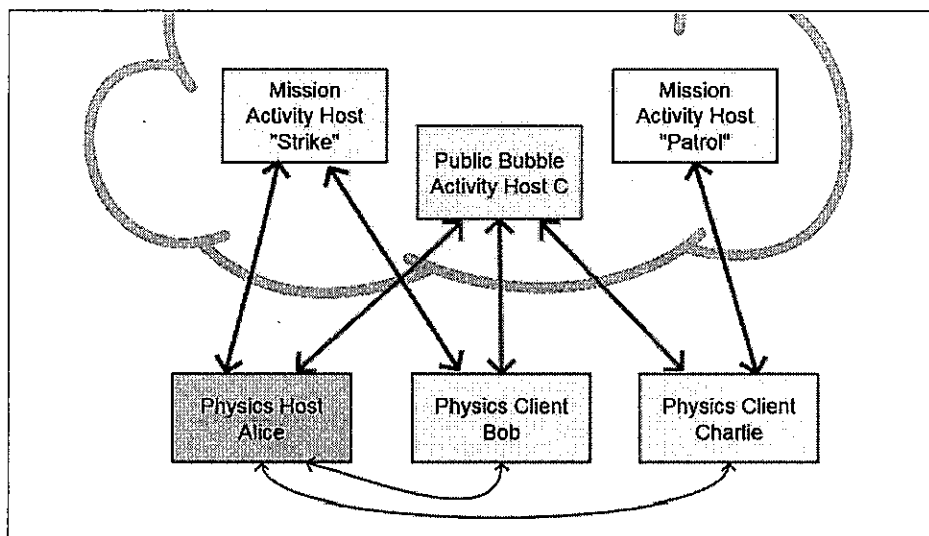
DESTINY 

This cool upside carries with it additional complexity—in order to do something like this, you have to split up your activity into Public and Private portions.

The Public Portions live on their respective Public Bubble Hosts, the private portions live on the Mission Host.

And for reasonably complex interactions between the two, you have to pass Global Flags back and forth between them, because there's very limited communication between Activity Hosts

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 111.



Finally, they're also simultaneously all connected to the same "Bubble Activity Host".

The Bubble Host is responsible for all the ambient scripting in the public bubble  
 It spawns and scripts all the ambient AI that you fight  
 It handles the respawn timing and placement of all the resource nodes and treasure chests  
 and it runs all the logic for all the public events.

Those are the main things that we do in our Destiny public bubbles – but  
 technologically a Bubble Host is almost identical to a Mission Host. So you could  
 write an arbitrarily complex script in there for a crazy public boss encounter.

I said "Almost Identical," because there is one key difference between Mission Hosts  
 and Bubble Hosts worth mentioning

Exhibit 2029 ([http://twvideo01.ubm-us.net/01/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/01/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 99.

As shown below, the Sony PlayStation Product includes functionality to allow each participant to have connections to at least three neighbor participants, including PS4 consoles and allows players to "Invite Friends" to join his/her network:

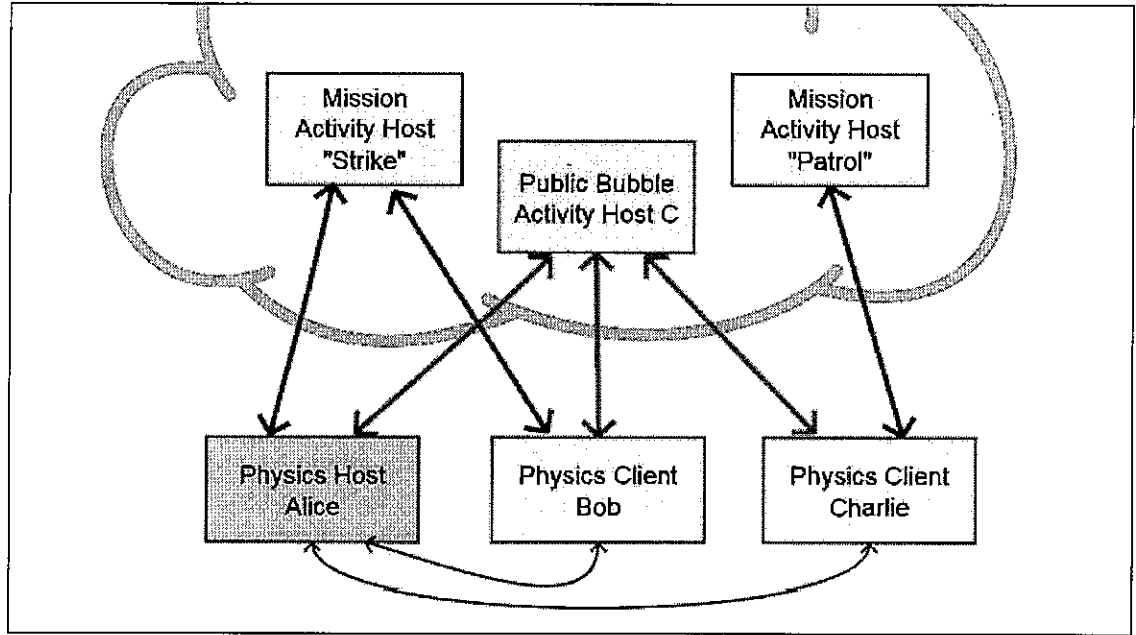


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 99.

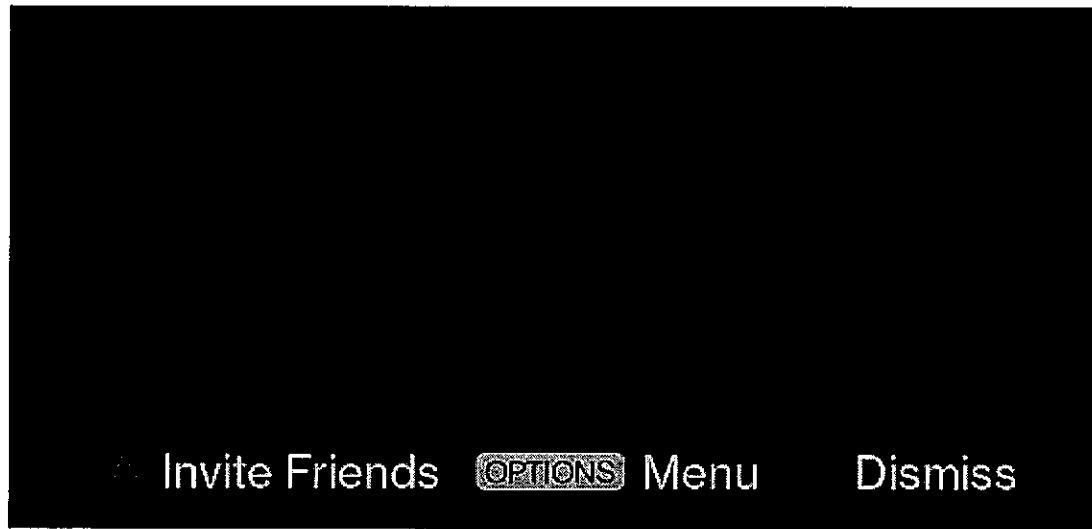
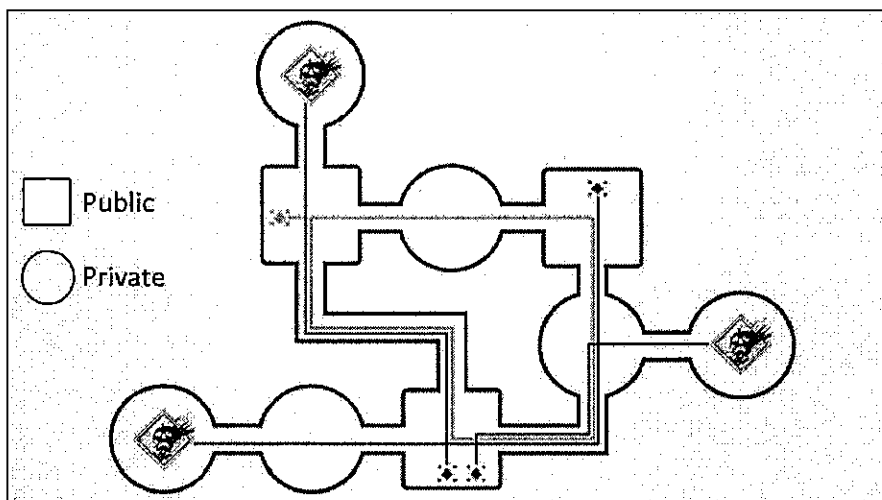


Exhibit 2037  
 ([https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src\\_vid=XXQfiwPzjmc&annotation\\_id=annotation\\_2453463955](https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src_vid=XXQfiwPzjmc&annotation_id=annotation_2453463955))

1 Friend Online   Invite Friends   **OPTIONS**   Menu   Dismiss

Exhibit 2037 (<https://www.youtube.com/watch?v=mfzIDQQLCqk>).

The Sony PlayStation Product includes functionality to create m-regular topologies of players when setting up logical and physical network topologies using the PlayStation Network SDKs and Activity Hosts, which are used to handle activity and failover states when players are no longer connected or leave via Host Migration to a new physics host to heal a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3:



But Destiny is a world of intersecting, not parallel lines. Most of the time, players are just passing through public bubbles. Any one of these players could be the current Physics Host, and as soon as she leaves and deinstantiates the bubble, we need to Host Migrate to a new physics host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 51; *see also* Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 40.

claim 6(b):  
attempting to  
send a message  
from the first  
computer to the  
second  
computer; and

The Sony PlayStation Product meets the recited claim language because it attempts to send messages from a first computer to second computer within m-regular connectivity meshes of players during different network game sessions and for different game session data and makes sure that each of the players is optimally connected to other players to ensure that all nodes are connected to the same number of nodes to ensure that no node is overloaded.

The Sony PlayStation Product includes functionality that attempts to send messages from a first computer to second computer within m-regular connectivity meshes of players during different network game sessions and for different game session data and makes sure that each of the players is optimally connected to other players to ensure that all nodes are connected to the same number of nodes to ensure that no node is overloaded, as shown in the screenshots below:

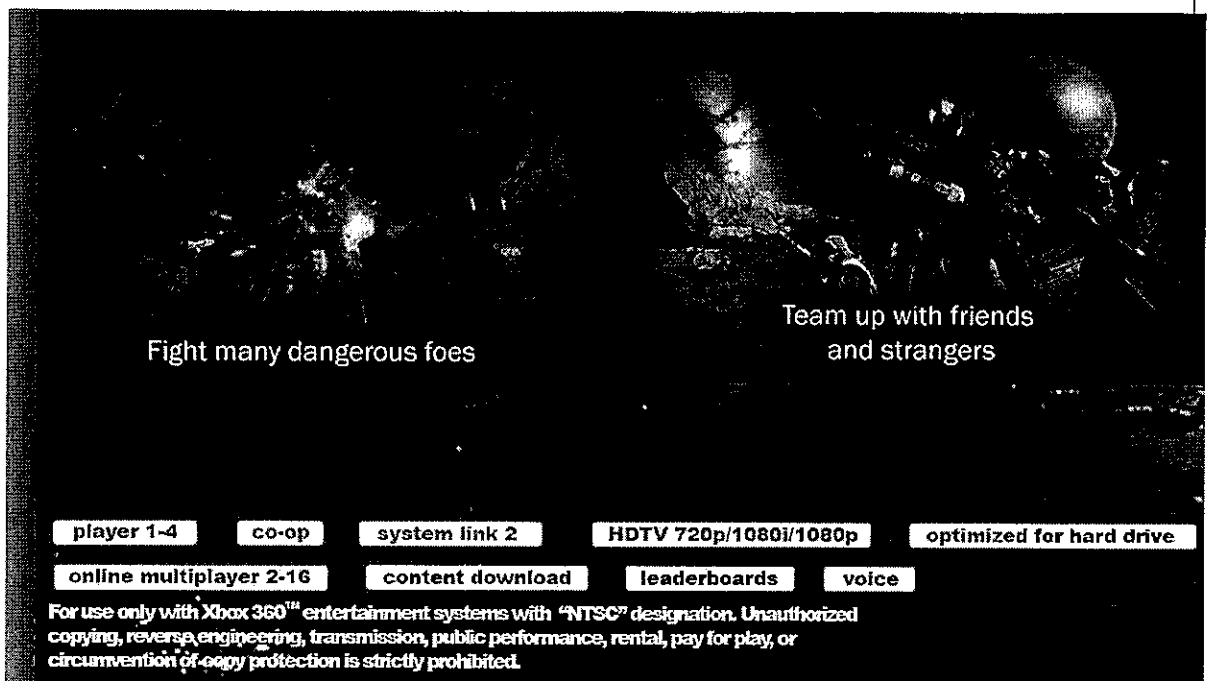


Exhibit 2030 (<http://vgboxart.com/viewfullsize/66658/Destiny/>);  
Exhibit 2031.

The following screen captures show that the Sony PlayStation Product includes functionality that utilizes a “mesh-based” network that supports “millions of players online at once” attempting to send messages from a first computer to second computer:

Multiplayer in Destiny is set to be unlike anything that's come before. We spoke with Bungie technical director Chris Butcher about how it works under the hood and what displays to the player in the game. Find out the nuts and bolts of how Destiny differs from both MMOs and multiplayer shooters to carve its own path.

**How did the big idea for Destiny's multiplayer philosophy start?**

You have all of these examples of people who are doing big server cluster things like World of Warcraft or something like that. But we didn't really want to do that, because if you think about those kinds of games, you've got a centralized server that's simulating everything in the world, but that can only scale up to some number of players. Maybe it's 1,000. Maybe it's 5,000. Maybe it's 20,000. You compare that to the population of a console game and it's tiny.

So what that means is that you have to have dozens or hundreds of these separate servers. So we started out by thinking, "We want to have a single world that everybody can be in."

We took this mesh-based networking that we've been developing for years and years with Halo and adapted that networking to work in a seamless interconnected world full of other players and AIs. So when you're playing a destination you're moving from area to area and every one of those areas has got this mesh networking with a group of players that are in it at this one time. And then it has its own servers for that particular area so you're continuously moving around between these groups of both consoles and also dedicated servers that are hosting it.

That's the thing that I'm really excited that we've been able to do because I think it's been really hard for us. And I don't really think anybody else is going to be able to pull it off in the timeframe we're talking about on consoles.

Exhibit2028 <http://www.gameinformer.com/b/features/archive/2013/12/06/the-matchmaking-technology-of-destiny.aspx?PostPageIndex=1>



**How does this mesh-based network play out in the game?**

What happens is everybody in the world can play together. There aren't these barriers that are in place. You're all playing in one connected online world. When you're moving from location to location you're always going to have people to play with because there's this huge population. You never have to go to an area of the world that's deserted because there happens to be no one here on the server at this time.

There are these artifacts that you get when you have, when you do a simulation that runs on a single server on a big mainframe type thing, there are two problems that you get. One problem is all of the 5,000 people on your server nobody is playing in Old Russia at the moment so it's just empty when you go there. Or the other problem is all 5,000 people logged in and tried to go to the same place at the same time and the server crashes or it gets so full up that it's totally lagged out. And if it does get full then there are some of those games that will start having different instances, but typically they don't handle that very well because it's not a core part of the game design.

For us we've kind of said we want this game world to be able to work with millions of players online at once. And that means playing to the strengths of the consoles. Being able to use these very powerful machines to run a lot of the simulation. Being able to use the servers in a seamless fashion so that as you're moving from place to place you're switching networks with all of the different people that are around you. You've got a very high quality fast action gameplay experience. If you have all of these calculations taking place in a central server that's one place in the world you can't really have a fast action experience.

What if you're playing from Brazil or the West Coast of America? When we have this big pool of global players to matchmake with we're able to use all of our technology to make sure you're playing with people who are physically located near you so you have good ping to everybody else. So you're able to have this great action experience that you're used to in these action games. But at the same time you can do it in this global fashion.

Exhibit 2028 <http://www.gameinformer.com/b/features/archive/2013/12/06/the-matchmaking-technology-of-destiny.aspx?PostPageIndex=1>

As a further example, the following screen capture shows eight participants interacting with each other attempting to send messages from a first computer to second computer:



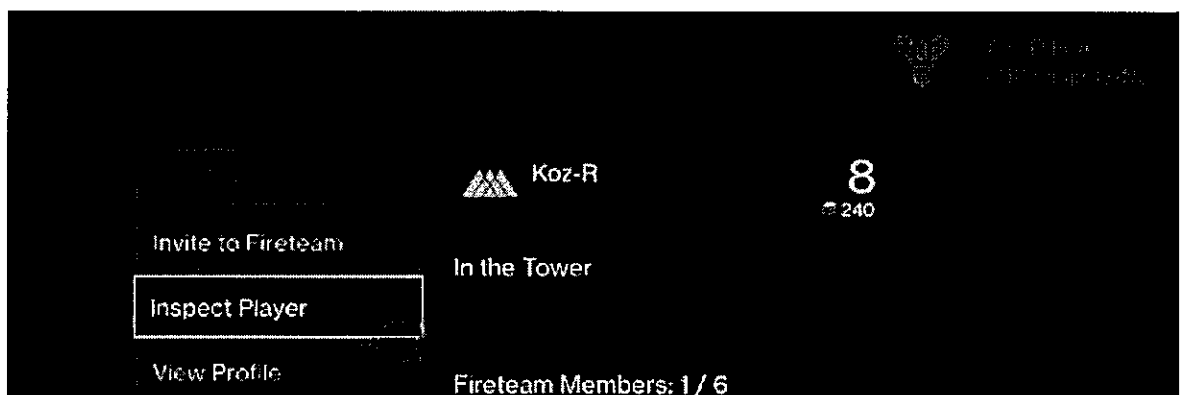
Exhibit 2033 <https://www.youtube.com/watch?v=dPcrnT0of5g>

When a user plays the product, connections to other players happens on the fly using “on the fly matchmaking” technology, “invisibly matching players with each other as they play.” This occurs by using a “dynamic network architecture” that allows game players’ consoles and/or game servers as participants to attempt to send messages from a first computer to second computer, as shown below:

**wolfking2010** If a Fireteam member has to leave can another player seamlessly join my game?

Certainly, your Highness. How and why and under what circumstances will be better experienced than explained. The social connections that you'll enjoy on your travels are just one of the ways that Destiny will surprise you.

Exhibit 2023 [Bungie Weekly Update Archive] <http://destiny.bungie.org/bwu/26>



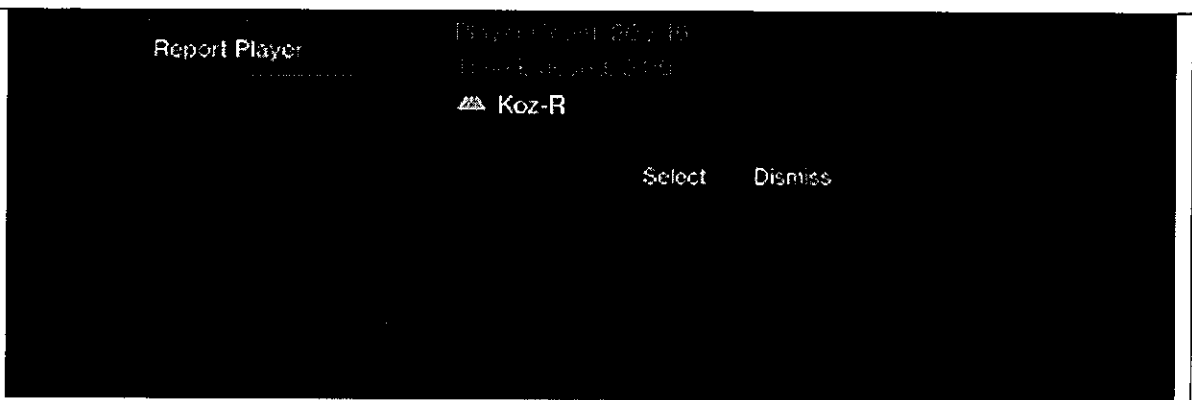


Exhibit 2034 <https://www.youtube.com/watch?v=MOY5zJcH0fi>

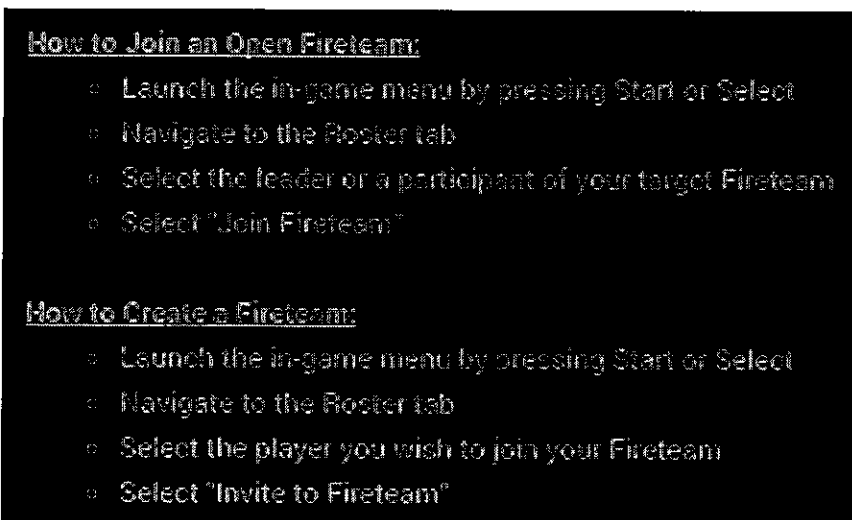


Exhibit 2024 [https://www.bungie.net/7\\_How-to-Join-or-Create-a-Fireteam/en/Help/Article/13978](https://www.bungie.net/7_How-to-Join-or-Create-a-Fireteam/en/Help/Article/13978)

As shown above, the Sony PlayStation product contains functionality to allow a player to join a particular multiplayer game of interest, with each player attempting to send messages from a first computer to second computer, such as providing a "Fireteam" mode where up to six participants can form a team to play the game simultaneously online and that this "Fireteam" can be joined by identifying another participant of the targeted Fireteam:

### The next step on that front begins with this Iron Banner.

Lord Saladin's battle for the Spark will feature new matchmaking settings that will assign more emphasis to connection quality. These changes will be made in an effort to reduce lag. There will still be some consideration given to matching you with worthy adversaries, but that's a thing we've done since Destiny first shipped.

Exhibit 2025 <https://www.bungie.net/en/News/News?aid=14278>

11:26	Iron Banner
zbone96	460
PattyBarrett	150
Spencer7brother	110
Bindrr	50
PetrolNinja	0
Alpha	870
GameOfJobs	110
KyleF329	0
Bravo	110

Exhibit 2035 <https://www.youtube.com/watch?v=YG7IhxdsciA>

As shown below, the Sony PlayStation Product includes functionality to allow each participant to have connections to at least three neighbor participants, with each player attempting to send messages from a first computer to second computer, including PS4 consoles and allows players to "Invite Friends" to join his/her network:

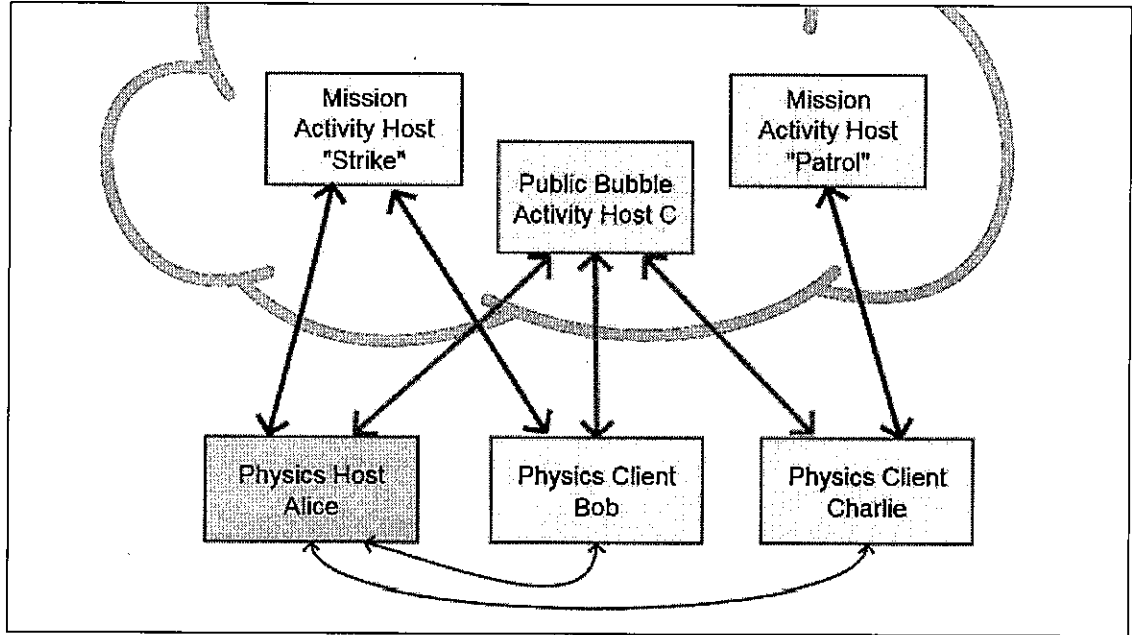


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 99

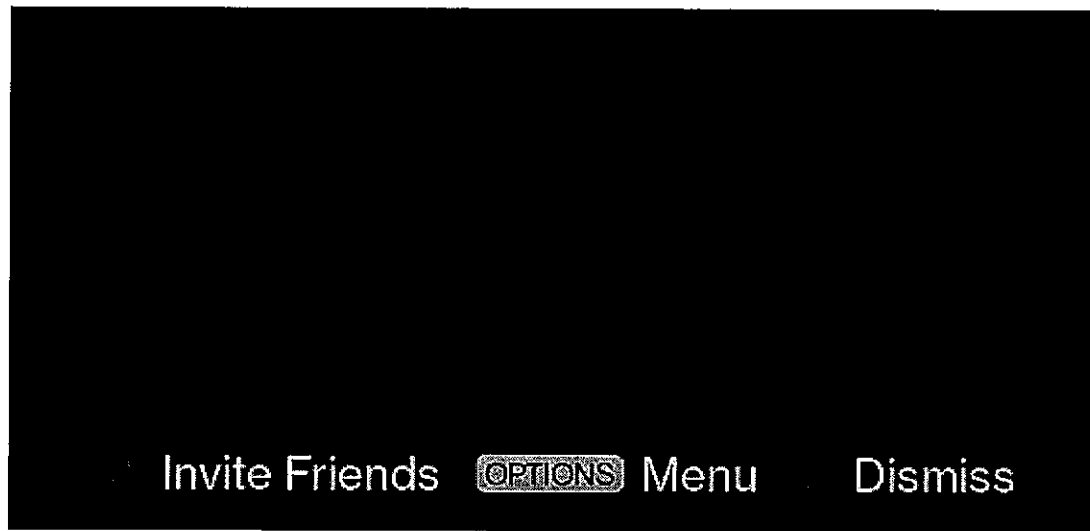


Exhibit 2037

[https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src\\_vid=XKQfiwPzjmc&annotation\\_id=annotation\\_2453463955](https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src_vid=XKQfiwPzjmc&annotation_id=annotation_2453463955)

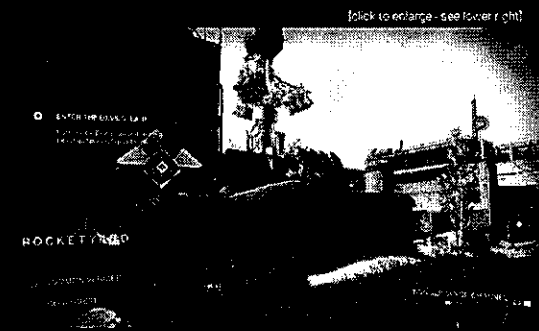
1 Friend Online   Invite Friends   **OPTIONS** Menu   Dismiss

Exhibit 2036 <https://www.youtube.com/watch?v=mfzIDQQLCqk>

The Sony PlayStation Product includes functionality to attempt to send messages from a first computer to second computer in providing chat data to players of corresponding activity channels in a networked environment where m-regular can indicate that each of the players is optimally connected to other players to ensure that all nodes are connected to the same number of nodes to ensure that no node is overloaded:

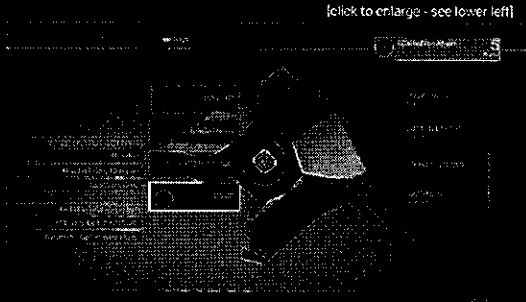
#### Joining Team Chat

If Team Chat is available, it can be accessed at any point in time by going into **Navigation Mode** in Destiny. As always, you activate that menu by deploying your Ghost.



Once in **Navigation Mode**, you will see the user interface for channel selection. The lower right of your screen will contain the following:

- Directional button icons
- Highlights for available chat options
- Text for current channel
- Icons for current channel

	<p><b>Voice Chat Settings</b></p> <p>As with everything in Destiny, your <b>Settings</b> menu will enable you to establish your preferences. You will have two options under <b>VOICE</b>. Choose the one that best suits your style of play.</p>  <p><b>Manually Opt-in (Default)</b> This is the default option. When playing a game, you will need to deliberately enter Navigation Mode to select Team Chat. Each member of a pre-formed party must select this option on their own.</p> <p><b>Automatic Opt-in When Solo</b> With this option, you'll be automatically added to the Team Chat channel when you're alone. The automated toggle will not happen if you're keeping the company of a friend in your Fireteam. That would separate you from them, and no one likes to be separated from their friends.</p> <p>Exhibit 2032 <a href="https://www.bungie.net/en/News/Article/12376/7_voice-chat-beta-in-destiny">https://www.bungie.net/en/News/Article/12376/7_voice-chat-beta-in-destiny</a></p>
<p><b>claim 6(c):</b> when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection; and</p>	<p>The Sony PlayStation Product meets the recited claim language because when the attempt to send the message is unsuccessful, it includes functionality to broadcast from the first computer a connection port search message indicating that the first computer needs a connection port.</p> <p>The Sony PlayStation Product includes functionality to broadcast from the first computer a connection port search message indicating that the first computer needs a connection when the attempt to send the message is unsuccessful by initiating an attempt by the match server, host server, or peer to find a connection port to another player that can be used to maintain an m-regular graph in the game session or match and to create an optimized connectivity mesh of players, and keeping games running whenever PlayStation consoles (aka Physics Hosts) disconnect from the game (aka Host Migration occurs) by electing a new Physics Host from one of the remaining players then to get a new authoritative simulation state from the new host, as described in the screenshots below:</p>

## Host Migration!

- Elect a new host
- Handoff of simulation authority
- Reconciliation of inconsistent state
- This was a rare occurrence in Halo

DESTINY

A Host Migration occurs whenever the Physics Hosting console disconnects from the game. In order to keep the game running, we need to elect a new Physics Host from one of the remaining players.

We pick a new host, and then need to get a new authoritative simulation state from the new host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 49;



## Bubbles

- A bubble is an autonomous unit of simulation
- Bubbles are our unit of asset loading
- Gold standard on PS3 was 6 vs 25

DESTINY 

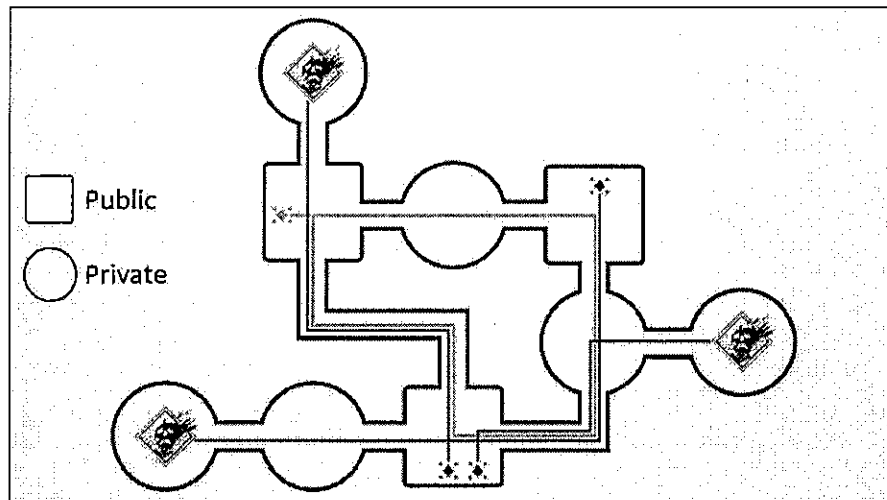
A bubble is our unit of simulation—a player is only ever simulating a single bubble's worth of combat and physics at any time.

A bubble is also our unit of asset streaming—you have at most 2 bubble's asset memory loaded at any time—the one you're currently simulating, and the one you're precaching.

For Simulation perf, we had a bunch of different perf rules depending on max player count, vehicles, etc., but our standard bubble was 6 vs 25—that meant 6 players, and 25 AI in a single bubble active at any one time.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 32.

The Sony PlayStation Product includes functionality to create m-regular topologies of players when setting up logical and physical network topologies to keep games running whenever PlayStation consoles (aka Physics Hosts) disconnect from the game (aka Host Migration occurs) by electing a new Physics Host from one of the remaining players then to get a new authoritative simulation state from the new host:



But Destiny is a world of intersecting, not parallel lines. Most of the time, players are just passing through public bubbles. Any one of these players could be the current Physics Host, and as soon as she leaves and deinstantiates the bubble, we need to Host Migrate to a new physics host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 51; *see also* Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 40.

### Activity Hosts

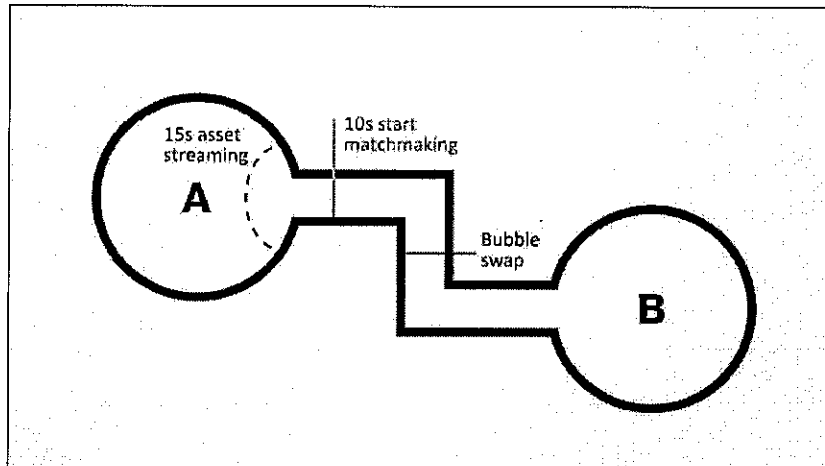
- No queues or downtime during launch
- 10,000 players per server
- Low Latency, Seamless Matchmaking

By combining our Activity Hosts with traditional Peer-to-peer networking, we get the low latency action gameplay of a Call of Duty or Halo, while constantly seamlessly matchmaking you to new strangers.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 11; *see also* Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 17 (“We force you to matchmaking with other players, even if all you want to do is play a solo campaign. Therefore we need to make sure that our matchmaking and networking goals never hurt that solo

campaign experience.”)

The Sony PlayStation Product includes functionality to create m-regular topologies of players when setting up logical and physical network topologies to handle activity and failover states when players are no longer connected or leave via Host Migration to a new physics host:



The neat thing we also do during these transitions is matchmake you to a new networked game. In order to meet new strangers in bubble B, we start matchmaking for a new host at the 10s mark, and are ready to seamlessly swap you to the new game when we perform our bubble swap.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 36.

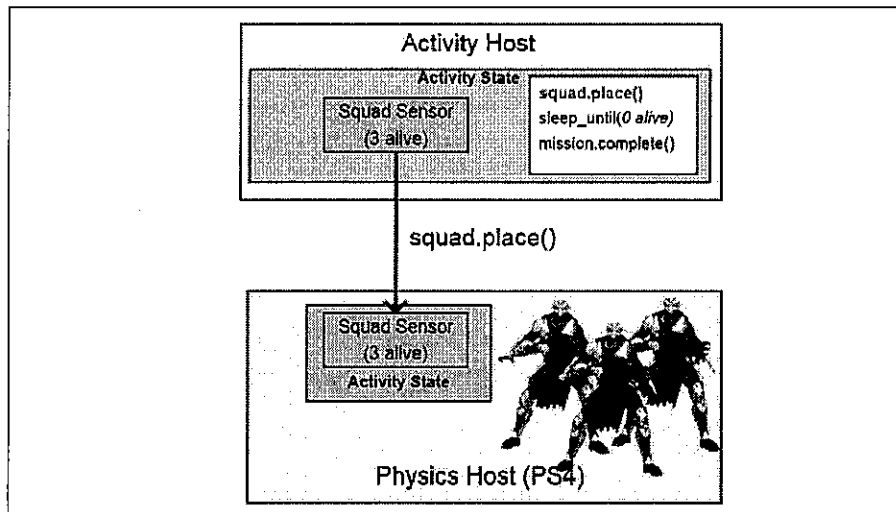


And we were able to support that load with just a few hundred servers in our datacenter, because we can handle loads of 10,000 players per server.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 10.

The Sony PlayStation Product includes functionality to create m-regular topologies of players when setting up logical and physical network topologies to seamlessly swap players to the new

game during matchmaking transitions to a networked game:



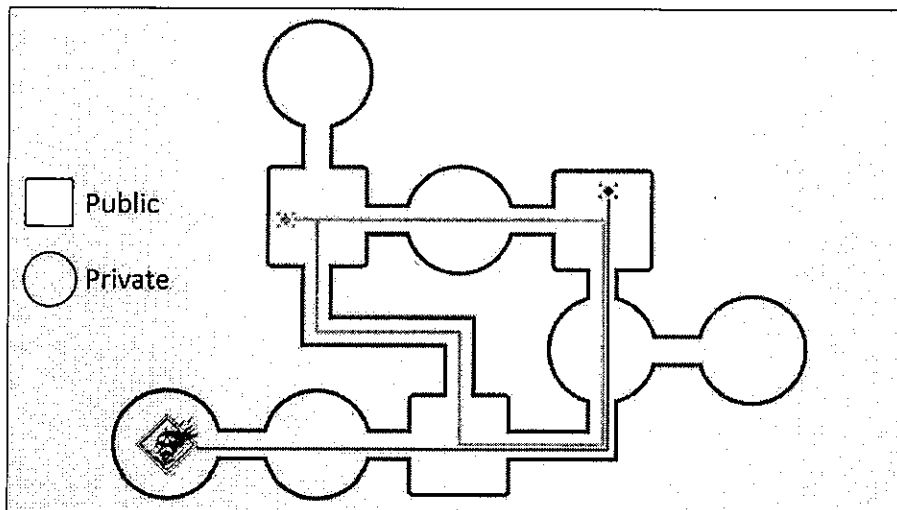
At this point the 3 AI are simulated on the Physics Host, and P2P networked to other clients.

Now there's already a couple interesting things to note here.

First, the Activity Script itself is running in the cloud – none of our Lua logic for Activity Scripts are executing on the PS4 client.

Second, it's worth pointing out that these 3 AI are not in "Activity State". There's a Squad Sensor inside activity state, but it's tracking very minimal state (there are 3 AI alive, and they're using this specific firing area).

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 80.



Now if I add some other activity lines – most of our activities start in a public bubble, and they all take you on a deliberate path through many bubbles. You typically get some exposure to 1-2 public bubbles during an activity line, and then dive into a private-bubble chain where we can have a hand-authored mission climax.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 45; see also Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 41 (“bubbles are our unit of autonomous simulation and matchmaking”).

## Activity Hosts

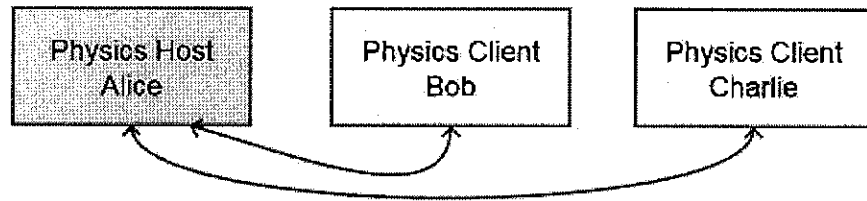
- No queues or downtime during launch
- 10,000 players per server
- Low Latency, Seamless Matchmaking
- PS4 Host Migrations every 160 seconds

DESTINY 

A typical Destiny player is Host Migrating between different PS4's once every 160 seconds, without noticing any discontinuity in their simulation.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 12.

As shown in the screenshots below, where not every player in the game session is directly connected, either logically or physically to every other PS4 console (aka Physics Host of Physics Client) in the game, the Sony PlayStation Product includes functionality that broadcasts from the first computer a connection port search message indicating that the first computer needs a connection when the attempt to send the message is unsuccessful by creating a graph of players when setting up a logical and physical network topology via Public Bubbles Activity Hosts:



So, let's suppose we've got 3 players in this public bubble – Alice, Bob, and Charlie.

They're Peer-to-peer connected to each other using traditional Reach networking, and Alice is the Physics Host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 96.

As shown in the following screenshots, using Bubble Activity Host for each of the public bubbles to handle the respawn timing and placement of all the resource nodes and runs all the logic for all the public events and Mission Activity Hosts for constant connection of all participants of the team mission:

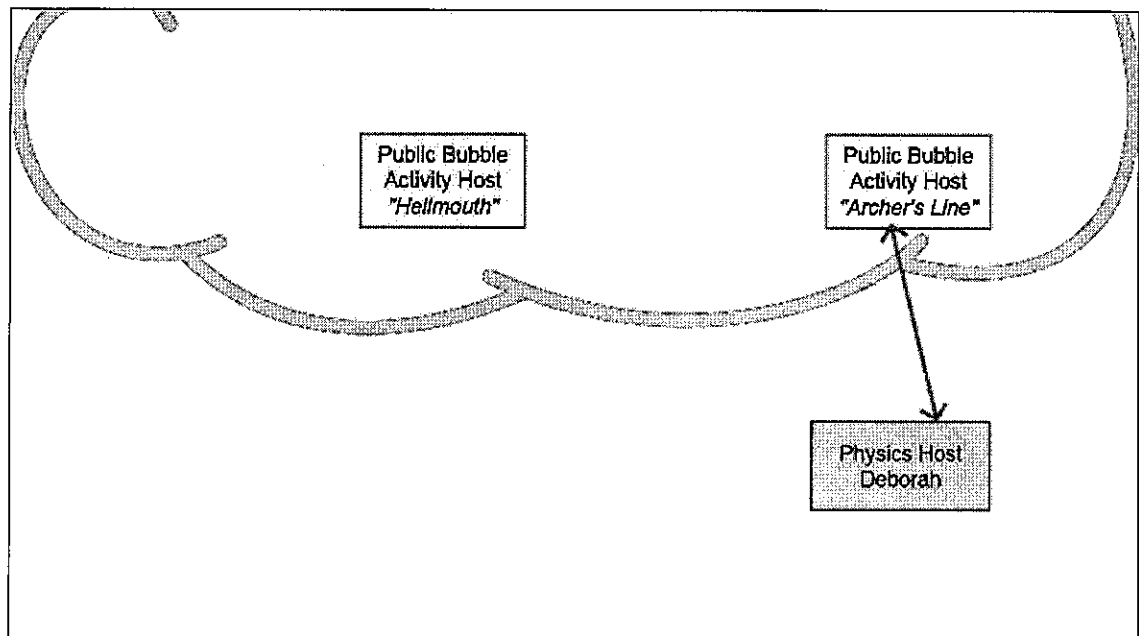


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 125.

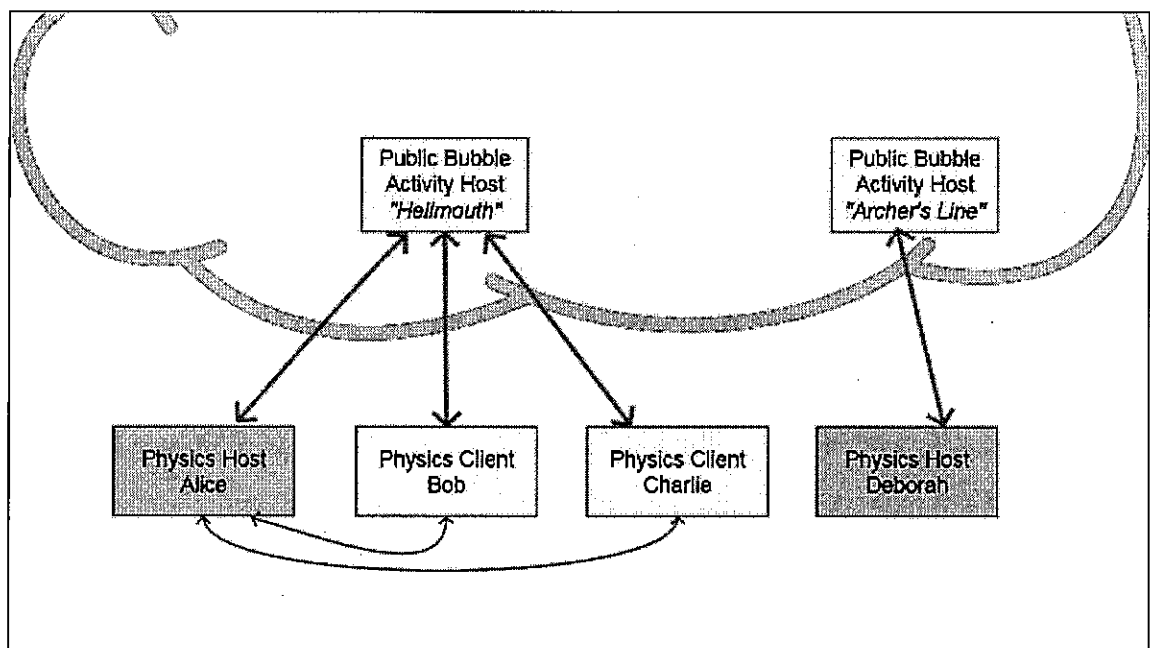


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 126.

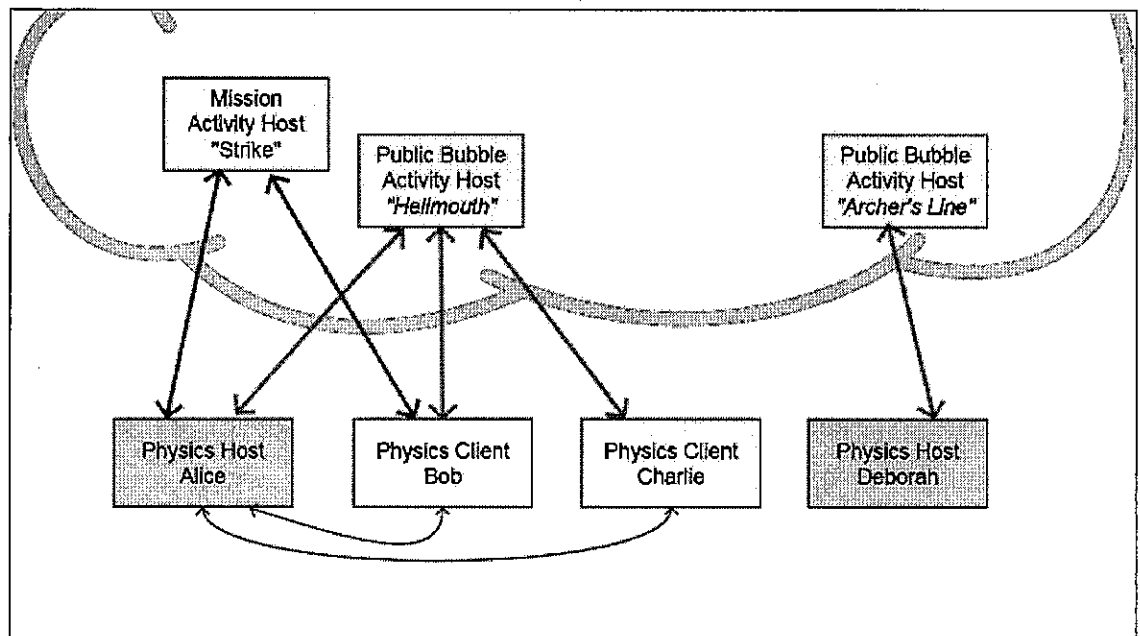


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 127.



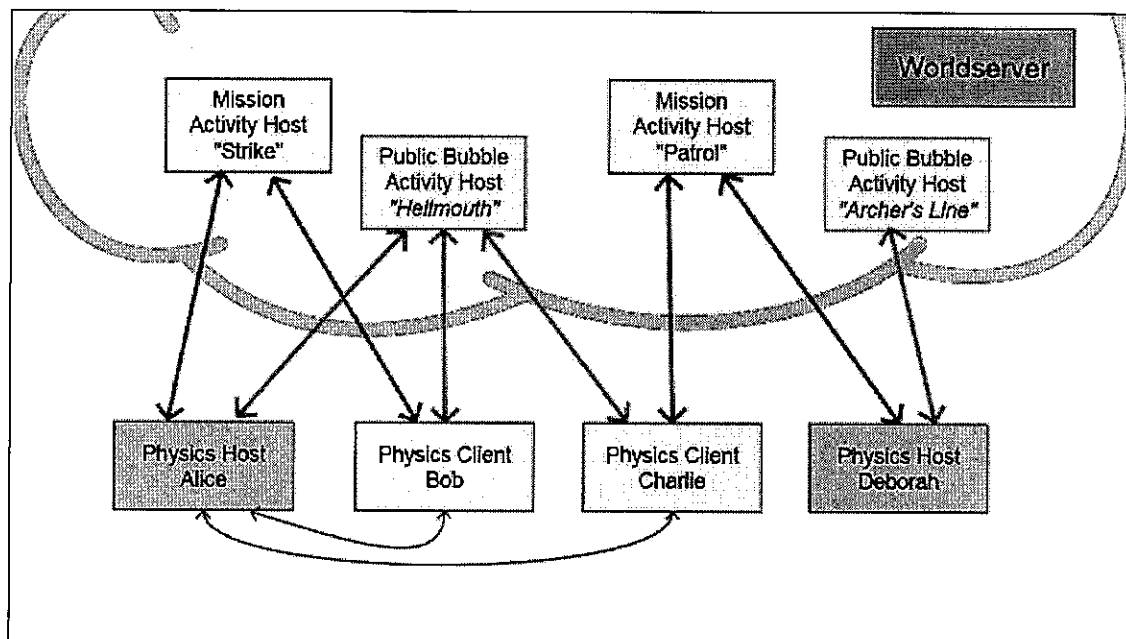


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 132

## "Mission" Activity Host

- One Mission Host per Fireteam
- Runs the Script for your current Activity
- Owns all private bubbles in the destination

DESTINY 

So, to reiterate:

Each Fireteam gets their own Mission Host. All fireteammates are always connected to the same mission host (and this may be the only connection they share, if they're not in the same bubbles)

The Mission Host runs the Activity Script specific to the activity you're on – like a given Story Mission Script.

The Mission Host also owns all the Private Bubbles in the destination – that way your fireteam can meet up in any of these private bubbles, but no strangers will ever show up there.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 101.

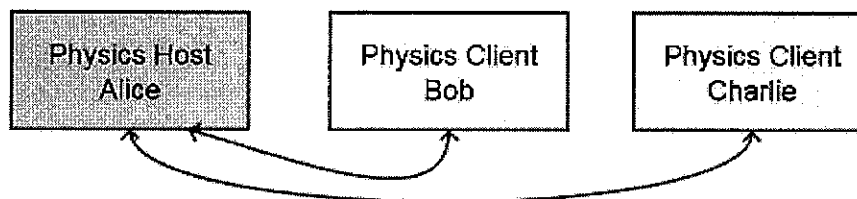
**claim 6(d):**  
having a third  
computer not  
already  
connected to  
said first  
computer  
respond to said

The Sony PlayStation Product meets the recited claim language because it includes functionality to have a third computer not already connected to said first computer respond to said connection port search message in a manner as to maintain an m-regular graph.

As shown below, the Sony PlayStation Product includes functionality for maintaining an m-regular graph by having a third computer not already connected to said first computer respond to said connection port search message in a manner that controls players disconnecting from a game session, and includes code for a match server, host server, or peers for receiving a

connection port search message in a manner as to maintain an m-regular graph.

disconnect notice from a player attempting to leave a game session. This functionality will initiate an attempt by the match server, host server, or peer to find a connection port to another player that can be used to maintain an m-regular graph in the game session or match and to create an optimized connectivity mesh of players and attempts to evenly distributed players on the logical and physical networks so that in an evenly-distributed multiplayer game, the network of players is m-regular by electing a new Physics Host from one of the remaining players then to get a new authoritative simulation state from the new host to keep games running whenever PlayStation consoles (aka Physics Hosts) disconnect from the game (aka Host Migration occurs) and by initiating an attempt by the match server, host server, or peer to find a connection port to another player that can be used to maintain an m-regular graph in the game session or match and to create an optimized connectivity mesh of players. The Sony PlayStation product describes the example where we've got 3 players in this public bubble – Alice, Bob, and Charlie. They're Peer-to-peer connected to each other using traditional Reach networking, and Alice is the Physics Host.



So, let's supposed we've got 3 players in this public bubble – Alice, Bob, and Charlie.

They're Peer-to-peer connected to each other using traditional Reach networking, and Alice is the Physics Host.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 96.

Then when 2 of them, Alice and Bob, do a Strike together that means they're connected to a "Mission Activity Host" for their mission. The Mission Activity Host is where all the script logic for their chosen Activity lives (firing off objectives, spawning bosses in their private bubbles:

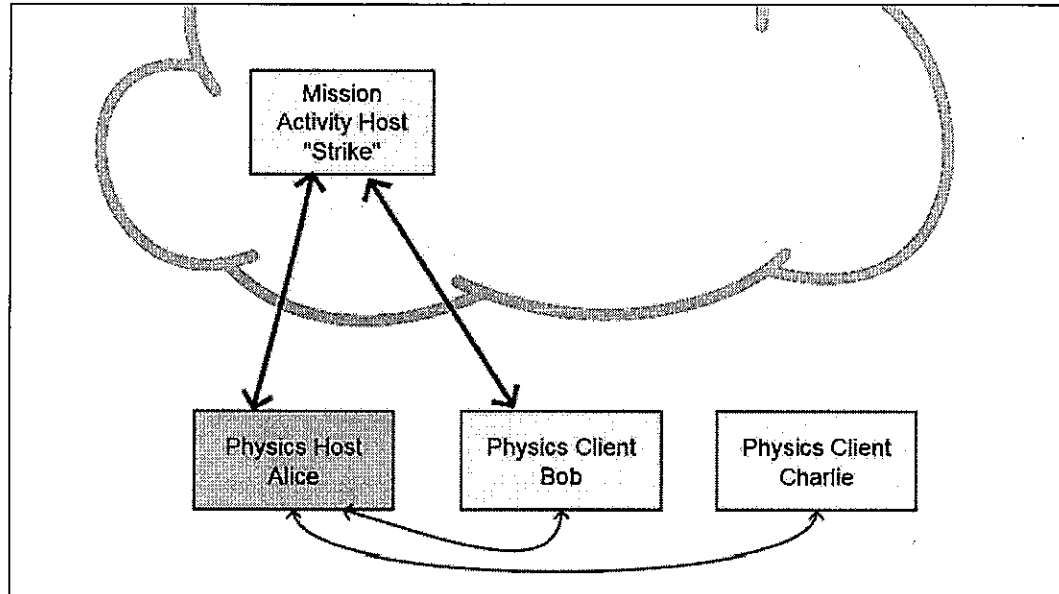


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 97.

Charlie is playing a Patrol, so while he's in the same bubble, he has a separate "Mission Activity Host," giving him local Patrol objectives:

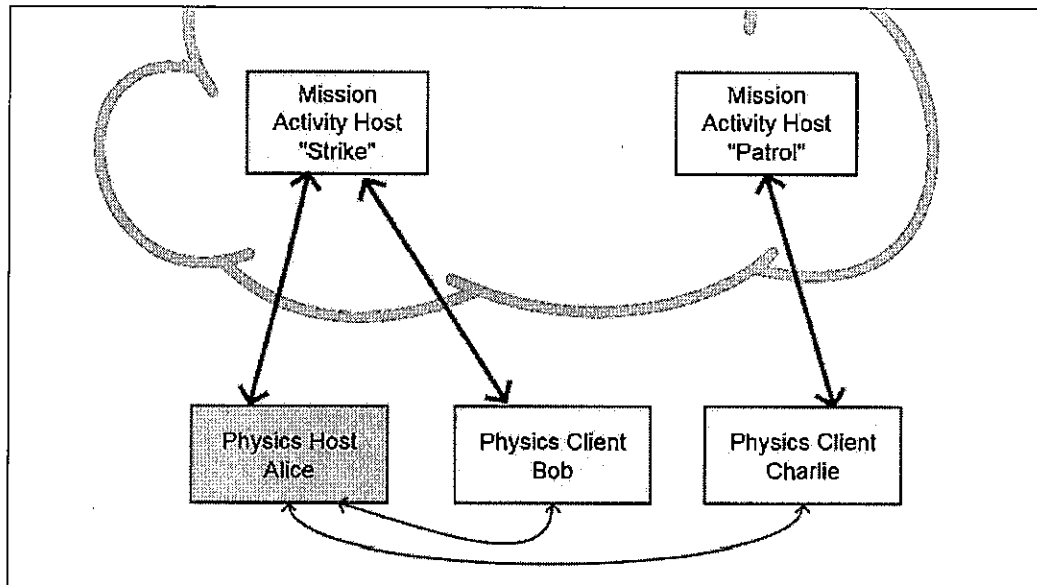


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 98.

As a result, the product makes sure they're also simultaneously all connected to the same "Bubble Activity Host" allowing constant and seamless matchmaking to new participants, without any discontinuity to maintain m-regular connectivity meshes of players during different network game sessions and for different game session data where m-regular can indicate that each of the players is optimally connected to other players to ensure that all nodes are connected to the same number of nodes to ensure that no node is overloaded:

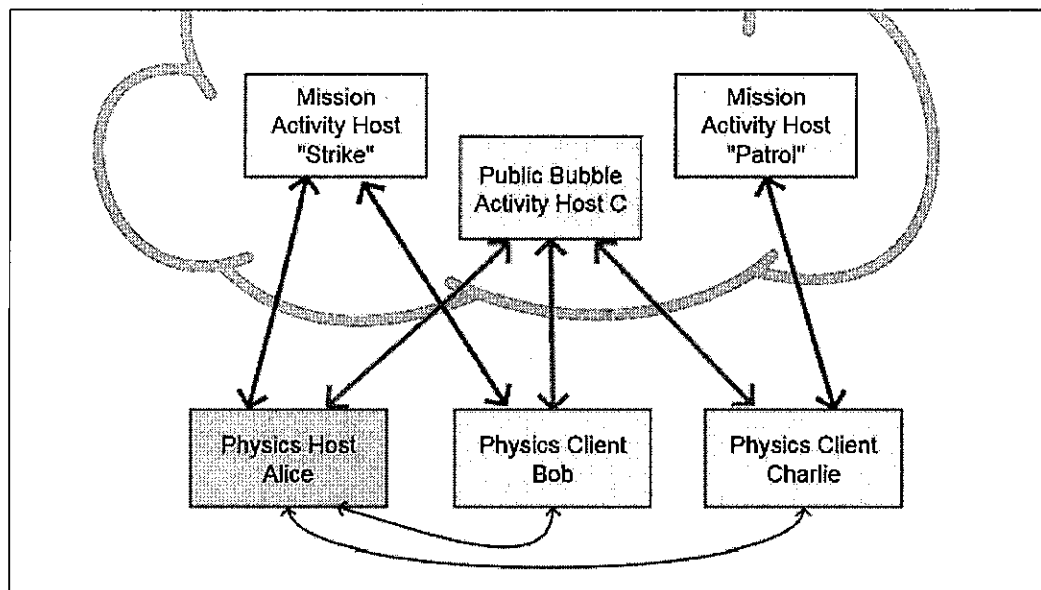


Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 99

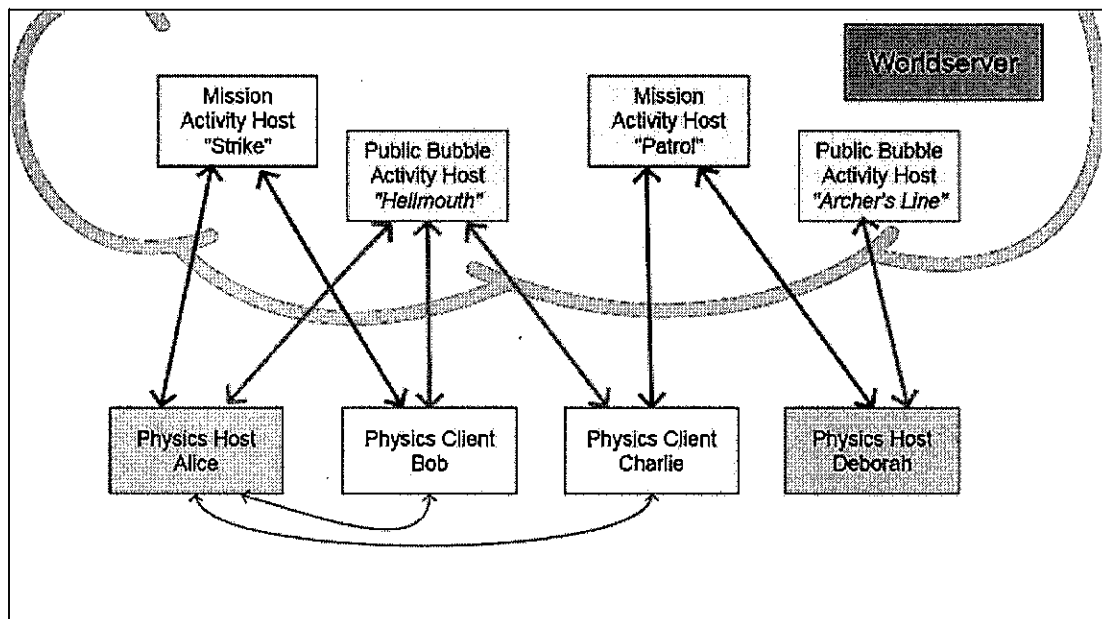


Exhibit 2029 (<http://twvideo01.ubm->

us.net/o1/vault/gdc2015/presentations/Truman\_Justin\_Shared\_World\_Shooter.pdf) at 100

The product has a third computer not already connected to said first computer respond to said connection port search message in a manner that attempts to maintain a m-regular graph in the way the product manages activity states when different players leave, are kicked, or are disconnected allow it to handle a hypothetical 1 million concurrent users with only a couple hundred servers:



### Activity State

- ~45MB per running Activity Host
- Can run 4600 Activity Host instances on one server
- Typically at least 2 players per Activity Host
- Can host 1 million players with ~200 servers

DESTINY

We tick our Activity Hosts at 10Hz, which allows us to run almost 5000 per server [40 core, 256GB]

Given that we typically have a bit over 2 players per Activity Host in real-world conditions, that means our datacenter can handle a hypothetical 1 million concurrent users with only a couple hundred servers, and that's with plenty of safety headroom on each machine.

That's dramatically better scale than trying to use a full dedicated server. With full dedicated servers, that same hypothetical 1 million players would require half a million headless PS3 processes, each running our full game simulation.

Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 88.

The product responds to said connection port search message in a manner that attempts to maintain a m-regular graph in forming network connections through TCP ports and relays to direct content through different NAT configurations during gameplay:

PlayStation™Network Sign-In	The status of your PlayStation™Network sign-in.
NAT Type	<p>How your PS4™ system is connected to the Internet</p> <p>This information can be used to judge the ease or difficulty of connecting to other PS4™ systems, such as when using communication features of games.</p> <p>Type 1: The system is connected directly to the Internet.</p> <p>Type 2: The system is connected to the Internet with a router.</p> <p>Type 3: The system is connected to the Internet with a router.</p>

Exhibit 2027 Test Internet Connection \_ PlayStation®4 User's Guide.pdf at 1.

Use PlayStation™Network to connect your PS4™ system to a PlayStation™Network server or to another PS4™ system. When you're using PlayStation™Network at an office or other location with a shared network, a firewall or other security measures might prevent your PS4™ system from connecting to PlayStation™Network. If this occurs, refer to the port numbers listed below, which are used when you connect your PS4™ system to a PlayStation™Network server.

TCP: 80, 443, 3478, 3479, 3480

UDP: 3478, 3479

Exhibit 2027 Test Internet Connection \_ PlayStation®4 User's Guide.pdf at 1

These are the port number that all games published by SCEE, may use for communicating with the game server:

TCP Ports:

80, 443, 5223, and what we call the 'port range' which is 10070 - 10080

UDP Ports:

3478, 3479, 3658, and 10070

These are the port numbers that the PlayStation Network will require to be open.

TCP Ports:

80, 443, and 5223

UDP Ports:

3478, 3479, and 3658

(Notice these port numbers are the same port numbers required for connecting to SCEE game servers)

Exhibit 2026 <http://community.eu.playstation.com/t5/PSN-Support/Port-Numbers-which-do-I-need-to-open-for-the-PlayStation-and-how/td-p/13390392> (Solved\_ Port Numbers, which do I need to open for the Play... - PlayStation .pdf);

see also Exhibit 2029 ([http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman\\_Justin\\_Shared\\_World\\_Shooter.pdf](http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf)) at 5

(describing how the Sony PlayStation Product can run "a console shooter that requires an always-online internet connection.");

see also Exhibit 2027 [http://manuals.playstation.net/document/en/ps4/settings/nw\\_test.html](http://manuals.playstation.net/document/en/ps4/settings/nw_test.html) ("Use PlayStation™Network to connect your PS4™ system to a PlayStation™Network server or to another PS4™ system.... refer to the port numbers listed below, which are used when you connect your PS4™ system to a PlayStation™Network server...TCP: 80, 443, 3478, 3479, 3480")





2/7/2017 C.A.R.

Patent Owner Acceleration Bay, LLC - Ex. 2031, p. 1